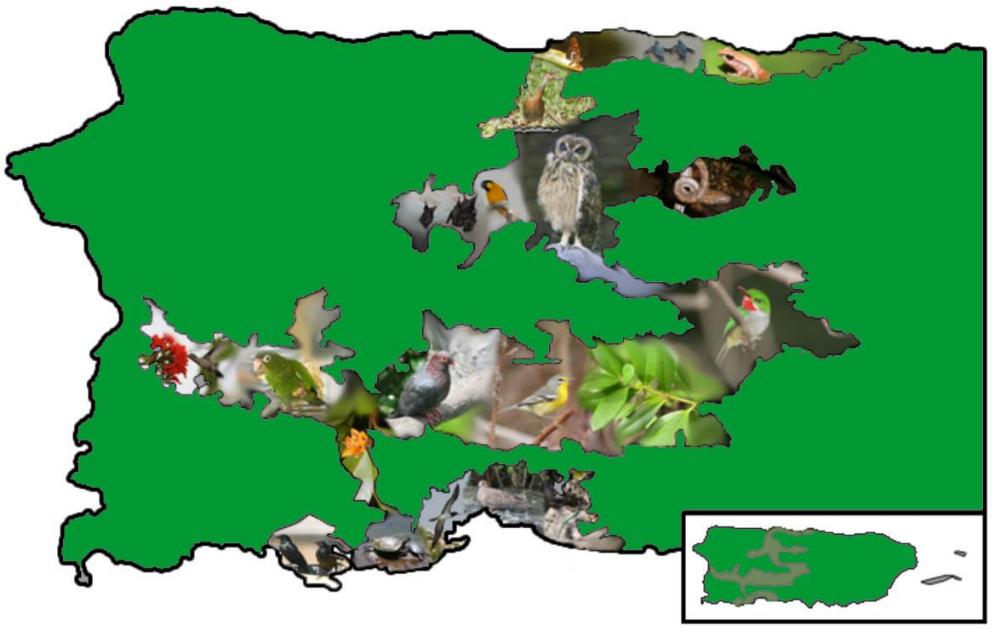
Puerto Rico State Wildlife Action Plan: Ten-Year Review (DRAFT)



Puerto Rico Department of Natural and Environmental Resources.

FOR REVIEW ONLY

Page

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

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A special recognition goes to the efforts of Mr. Eduardo Ventosa, from Effective Environmental Restoration, Inc., who helped organizing the revision efforts by

integrating all edits and new information and provided valuable assistance pro-bono.

Cover

The PRSWAP cover design was inspired by one of the newest and more important initiatives DNER is currently working to implement. The delineated area in western Puerto Rico represents the “Bosque Modelo”, or Model Forest. This is a large-scale project that aims to increase forested habitat connectivity and overall forest cover in the focus area, by engaging partners, communities and organizations in outreach, conservation and restoration practices.

The cover was designed by IDEAS, Inc. with pictures of wildlife provided by Mr. José Salguero and Mr. Alcides Morales. Species pictured are all considered of greatest conservation need in this document.

EXECUTIVE SUMMARY

Ten years ago, the first comprehensive strategy for the conservation of Puerto Rico's wildlife— a Comprehensive Wildlife Conservation Strategy (CWCS, 2005) was published and approved by the US Fish and Wildlife Service (USFWS). The contents of this plan has formally and inclusively informed DNER's local conservation initiatives and research. The original strategy, which is now revised and presented as the Puerto Rico State Wildlife Action Plan (PRSWAP, 2015), was prepared as a requirement for participating in the US Fish and Wildlife Service's State Wildlife Grants (SWG) Program. The document rapidly evolved into a hands on guidebook for prioritizing and implementing projects under the SWG program, which have focused on the island's non-game species and their associated habitats.

In this ten-year revision, we are proud to report that great progress has been made in addressing the original plan's priorities, as well as meeting the expected benefits stated in the original Comprehensive Wildlife Conservation Strategy from 2005.These included:

- Identifying and addressing the greatest conservation needs of Puerto Rico's fish and wildlife populations.
- Prioritizing efforts on species with greatest conservation needs.
- Allowing the Department of Natural and Environmental Resources (DNER) to work with local, non-profit and federal partners to conserve, enhance and protect Puerto Rico's diverse, but not necessarily rare or at risk, fish and wildlife species and their habitats.
- Improving DNER's ability to address present and future challenges for Puerto Rico's fish and wildlife populations.

- Integrating monitoring and management actions for game and non-game species.

Careful analysis is not required to understand that ten years have only served to identify and partially address the needs of Puerto Rico's fish and wildlife resources. This task will forever remain ongoing, due to the unstable nature of our environmental and socio-economic realms. Besides the intrinsic and monumental challenges of the aforementioned assignments, Puerto Rico receives limited federal funding allocations, restricting DNER's projects and potential achievements in scope and size. Notwithstanding, the following actions have been completed, and reflect the benefits of having a constantly up to date State Wildlife Action Plan:

1. New species of conservation concern have been identified, and the status of several Data Deficient species was assessed, and their status updated.
2. Marine and terrestrial gap analysis projects were completed.
3. New habitats have been identified as habitats of greatest conservation need.
4. Climate change has been recognized as a new stressor and threat for fish and wildlife species and their habitats.
5. DNER has adopted the creation or enhancement of biological corridors as a new conservation priority.
6. DNER updated the strategic plan for fish and wildlife resources in 2014.
7. DNER identified the Puerto Rican Parrot as a surrogate species for promoting the conservation of wildlife species with similar diet and habitat needs.
8. DNER has adopted a more aggressive approach towards the eradication of exotic invasive species.
9. The Puerto Rico State Wildlife Action Plan recognizes that landscape scale conservation and habitat restoration are essential tools to promote connectivity and habitat enhancement and protection.

The milestones reached in the conservation of Puerto Rico's fish and wildlife resources during the last ten years are considerable, but the island continues to face significant challenges. Despite the projects completed, their results and benefits, the current unstable socioeconomical status of the island has negative impacts in the environment. Futhermore, projections indicate that climate change, and particularly sea level rise, will exacerbate the already compromised scenario on the island for native and endemic fish and wildlife species.

SUMMARY OF CHANGES

Chapter	Section	Summary	Page(s)
I - Introduction	Conclusion	Top Conservation Initiatives to be completed during the next decade as part of the Puerto Rico 2015 State Wildlife Action Plan.	22-23
II – SGCN	Status and Protection of SGCN	New species were added, others were removed. Plants and pollinators were included for this review.	28-32
II - SGCN	Abundance and distribution of SGCN	The abundance or population estimates, and the documented recent distribution of the Puerto Rico SGCN	33-46
III – Habitat Requirement	Locations and condition of habitats and community types	Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in Element 1 are described in the following section. Each key habitat is classified by taxon.	46-61
III – Habitat Requirement	Forest Composition	Types and conditions of our forests	61-65
IV – Identifying Stressors/Threats	List of main stressor/threats	New stressors/threats were added	76-96
IV – Identifying Stressors/Threats	Problems which affect SGCN	A new table was added. This table describes the problems which may adversely affect species identified in Element 1 or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and enhance conservation of these species and habitats	98-100
V – Conservation Strategies for PRSWAP	PR GAP	Update of the PR GAP data included	101
V – Conservation Strategies for PRSWAP	Sportfish Gap Analysis Project	To develop a comprehensive set of databases on Puerto Rico's freshwater and marine recreational fisheries resources.	102
V – Conservation Strategies for PRSWAP	Develop strong private lands programs	New available private lands programs were added.	103-105
V – Conservation Strategies for PRSWAP	Comprehensive Land Use Plan	A new Land Use Plan (2014) was added.	125-128
V – Conservation Strategies for PRSWAP	Identification of areas of hydrologic importance	Puerto Rico's most important hydrological regions were identified.	128-129
V – Conservation Strategies for PRSWAP	Conserving Working forest landscape	In order to promote the forest landscape, the outputs, priority landscape and the strategies are	130-131

		show.	
V – Conservation Strategies for PRSWAP	Protecting forests and wildlife from harm	Methods to identify, manage and reduce threats to the forest and its wildlife are mentioned.	131-134
V – Conservation Strategies for PRSWAP	Enhance public benefits associated with forests and wildlife.	Strategies recognized for this goal are analyzed.	134-136
V – Conservation Strategies for PRSWAP	Marine Mammals Rescue Program	Description of the actions during a marine mammal situation, including stranding and necropsies.	136-137
V – Conservation Strategies for PRSWAP	Conservation Actions for priority species and habitats	Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats.	137-138
VI – Habitats of Greatest Conservation Need	Terrestrial Habitats	Urban Forests were added in this review.	141-143
VI – Habitats of Greatest Conservation Need	Freshwater Habitats	Riparian Forests and Mangrove Forests were added.	145-146 and 150
VI – Habitats of Greatest Conservation Need	Saltwater Habitats	Coral Reefs were added.	150-151
VI – Habitats of Greatest Conservation Need	Marine Protected Areas	These protected areas were added.	171-172
VI – Habitats of Greatest Conservation Need	Caribbean Landscape Conservation Cooperative	To develop and provide the best available conservation science and strategies in order to conserve, restore and sustain natural and cultural resources in the US Caribbean.	169-171
VI – Habitats of Greatest Conservation Need	Puerto Rico Model Forest	This initiative, which started in 2014, was included.	172-173
VI – Habitats of Greatest Conservation Need	Avian Conservation Planning Priorities Report (2015)	This report (Nytch et al., 2015) was included. Historical and present habitat threats, conservation opportunities, and management strategies to protect important native and migratory birds in Puerto Rico and the USVI are discussed.	173-182
VII – Monitoring and Adaptation of Conservation Action	Joint Priority Landscapes	This effort seeking public engagement began in 2011, and was included in this plan.	197-200

CHAPTER 1. INTRODUCTION

I. Background

The Caribbean is considered a global biodiversity hotspot (Cincotta and Engelman 2000; Helmer et al. 2002; Myers et al. 2000). The islands commonly known as the Greater Antilles occupy the larger area within the Caribbean Region, with Puerto Rico being the smallest (8,892 km^2 or 3,425 $miles^2$) and most eastward (18º 15'North/66º 30' West) (Cruz and Boswell 1997). The majority (80%) of documented species extinctions have occurred on islands (Island Conservation, 2014). The combination of high extinction rates with high indices of biodiversity and endemism makes implementing conservation initiatives and allocating funding toward these ecosystems a necessary and important priority.

The unsustainable exploitation of resources (Myers 1989), habitat loss and invasive species (Walker and Steffen 1997) are considered the main causes of species extinctions on islands. Moreover, insular species exhibit greater extinction rates, and are more susceptible to environmental stress than their mainland counterparts (Vitousek 1988, Vitousek et al. 1995). This increased vulnerability has been linked to low population numbers, reduced genetic diversity, constrained geographical range (Adsersen 1995, Vitousek, 1988), and limited migratory capabilities (Ives and Foufopoulus 2003).

Puerto Rico is a group of several islands and cays where the majority are managed as protected areas under local and federal designations, and only a few are privately owned. The complex topography, soils and climate produce distinct life zones (Ewel and Whitmore 1973), and several vegetation associations, ranging from high elevation elfin forest to coastal alluvial swamps. Likewise, the marine environment is diverse, including some of the deepest depths in the world (found in the Puerto Rican Trench), and shallow ecosystems dominated by coral reefs and sea grass prairies.

Habitats in Puerto Rico have degraded over the past 3 to 4 centuries as a result of human population growth and the increased use of natural and environmental resources, significantly transforming the landscape. Population growth caused a dramatic change in the local economy, shifting from an agriculture-based (ca. 1930-1950) to an industrialized economy (López et al. 2001). These changes resulted in major deforestation during the first half of the past century. The abandonment of agricultural lands sparked a remarkable forest recovery process, where the forest cover on the island increased from approximately 6% to 34% (Birdsey and Weaver 1987). However, the island's growing population has affected forest recovery, as many abandoned agricultural lands have been replaced by rapid urbanization (López et al. 2001).

Puerto Rico's current economy is influenced by high public debts to local and external investors, causing a stagnation that has halted the production of infrastructure and caused a massive emigration of human resources. The current mosaic of land uses and conditions found on the island represent a significant challenge for conservation, in which species and habitat conservation must be harmonized in managed and undisturbed ecosystems. Timely and proactive landscape conservation approaches, such as the creation and enhancement of biological corridors, have been identified as a priority for the island.

Puerto Rico has approximately 5,847 native wildlife species. Of these, 54 are reptiles (Rivero 1998, Hedges 1993), 19 are amphibians (Rivero 1998, Hedges, 1993), 5,573 are insects (Torres and Medina-Gaud 1998), 190 are birds (Raffaele 1989), and 15 are mammals. Most of these are non-game species, and are poorly known by the government and the general public. Unless recognized as threatened or endangered (T/E), non-game species lack the public constituency and awareness needed to support basic research and management actions. As a result, the population status and distribution of most non-game,

unlisted species is unknown, limiting the implementation of actions and management strategies.

In Puerto Rico, management priorities for wildlife and fisheries resources have been sharply delineated based on conditions established by the three primary sources of federal funds that support the majority of DNER's management efforts. These are the Wildlife and Sport Fish Restoration Programs (WSFR), the Endangered Species Program (ES) and the State Wildlife Grants Program (SWG). User fees and taxes paid by hunters and anglers have funded management and restoration efforts during several decades, but these funds are primarily aimed at the conservation of game species, and are not sufficient for addressing the needs of the other species. In fact, the total allocated amount for endangered, threatened and species of greatest conservation needs - identified as Data Deficient - (García et al. 2005), has been approximately $750,000 per year. Consequently, conservation goals and initiatives can only be achieved by teaming with conservation entities, particularly the US Fish and Wildife Service (federal), National Resources Conservation Services (federal) and non-governmental organizations such as The Nature Conservancy (International), Para La Naturaleza (local), Ciudadanos del Karso (local), and Casa Pueblo (local). Such partnerships are instrumental for fulfilling the shared goal of conserving wildlife resources and their habitats.

II. Objective

The State Wildlife Action Plan (SWAP) represents a comprehensive, statewide approach for conserving Puerto Rico's wildlife and natural areas for future generations. The objectives of this document include: (1) Identifying the current status of the species and their habitats, (2) Identifying and updating conservation priorities for these species and their habitats, and (3) establishing a regular monitoring process aimed at updating the previous two objectives.

III. Expected Results and Benefits

The Puerto Rico State Wildlife Action Plan will:

- Identify and address the greatest conservation needs of Puerto Rico's fish and wildlife populations.
- Prioritize efforts for species with the greatest conservation needs.
- Allow DNER to work in partnership to conserve, enhance and protect Puerto Rico's diverse, but not necessarily rare or at risk, fish and wildlife species.
- Improve DNER's ability to address present and future conservation challenges and opportunities.
- Integrate the monitoring and management of game and non-game species.

IV. Approach

Staff from the Puerto Rico DNER revised the original Comprehensive Wildlife Conservation Strategy (CWCS) from 2005 using internal resources. However, stakeholders, academics, local and federal agencies, and the general public have actively participated in the review process for the priority list of Species with the Greatest Conservation Needs (SGCN). DNER staff referred to existing Wildlife Action Plans from other states, and the Guiding Principles for States to Consider in Developing Comprehensive Wildlife Conservation Plans for State Wildlife Grants. A draft version of the new Puerto Rico State Wildlife Action Plan (PRSWAP) was posted in the agency's website and social media channels for a 30-day period, in order to allow for a broad and general public review.

The original Comprehensive Wildlife Conservation Strategy (CWCS, 2005), the updated Fisheries and Wildlife Resources Strategic Plan (DNER 2014), the Puerto Rico Critical Wildlife Areas (Ventosa-Febles et al. 2005a), the Puerto Rico

Waterfowl Focus Areas (Ventosa-Febles et al. 2005b), the Puerto Rico Terrestrial Gap Analysis (2007) and Aquatic Gap Analysis (2011) were important sources of information used to update and inform the statuses and actions presented in this plan. These documents collected and updated detailed information about Puerto Rico's wildlife species and their habitat in the years prior to the publication of this plan.

The Puerto Rico State Wildlife Action Plan addresses the following elements:

Element 1: Inventory

Information on the distribution and abundance of wildlife species, including low and declining populations as the State Fish and Wildlife Agency deems appropriate, that are indicative of the diversity and health of the State's wildlife.

Element 2: Condition

Description of the locations and relative condition of key habitats and community types essentials to conservation of species identified in Element 1.

Element 3: Threats

Descriptions of problems which may adversely affect species identified in Element 1 or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats.

Element 4: Actions

Descriptions of conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions.

Element 5: Monitoring

Proposed plans for monitoring species identified in Element 1 and their habitats, for monitoring the effectiveness of the conservation actions proposed in Element 4 and for adapting these conservation actions to respond appropriately to new information or changing conditions.

Element 6: Review

Descriptions of procedures to review the PRSWAP at intervals not exceeding ten years.

Element 7: Coordination

Plans for coordinating the development, implementation, review, and revision of the PRSWAP with federal, state, and local agencies.

Element 8: Public Participation

Involvement of general public in the development of the conservation strategy and resulting actions.

VI. Conclusion

The original Comprehensive Wildlife Conservation Strategy (2005) considered the broad range of Puerto Rico's wildlife, with an emphasis placed on the species and habitats with greatest conservation needs, particularly species considered Data Deficient (DD). The major accomplishments under the guidance of the 2015 PSWAP include:

- The inclusion of 284 species identified as Species of Greatest Conservation Need (SGCN). Plant species (60) are a new and important component of the revised plan.

- Several species previously identified as Data Deficient were studied and their designations updated. Great progress was made with the native river fish communities, an amphidromous group that was previously poorly studied on the island.
- Completed databases resulting from terrestrial and aquatic gap analysis projects. Results from these projects have identified potential conservation targets and priorities for future research in Puerto Rico.
- Coral reefs, as well as riparian and mangrove forests have been identified as new habitats of greatest conservation need.
- Climate change has been recognized as a new stressor and threat for native and endemic wildlife species and habitats. Information presented in Puerto Rico's State of the Climate 2010-2013 publication has been evaluated and included in this document.
- DNER has adopted the creation and enhancement of biological corridors linking public and private wildlife habitats and/or new riparian and marine corridors as a new conservation priority. These actions will benefit native, endemic and migratory species whose habitats and ranges are projected to shift as a direct result of climate change.
- The "Puerto Rico Model Forest" (Bosque Modelo) initiative has been created and implemented with the collaboration of local NGOs, academia and federal partner agencies. The ultimate goal for the project is to protect and manage forested lands on a landscape scale, including the communities that live within them, their needs and the potential for economic development of the area.
- The strategic plan for Puerto Rico's fish and wildlife resources was updated in 2014. This new document expanded the scope, prioritized actions and assigned specific responsibilities to different actors beyond the DNER's Fisheries and Wildlife Bureau (now known as the Research, Habitat Conservation and Biodiversity Bureau).

- DNER has adopted the Puerto Rican Parrot as an emblematic and surrogate species for advancing the conservation of other wildlife species and habitats, through a landscape ecology approach.
- The agency has also implemented a more aggressive approach towards the eradication of specific invasive species that were negatively affecting the ecological, economic and cultural attributes of natural areas and habitats of concern. This includes the successful eradication of rats from Monito Island, and the advanced progress of the eradication program for invasive, non-human primates in Southwest Puerto Rico.

This revised document includes the development and improvement of biological corridors as a new priority (e.g. Figure 1). These actions are of utmost importance in order to address and adapt to changes and threats caused by climate change, which are projected to shift changes in the current habitat use and distribution of Puerto Rico's wildlife. By prioritizing the creation of habitat corridors and "softening" the mosaic of fragmented habitat found on the highly urbanized island, DNER will work to protect and adapt the landscape and facilitate the projected changes in species ranges caused by a changing climate.

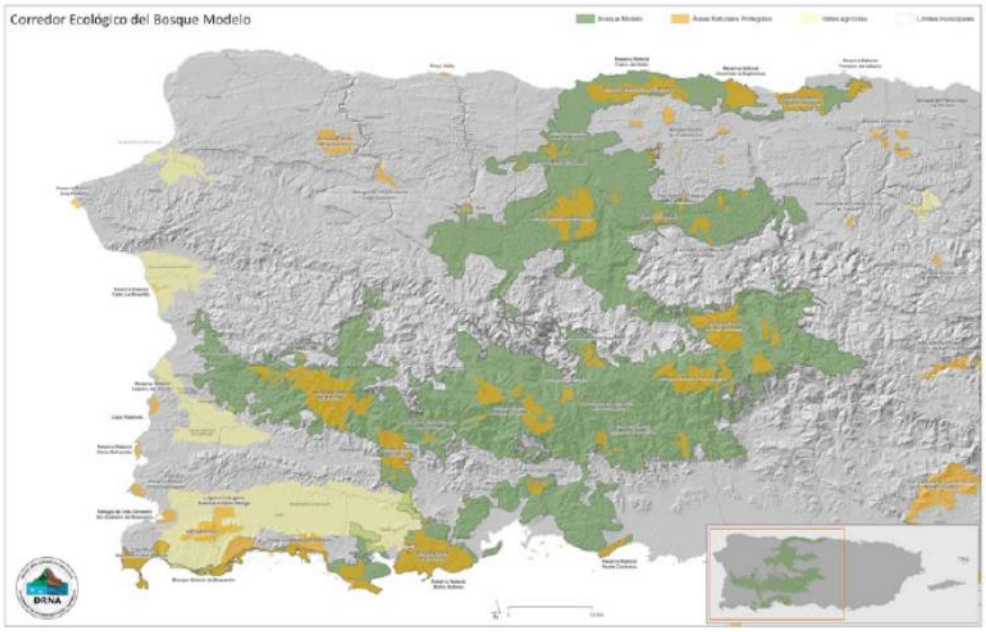


Figure 1. Designation of the Puerto Rico Model Forest

Top Conservation Initiatives to be completed during the next decade as part of the Puerto Rico 2015 State Wildlife Action Plan

- Work in coordination with the USFWS to re-establish or enhance river connectivity for the conservation of native freshwater species through the removal of dams or the installation of biological passages by 2025.
    - Objective: Impact five (5) major rivers; one (1) every two years

- Complete an assessment of at least 20% of the wildlife species classified as data deficient (DD) in this document by 2025.

- Evaluate the rat eradication program in the seabird populations of Monito Island by 2020.
    - Compare pre (1973) and post (2015-16) eradication populations for the three (3) booby species (Brown, Red-footed and Masked) found on Monito Island.

- Control invasive feral pigs from Mona Island and Puerto Rico.

- Eradicate feral non-human primates from Southwest Puerto Rico by 2020.

- Re-establish long spinned sea urchin (*Diadema antillarum*) populations on important coral reefs habitats.
    - Develop sea urchin farms in two important Marine Protected Areas, with at least two (2) new populations per site.

- Coordinate the establishment of two Puerto Rican Parrot breeding populations with the USFWS and USFS as part of the Model Forest Conservation Initiative, by 2025.
    - Continue interagency efforts to reintroduce a new PRP population in the Maricao State Forest.
    - Strengthen the PRP population in the Río Abajo State Forest and adjacent lands.

- Establish a long-term annual monitoring program for endemic and native avian species, as well as neotropical of Puerto Rico (2015-2025).

- Complete a risk assessment analysis to identify, prioritize and initiate proactive conservation measures for wildlife species threatened by rising sea levels. This includes:
    - Seabird nesting colonies
    - Reptile communities on low profile cays

- Efforts toward restoring the natural connectivity for some of the most important coastal lagoons in Puerto Rico
    - Joyuda Lagoon (2020-2025)
    - Tortuguero Lagoon (2020-2025)

- The creation or enhancement of biological corridors and habitat connectivity between important wildlife critical habitats, including:

- Southwest Corridor (Guánica-Susúa-Maricao State Forests)
- Central Karst Corridor (Guajataca-Río Encantado-Río Abajo)

CHAPTER 2. SPECIES OF GREATEST CONSERVATION NEED

The New Wildlife Law of Puerto Rico (Law No. 241 of August 15, 1999) and its Regulations (Regulation No. 6765, for the Conservation and Management of Wildlife, Exotic Species and Hunting in the Commonwealth of Puerto Rico, and Regulation No. 6766, to Govern the Threatened and Endangered Species of the Commonwealth of Puerto Rico), are the legal framework that support DNER's mission to protect Puerto Rico's wildlife resources (DRNA 2004). Other selected statutes related to wildlife and forest resources protection in Puerto Rico are listed in Table 1.

Table 1. List of selected statutes.

Statutes	Name	Objective
Constitution of the Commonwealth of Puerto Rico adopted in 1952	Constitution	It establishes as a public policy "the most efficient conservation of natural resources, as well as the best development and use of these for the benefit of the community".
Commonwealth Law No. 23 of 1972, as amended	Organic Law of the Department of Natural Resources	It creates DNER and assigns to it, among several things, the responsibility of establishing programs for the conservation of the PR natural resources, including forests.
Commonwealth Law No. 133 of 1975, as amended	Puerto Rico Forests Act	It establishes the public policy of the Commonwealth to protect, expand and conserve the forest resources of PR. It creates the Commonwealth Forest Service.
Planning Board Regulation No. 25	Planting, Cutting and Foresting Regulations for Puerto Rico	It requires a DNER permit for cutting and grooming trees on public or private land in Puerto Rico.
Commonwealth Law No. 144 of 1976, as amended	Law for the extraction and excavation of Earth's crust components	It prohibits the issuance of Earth's crust components extractions and excavations in natural resources "reserves" (includes Commonwealth Forests)
Commonwealth Law No. 136 of 1976 (also known as the "Water Act")	Act for the Conservation, Development and Use of the Water Resources of Puerto Rico	It assigns the faculty of planning and ruling the usage, conservation and development of water resources in the Commonwealth, to DNER, including those superficial as subterranean water.
Commonwealth Law	Department of Natural	It creates DNER Ranger Corps to enforce

No.29 of 1976	and Environmental Resources Rangers Corp Act	all the Commonwealth statutes available for the protection of all natural resources (forests included).
Commonwealth Law No. 241 of 1999	New Wildlife Law of Puerto Rico	It authorizes the DNER Secretary to rule all activities related to the wildlife well-being, included its habitats (forests included).

Species of conservation priorities were originally listed in Regulation No. 6766 (Table 2). This regulation presented an updated species list with their respective level of endangerment. However, our PRSWAP includes an improved list of species of greatest conservation need (SGCN), using recently available source of information (e.g., Núñez-García and Hunter 2000, Nitch et al., 2015, among others; Table 2). Some of these species will be recommended for listing under Regulation No. 6766.

Information about threats, population numbers, current distribution, and reason for categorization are included for each species. The DNER adopted the following five categories from the International Union for the Conservation of Nature (IUCN) Red List (1994) in order to classify priority species (Table 2). Although DNER adopted the IUCN categories, as part of the Section 6 Cooperative Agreement between USFWS and DNER, Regulation 6766 also includes all species listed under the Endangered Species Act (ESA) for Puerto Rico. See appendix I for detailed category definitions.

1. Critically Endangered (CR): A critically endangered species faces an extremely high risk of extinction in the wild in the immediate future.
2. Endangered (EN): A species is considered endangered when it is not CR, but faces a very high risk of extinction in the wild in the near future.
3. Vulnerable (VU): A species is considered vulnerable when it is not CR or EN, but it faces a high risk of extinction in the wild in a foreseeable future.

4. Low Risk (LR): A species is considered low risk when, after an evaluation, it did not satisfy any of the previous categories (CR, EN, or VU) and it is not Data Deficient.
5. 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 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.

Table 2. Number of species by taxon included in Regulation No. 6766 as SGCN.

Taxon	CR	EN	VU	DD	LR	Total
Amphibians	3	1	4	1	0	**9**
Birds	7	5	5	9	1	**27**
Reptiles	3	6	3	5	0	**17**
Marine Mammals	0	1	1	0	0	**2**
Terrestrial Mammals	0	0	3	2	1	**6**
Fresh Water Fish	2	1	1	0	0	**4**
Marine Fish						
Terrestrial Invertebrates						
Fresh Water Invertebrates	2	0	1	8	8	**19**
Marine Invertebrates						
Plants	30	15	3	0	0	**48**
Total	**47**	**29**	**21**	**25**	**10**	**132**

Species and Actions for Prioritization

Conservation actions and funding allocation are ranked according to the level of endangerment of the taxon. Critically endangered species receive the highest conservation priority, followed by endangered, vulnerable and low risk (Figure 2). Data deficient species are important because they may be included into any of

the previous categories after adequate data collection and evaluation. However, DNER is strongly concerned about Data Deficient (DD) species (Table 3), which comprise the majority of the SGCN list. Thus, we seek to encourage and facilitate research on this group. Interestingly, a large portion of the DD species is considered non-game. The lack of information about non-game species is primarily related to the scarcity of funding to determine basic population parameters and threats, although members of academia and NGOs have worked, and continue to contribute information to partially fill this knowledge gap.

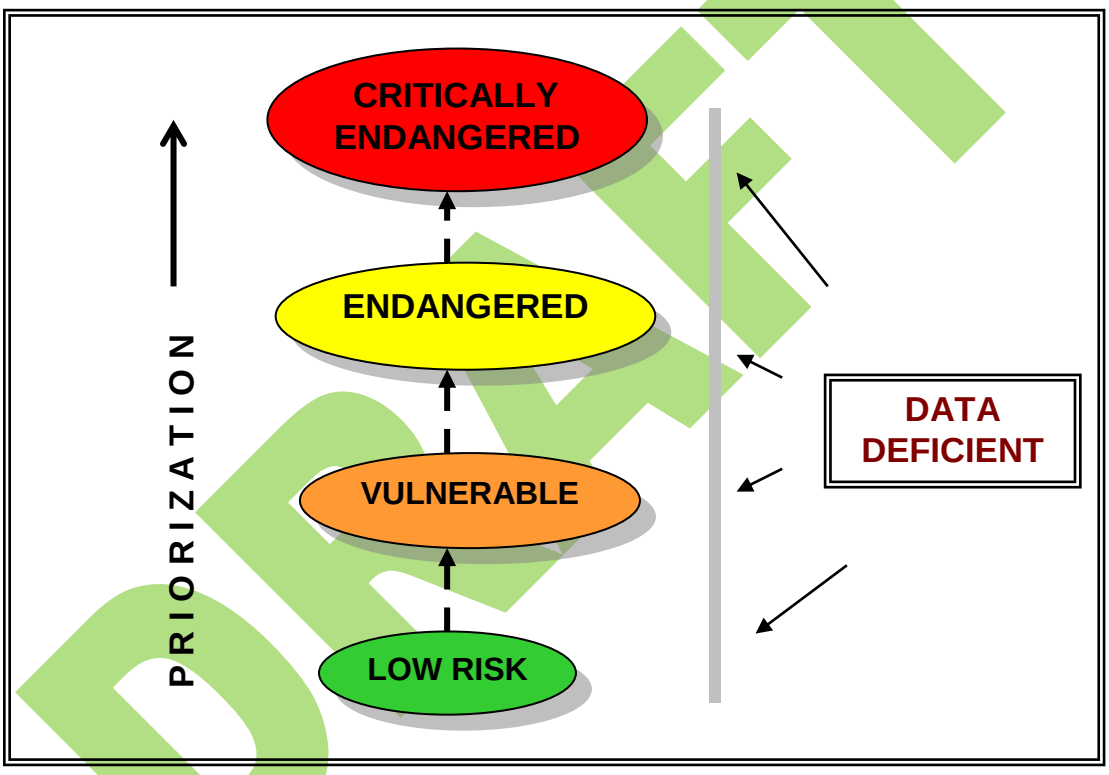


Figure 2. Scheme of species and actions of conservation priorization.

Table 3. Number of species per taxon included in the PRSWAP as SGCN.

Taxon	CR	EN	VU	DD	LR	Total
Amphibians	5	1*	4	6	0	**15**
Birds	5	8	15	27	5	**60**
Reptiles	3	5	4	11	0	**23**
Marine Mammals	0	2	0	1	0	**3**
Terrestrial Mammals	0	1	6	4	2	**13**
Fresh Water Fishes	0	0	0	3	6	**9**
Salt Water Fishes	1	3	8	40	0	**52**

Invertebrates	3	6	10	25	5	**49**
Plants	33	24	3	0	0	**60**
Total	**50**	**49**	**50**	**117**	**18**	**284**

*One species, within two populations, is classified as CR and EN.

Status and protection of the species of greatest conservation needs

The following list details information related to species of greatest conservation need (SGCN) for Puerto Rico. The letters E, N, M, and I in the broad distribution status column, identify the species as endemic, native, migratory, or introduced, respectively. Appendix I contains additional definitions.

Taxon	Common Name	Scientific Name	Category 2005	Category 2015	Broad Distribution Status
Marine Mammalas	Humpback Whale	*Megaptera novaeangliae*	VU	EN	M
Marine Mammalas	Bottlenose Dolphin	*Tursiops truncatus*	DD	DD	N
Marine Mammalas	West Indian Manatee	*Trichechus manatus*	EN	EN	E
Taxon	**Common Name**	**Scientific Name**	**Category 2005**	**Category 2015**	**Broad Distribution Status**
Terrestrial Mammals	Brazilian Free Tailed Bat	*Tadarida brasiliensis*	LR	LR	N
Terrestrial Mammals	Velvety Free-Tailed Bat	*Molossus molossus*	DD	LR	N
Terrestrial Mammals	Antillean Ghost-faced Bat	*Mormoops blainvillei*	DD	VU	N
Terrestrial Mammals	Parnell's Mustached Bat	*Pteronotus portoricensis*	DD	VU	E
Terrestrial Mammals	Sooty Mustached Bat	*Pteronotus quadridens*	DD	VU	N
Terrestrial Mammals	Fishing Bat	*Noctilio leporinus*	DD	DD	N
Terrestrial Mammals	Red Fruit Bat	*Stenoderma rufum*	VU	VU	E
Terrestrial Mammals	Brown Flower Bat	*Erophylla bombifrons*	VU	VU	N
Terrestrial Mammals	Jamaican Fruit Bat	*Artibeus jamaicensis*	DD	DD	N
Terrestrial Mammals	Cave Bat	*Brachyphylla cavernarum*	DD	DD	N
Terrestrial Mammals	Greater Antillean Long Tongued Bat	*Monophyllus redmani*	DD	VU	N
Terrestrial Mammals	Big Brown Bat	*Eptesicus fuscus*	DD	DD	N
Terrestrial Mammals	Red Bat	*Lasiurus minor*	DD	EN	N
Taxon	**Common Name**	**Scientific Name**	**Category 2005**	**Category 2015**	**Broad Distribution Status**
Birds	Sharp-shinned Hawk	*Accipiter striatus venator*	CR	CR	N
Birds	Broad-winged Hawk	*Buteo platypterus brunnescens*	CR	CR	N
Birds	West Indian Whistling Duck	*Dendrocygna arborea*	CR	CR	N
Birds	Masked Duck	*Nomonix dominicus*	EN	EN	N
Birds	Ruddy Duck	*Oxyura jamaicensis*	VU	VU	N
Birds	White-cheeked Pintail	*Anas bahamensis*	VU	VU	N
Birds	Black Swift	*Cypseloides niger*	DD	VU	M
Birds	Limpkin	*Aramus guarauna*	CR	DD	N
Birds	Least Bittern	*Ixobrychus exilis*	DD	DD	N
Birds	Puerto Rican Nightjar	*Antrostomus noctitherus*	EN	EN	E
Birds	Antillean Nighthawk	*Chordeiles gundlachi*	-	DD	M
Birds	Snowy Plover	*Charadrius nivosus*	CR	CR	M
Birds	American Golden Plover	*Pluvialis dominica*	-	DD	M
Birds	Piping plover	*Charadrius melodus*	CR	DD	M

Birds	Wilson's plover	*Charadrius wilsonia*	CR	VU	N
Birds	Plain Pigeon	*Patagioenas inornata wetmorei*	EN	EN	E
Birds	White-crowned Pigeon	*Patagioenas leucocephala*	DD	VU	N
Birds	Key West Quail-Dove	*Geotrygon chrysia*	DD	DD	N
Birds	Ruddy Quail-Dove	*Geotrygon montana*	DD	DD	N
Birds	Bridled Quail-Dove	*Geotrygon mystacea*	DD	DD	N
Birds	Yellow-billed Cuckoo	*Coccyzus americanus*	DD	DD	N
Birds	Puerto Rican Lizard-Cuckoo	*Saurothera vieilloti*	DD	LR	E
Birds	Elfin Woods warbler	*Setophaga angelae*	VU	EN	E
Birds	Yellow warbler	*Setophaga petechia*	VU	VU	N
Birds	Grasshopper Sparrow	*Ammodramus savannarum*	DD	VU	N
Birds	Adelaide's Warbler	*Setophaga adelaidae*	DD	LR	E
Birds	Prairie Warbler	*Setophaga discolor*	DD	DD	M
Birds	Puerto Rican bullfinch	*Loxigilla portoricensis*	DD	LR	E
Birds	Puerto Rican Tanager	*Nesospingus speculiferus*	DD	DD	E
Birds	Puerto Rican Spindalis	*Spindalis portoricensis*	DD	LR	E
Birds	Black-whiskered Vireo	*Vireo altiloquus*	DD	DD	N
Birds	Puerto Rican Vireo	*Vireo latimeri*	VU	VU	E
Birds	Bicknell's Thrush	*Catharus bicknelli*	-	DD	M
Birds	Golden-winged Warbler	*Vermivora chrysoptera*	-	DD	M
Birds	Bay-breasted Warbler B	*Setophaga castanea*	-	DD	M
Birds	Golden-winged Warbler	*Vermivora cyanoptera*	-	DD	M
Birds	Prothonothary Warbler	*Protonotaria citrea*	-	DD	M
Birds	Worm-eating Warbler	*Helmitheros vermivorum*	-	DD	M
Birds	Swainson's Warbler	*Limnothlypis swainsonii*	-	DD	M
Birds	Canada Warbler	*Cardellina canadensis*	-	DD	M
Birds	White Ibis	*Eudocimus albus*	-	VU	N
Birds	Glossy Ibis	*Plegadis falcinellus*	-	DD	N
Birds	American Oystercatcher	*Haematopus palliatus*	LR	VU	N
Birds	Cave Swallows	*Petrochelidon fulva*	DD	DD	N
Birds	Caribbean Martin	*Progne dominicensis*	-	DD	N
Birds	Yellow-shouldered blackbird	*Agelaius xanthomus*	EN	EN	E
Birds	Puerto Rican Oriole	*Icterus portoricensis*	DD	DD	E
Birds	Roseate Tern	*Sterna dougallii*	VU	VU	N
Birds	Brown Noddy	*Anous stolidus*	DD	DD	M
Birds	Bridled Tern	*Sterna antillarum*	DD	VU	M
Birds	Brown Pelican	*Pelecanus occidentalis*	EN	EN	N
Birds	Red-billed Tropicbird	*Phaethon aethereus*	DD	EN	M
Birds	Magnificent Fragate Bird	*Fregata magnificens*			N
Birds	White-tailed Tropicbird	*Phaethon lepturus*	DD	EN	M
Birds	Puerto Rican Woodpecker	*Melanerpes portoricensis*	DD	LR	E
Birds	Pied-billed Grebe	*Podilymbus podiceps*	DD	DD	N
Birds	Audubon's Shearwater	*Puffinus iherminieri*	CR	VU	M
Birds	Least Grebe	*Tachybaptus dominicus*	DD	DD	N
Birds	Puerto Rican Parrot	*Amazona vittata*	CR	CR	E
Birds	Caribbean Coot	*Fulica caribaea*	VU	VU	N
Birds	Yellow-breasted Crake	*Porzana flaviventer*	DD	VU	N
Taxon	**Common Name**	**Scientific Name**	**Category 2005**	**Category 2015**	**Broad Distribution Status**
Reptiles	Puerto Rican Bank Boa/Virgin Island Boa	*Chilobotrus granti*	CR	CR	N
Reptiles	Mona Island Boa	*Chilobotrus monensis*	EN	VU	E
Reptiles	Puerto Rican Boa	*Chilobotrus inornatus*	VU	VU	E
Reptiles	Green Sea Turtle	*Chelonia mydas*	EN	EN	N
Reptiles	Hawksbill Sea Turtle	*Eretmochelys imbricata*	EN	EN	N
Reptiles	Leatherback Sea Turtle	*Dermochelys coriacea*	EN	EN	N
Reptiles	Puerto Rican Slider	*Trachemys stejnegeri*	DD	DD	E
Reptiles	Monito Island Gecko	*Sphaerodactylus micropithecus*	CR	CR	E
Reptiles	Desecheo Island Gecko	*Sphaerodactylus levinsi*	DD	DD	E
Reptiles	Pandura's Gecko	*Sphaerodactylus gaigae*	DD	DD	

Reptiles	Mona Island Iguana	*Cyclura stejnegeri*	EN	EN	E
Reptiles	Culebra's Giant Lizard	*Anolis roosevelti*	CR	CR	E
Reptiles	Dry Forest Lizard	*Anolis cooki*	DD	EN	E
Reptiles	Puerto Rican Giant Lizard/Giant Anole	*Anolis cuvieri*	-	DD	E
Reptiles	Southern Garden Lizard	*Anolis poncensis*	VU	VU	E
Reptiles	Puerto Rican Galliwasp	*Diploglossus pleei*	-	DD	E
Reptiles	Puerto Rican Twig Anole, Pygmy Anole	*Anolis occultus*	DD	DD	E
Reptiles	Southern Ground Lizard	*Ameiva wetmorei*	DD	DD	
Reptiles	Slippery Back Skink	*Mabuya sloanii*	VU	VU	
Reptiles		*Typhlops platycephalus*	DD	DD	
Reptiles		*Typhlops rostellatus*	DD	DD	
Reptiles		*Typhlops granti*	DD	DD	
Reptiles		*Typhlops hypomethes*	DD	DD	
Taxon	**Common Name**	**Scientific Name**	**Category 2005**	**Category 2015**	**Broad Distribution Status**
Amphibians	Puerto Rican Crested Toad	*Peltophryne lemur*	CR	CR + EN	E
Amphibians	Eneida Coqui/Mottled Coqui	*Eleutherodactylus eneidae*	CR	CR	E
Amphibians	Golden Coqui	*Eleutherodactylus jasperi*	CR	CR	E
Amphibians	Web Footed Coqui	*Eleutherodactylus karlschmidti*	CR	CR	E
Amphibians	Plain Coqui	*Eleutherodactylus juanariveroi*	CR	CR	E
Amphibians	Cave Coqui	*Eleutherodactylus cooki*	VU	VU	E
Amphibians	Warty Coqui	*Eleutherodactylus locustus*	VU	VU	E
Amphibians	Richmond's Coqui	*Eleutherodactylus richmondi*	VU	VU	E
Amphibians	Puerto Rican Mountain Coqui/Forest Coqui	*Eleutherodactylus portoricensis*	VU	VU	E
Amphibians	Grass Coqui	*Eleutherodactylus brittoni*	DD	DD	E
Amphibians	Cricket Coqui	*Eleutherodactylus gryllus*	DD	DD	E
Amphibians	Hedrick's Coqui	*Eleutherodactylus hedricki*	DD	DD	E
Amphibians	Mona Island Coqui	*Eleutherodactylus monensis*	DD	DD	E
Amphibians	Burrowing Coqui	*Eleutherodactylus unicolor*	DD	DD	E
Amphibians	Wrinkled Frog	*Eleutherodactylus wightmanae*	DD	DD	E
Taxon	**Common Name**	**Scientific Name**	**Category 2005**	**Category 2015**	**Broad Distribution Status**
Freshwater Fishes	American Eel	*Anguilla rostrata*	DD	LR	N
Freshwater Fishes	Bigmouth Sleeper	*Gobiomorus dormitor*	DD	LR	N
Freshwater Fishes	Sirajo Gobby	*Sicydium plumieri*	-	LR	N
Freshwater Fishes	Spotted Algae Eating Gobby	*Sicydium punctatum*	DD	LR	N
Freshwater Fishes	Burro	*Pomadasys crocro*	DD	DD	N
Freshwater Fishes	Short-tail River Pipefish	*Microphis brachyurus*	DD	DD	N
Freshwater Fishes	Fat Sleeper	*Dormitator maculatus*	DD	DD	N
Freshwater Fishes	River Goby	*Awaous banana*	DD	LR	N
Freshwater Fishes	Mountain Mullet	*Agonostomus monticola*	DD	LR	N
Taxon	**Common Name**	**Scientific Name**	**Category 2005**	**Category 2015**	**Broad Distribution Status**
Saltwater Fishes	Tarpon Snook	*Centropomus pectinatus*	DD	DD	N
Saltwater Fishes	Mexican Snook	*Centropomus mexicanus*	DD	DD	N
Saltwater Fishes	Common Snook	*Centropomus undecimalis*	-	DD	N
Saltwater Fishes	Nurse Shark	*Ginglymostoma cirratum*	VU	VU	N
Saltwater Fishes	Tarpon	*Megalops atlanticus*	DD	DD	N
Saltwater Fishes	Spotted Goatfish	*Pseudupeneus maculatus*	DD	DD	N
Saltwater Fishes	Yellow Goatfish	*Mulloidichthys martinicus*	DD	DD	N
Saltwater Fishes	Goliath Grouper	*Epinephelus itajara*	CR	CR	N

Saltwater Fishes	Nassau Grouper	*Epinephelus striatus*	EN	EN	N
Saltwater Fishes	Red Grouper	*Epinephelus morio*	-	EN	N
Saltwater Fishes	Black Grouper	*Mycteroperca bonaci*		EN	N
Saltwater Fishes	Sea Horse	*Hippocampus spp.*	VU	VU	N
Saltwater Fishes	Bonefish	*Albula vulpes*	-	DD	N
Saltwater Fishes	Permit	*Trachinotus falcatus*	-	DD	N
Saltwater Fishes	Palometa	*Trachinotus goodei*	-	DD	N
Saltwater Fishes	Cutless fish	*Trichiurus lepturus*		DD	N
Saltwater Fishes	Scalloped hammerhead shark	*Sphyrna lewini*		VU	N
Saltwater Fishes	Smalltooth sawfish	*Pristis pectinata*		EN	N
Saltwater Fishes	Greater Amberjack	*Seriola dumerilli*	-	DD	
Saltwater Fishes	Blue Runner	*Caranx crysos*	-	DD	
Saltwater Fishes	Horse Eye Jack	*Caranx latus*	-	DD	
Saltwater Fishes	Caribbean Reef Shark	*Carcharhinus perezi*	-	DD	
Saltwater Fishes	Tiger Shark	*Galeocerdo cuvieri*	-	DD	
Saltwater Fishes	Lemon Shark	*Negaprion brevirostris*	-	DD	
Saltwater Fishes	Spotted eagle ray	*Aetobatus narinari*	-	DD	
Saltwater Fishes	Coney	*Cephalophilis fulvus*	-	DD	
Saltwater Fishes	Rock Hind	*Epinephelus adscencionis*	-	DD	N
Saltwater Fishes	Hogfish	*Lachnolaimus maximus*	-	DD	N
Saltwater Fishes	Mangrove Snapper	*Lutjanus griseus*	-	DD	N
Saltwater Fishes	Caribbean Red Snapper	*Lutjanus purpureus*		EN	N
Saltwater Fishes	Lane Snapper	*Lutjanus synagris*	-	DD	N
Saltwater Fishes	Mutton snapper	*Lutjanus analis*	-	DD	N
Saltwater Fishes	Vermillion Snapper	*Rhomboplites aurorubens*	-	DD	N
Saltwater Fishes	Gray Snapper	*Lujatnus griseus*	-	DD	N
Saltwater Fishes	Silk Snapper	*Lujatnus vivanus*	-	DD	N
Saltwater Fishes	Dog Snapper	*Lujatnus jocu*	-	DD	N
Saltwater Fishes	Cubera Snapper	*Lujatnus analis*	-	DD	N
Saltwater Fishes	Crevalle Jack	*Caranx hippos*	-	DD	N
Saltwater Fishes	Jolthead Porgy	*Calamus bajonado*	-	DD	N
Saltwater Fishes	Rainbow Parrotfish	*Scarus guacamaia*	DD	VU	N
Saltwater Fishes	Blue Parrotfish	*Scarus coeruleus*	-	VU	N
Saltwater Fishes	Midnight Parrotfish	*Scarus coelestinus*	-	VU	N
Saltwater Fishes	Princess Parrotfish	*Scarus taeniopterus*	-	DD	N
Saltwater Fishes	Queen Parrotfish	*Scarus vetula*	-	DD	N
Saltwater Fishes	Redtail Parrotfish	*Sparisoma chrysopterum*	-	DD	N
Saltwater Fishes	Stoplight Parrotfish	*Sparisoma viride*	-	DD	N
Saltwater Fishes	Reef Croaker	*Odontoscion dentex*	-	DD	N
Saltwater Fishes	Barred Grunt	*Conodon nobilis*	-	DD	N
Saltwater Fishes	White Grunt	*Haemulon plumieri*	-	DD	N
Saltwater Fishes	Black Grunt	*Haemulon bonariense*	-	DD	N
Saltwater Fishes	Smallmouth Grunt	*Haemulon chrysargyreum*	-	DD	N

Taxon	**Common Name**	**Scientific Name**	**Category 2005**	**Category 2015**	**Broad Distribution Status**
Invertebrates	Lobed Star Coral	*Orbicella annularis*	-	VU	N
Invertebrates	Mountainous Star Coral	*Orbicella faveolata*	-	VU	N
Invertebrates	Boulder Star Coral	*Orbicella franksi*	-	VU	N
Invertebrates	Pillar Coral	*Dendrogyra cylindrus*	-	VU	N
Invertebrates	Rough Cactus Coral	*Mycetophyllia ferox*	-	VU	N
Invertebrates	Staghorn Coral	*Acropora cervicornis*	-	VU	N
Invertebrates	Elkhorn Coral	*Acropora palmata*	-	VU	N
Invertebrates	Boulder brain coral	*Colpophyllia natans*	-	DD	N
Invertebrates	Fused staghorn	*Acropora prolifera*	-	DD	N
Invertebrates		*Agaricia lamarcki*	-	EN	N
Invertebrates		*Montastraea annularis*	-	EN	N
Invertebrates		*Montastraea faveolata*	-	EN	N
Invertebrates		*Montastraea franksi*	-	EN	N
Invertebrates		*Dichocoenia stokesii*	-	EN	N
Invertebrates		*Oculina varicosa*	-	EN	N
Invertebrates	Threerowed Sea Cucumber	*Isostichopus badionotus*	-	VU	N
Invertebrates	Furry Sea Cucumber	*Astichopus multifidus*	-	DD	N
Invertebrates	West Indian Sea	*Actinopyga agassizii*	-	DD	N

	Cucumber				
Invertebrates		*Agapostemon viequensis*	-	DD	
Invertebrates		*Coelioxys spinosa*	-	DD	
Invertebrates		*Melissodes trifasciata*	-	DD	
Invertebrates		*Nomada krugii*	-	DD	
Invertebrates		*Xeromelecta tibialis*	-	DD	
Invertebrates		*Ceratina guarnacciana*	-	DD	
Invertebrates		*Strombus gigas*	-	LR	
Invertebrates	Long Spined Sea Urchin	*Diadema antillarum*	-	DD	
Invertebrates	Puerto Rican Harlequin Butterfly	*Atlantea tulita*	CR	CR	N
Invertebrates	Mona's Cave Shrimp	*Typhlatya monae*	CR	CR	N
Invertebrates	Mona/Monito/Little-land Crab	*Alloweckellila gurnee*	CR	CR	N
Invertebrates	Purple Land Crab	*Gecarcinus lateralis*	DD	DD	N
Invertebrates	Common Land Crab	*Gecarcinus guanhumi*	LR	LR	N
Invertebrates	Mangrove Crab	*Aratus pisonii*	DD	DD	N
Invertebrates	Mangrove Root Crab	*Goniopsis cruentata*	LR	LR	N
Invertebrates	Fiddler Crab	*Uca leptodacyla*	DD	DD	N
Invertebrates	Fiddler Crab	*Uca thayeri*	DD	DD	N
Invertebrates	Fiddler Crab	*Uca vocator*	DD	DD	N
Invertebrates	Fiddler Crab	*Uca major*	DD	DD	N
Invertebrates	Swamp Ghost Crab	*Ulcides cordatus*	LR	LR	N
Invertebrates	River Shrimp	*Macrobrachium acanthurus*	DD	DD	N
Invertebrates	River Shrimp	*Macrobrachium faustinum*	-	DD	N
Invertebrates	River Shrimp	*Macrobrachium heterochirus*	DD	LR	N
Invertebrates	River Shrimp	*Macrobrachium carcinus*	LR	VU	N
Invertebrates	Shrimp	*Macrobrachium crenulatum*	LR	DD	N
Invertebrates	Green Lobster	*Panulirus laevicauda*	VU	DD	N
Invertebrates	Buruquena	*Epilobocera sinuatifrons*	LR	DD	N
Invertebrates	Octopus	*Octopus spp*	DD	DD	N
Invertebrates	Queen Conch	*Cittarium pica*	DD	VU	N
Invertebrates	West Indian Topshell	*Sabellastarte magnifica*	DD	DD	N
Invertebrates	Magnificent Feather Duster	*Bispirina brunnea*	DD	DD	N
Taxon	**Common Name**	**Scientific Name**	**Category 2005**	**Category 2015**	**Broad Distribution Status**
Plants	-	*Marsdenia woodburyana*	-	EN	N
Plants	Cook's Holly	*Ilex cookii*	-	CR	E
Plants	-	*Ilex sintenisii*	-	EN	E
Plants	Palma Manaca	*Calyptronoma rivalis*	-	EN	N
Plants	-	*Pseudophoenix sargentii*	-	EN	N
Plants	Palma de Lluvia	*Gaussia attenuata*	-	EN	N
Plants	Palma de Sombrero	*Sabal causiarum*	-	EN	N
Plants	-	*Chromolaena borinquensis*	-	EN	E
Plants	-	*Vernonia proctorii*	-	CR	E
Plants	Higüero de Sierra	*Crescentia portoricensis*	-	CR	E
Plants	Puerto Rico Manjack	*Varronia bellonis*	-	EN	E
Plants	-	*Varronia rupicola*	-	VU	N
Plants	Vahl's Boxwood	*Buxus vahlii*	-	EN	N
Plants	-	*Leptocereus grantianus*	-	CR	E
Plants	Chupacallos	*Pleodendron macranthum*	-	CR	E
Plants	Helecho de Bosque Enano.	*Alsophyla amintae*	-	EN	E
Plants	-	*Gonocalyx concolor*	-	CR	E
Plants	-	*Lyonia truncata var. proctorii*	-	CR	E
Plants	Tamarindillo	*Chamaecrista glandulosa var. mirabilis*	-	CR	E
Plants	Cobana Negra.	*Stahlia monosperma*	-	CR	N
Plants	-	*Gesneria pauciflora*	-	VU	E
Plants	Palo de Rosa	*Ottoschulzia rhodoxylon*	-	CR	N
Plants	Nogal / West Indian Walnut	*Juglans jamaicensis*	-	CR	N
Plants	Capa Rosa, Palo de Rosa	*Callicarpa ampla*	-	CR	N

Plants	Nigua/ Palo de Nigua	*Cornutia obovata*	-	CR	E
Plants	Bariaco	*Trichilia triacantha*	-	CR	N
Plants	-	*Calytranthes acevedoi*	-	EN	E
Plants	-	*Calyptranthes estremerae*	-	EN	E
Plants	-	*Eugenia fajardensis*	-	CR	E
Plants	Uvillo	*Eugenia haematocarpa*	-	EN	E
Plants	-	*Eugenia woodburyana*	-	EN	E
Plants	Ausú	*Myrcia paganii*	-	CR	E
Plants	Araña	*Schoepfia arenaria*	-	EN	E
Plants	-	*Cranichis ricartii*	-	CR	E
Plants	-	*Lepanthes eltoroensis*	-	VU	E
Plants	-	*Peperomia wheeleri*	-	EN	E
Plants	-	*Aristida chaseae*	-	EN	E
Plants	Pelos del Diablo	*Aristida portoricensis*	-	EN	E
Plants	-	*Adiantum x vivesii*	-	CR	E
Plants	-	*Elaphoglossum serpens*	-	CR	E
Plants	-	*Polystichum calderonense*	-	CR	E
Plants	-	*Tectaria x estremerana*	-	CR	E
Plants	-	*Thelypteris inabonensis*	-	CR	E
Plants	-	*Thelypteris verecunda*	-	CR	E
Plants	-	*Thelypteris yaucoensis*	-	CR	E
Plants	-	*Auerodendron pauciflorum*	-	CR	E
Plants	-	*Catesbaea melanocarpa*	-	CR	N
Plants	-	*Mitracarpus maxwelliae*	-	EN	E
Plants	-	*Mitracarpus polycladus*	-	EN	N
Plants	Quina	*Stenostomun sintenisii*	-	EN	N
Plants	St. Thomas prickly-ash	*Zanthoxylum thomasianum*	-	EN	N
Plants	Palo de Ramón	*Banara vanderbiltii*	-	CR	E
Plants	-	*Xylosma pachyphyllum*	-	CR	E
Plants	-	*Xylosma pachyphyllum*	-	CR	E
Plants	Mata Buey	*Goetzea elegans*	-	EN	E
Plants	Erubia	*Solanum ensifolium*	-	EN	E
Plants	Palo de Jazmín	*Styrax portoricensis*	-	CR	E
Plants	Palo Colorado	*Ternstroemia luquillensis*	-	CR	E
Plants	-	*Ternstroemia subsessilis*	-	CR	E
Plants	-	*Bonellia pauciflora*	-	CR	N

The abundance or population estimates, and the documented recent distribution of the Puerto Rico SGCN are shown in the following list:

Taxon	Common Name	Abundance or Population Estimates	Recent Distribution
Marine Mammals	Humpback Whale	7698	North Atlantic, Caribbean during the winter (waring et al 2016).
Marine Mammals	Bottlenose Dolphin	Unknown	Worldwide tropical zones (Waring et al, 2016).
Marine Mammals	West Indian Manatee	Range from 350 to 600	All Puerto Rico coastline. Largest population in Salinas/Guayama area, including Jobos Bay National Estuarine Research Reserve.
Taxon	**Common Name**	**Abundance or Population Estimates**	**Recent Distribution**
Terrestrial Mammals	Brazilian Free Tailed Bat	Unknown	Cool chambers in cave.
Terrestrial Mammals	Velvety Free-Tailed Bat	Unknown	Mostly associated to human settlements. Corredor El Yaguazo, Cataño. Vieques NWR, Vieques. Cueva Esqueleto in Playa Sardidnera, Mona Island Natural Reserve.
Terrestrial Mammals	Antillean Ghost-faced Bat	Over 40,000 in Cucaracha Cave, Aguadilla	Hot caves. Corredor El Yaguazo, Cataño. Cueva Negra in Playa Sardinera, Mona Island Natural Reserve.
Terrestrial Mammals	Parnell's Mustached Bat	Unknown. It is considered uncommon in Puerto Rico	Humid and warm caves. Corredor El Yaguazo, Cataño. Cueva Caballos in Playa Pájaros, Mona Island Natural Reserve. Cueva Murciélagos in Playa Uveros, Mona Island Natural Reserve. Cueva Naranjos, Juana Diaz.
Terrestrial Mammals	Sooty Mustached Bat	Unknown. Over 140,000 in Cucaracha Cave, Aguadilla	Deep recesses of hot caves. Corredor El Yaguazo, Cataño (Rodriguez-Durán and Lewis, 1987).
Terrestrial Mammals	Fishing Bat	Unknown	Cool chambers in caves. Vieques NWR, Vieques.
Terrestrial Mammals	Red Fruit Bat	Unknown	Inhabits on trees. Vieques NWR, Vieques.
Terrestrial Mammals	Brown Flower Bat	Unknown	Hot caves. Cerro Cuevas, Juana Díaz. Bridge in Winston Churchill Ave. and Rio Piedras, San Juan. Corredor El Yaguazo, Cataño.
Terrestrial Mammals	Jamaican Fruit Bat	Unknown. It is found in a wide range of caves than any other bat species	Caves ranging from some that are shallow and well lighted to those that are deep and totally dark, also found in trees and anthropogenic structures. Vieques NWR, Vieques. Playa Sardinera, Mona Island Natural Reserve.
Terrestrial Mammals	Cave Bat	Unknown	Hot caves. Corredor El Yaguazo, Cataño.
Terrestrial Mammals	Greater Antillean Long Tongued Bat	Over 500,000 in Cucaracha Caves, Aguadilla.	Hot caves. Cueva Murciélagos in Playa Uveros, Mona Island Natural Reserve.
Terrestrial Mammals	Big Brown Bat	Unknown	Shallow caves and cave like structures, such as abandoned tunnels and culverts under roads.
Terrestrial Mammals	Red Bat	Unknown	Inhabits on Karst zone. Corredor El Yaguazo, Cataño.

Taxon	Common Name	Abundance or Population Estimates	Recent Distribution
Birds	Sharp-shinned Hawk	Less than 140 individuals	High elevation forests.
Birds	Broad-winged Hawk	Less than 150 individuals	Dense forests.
Birds	West Indian Whistling Duck	About between 100 and 200 individuals (20-50 pairs)	Freshwater forested wetlands, isolated ponds and brackish lagoons.
Birds	Masked Duck	100-150 individuals (30-50 pairs)	Freshwater and brackish water bodies, with floating vegetation.
Birds	Ruddy Duck	About 1,500 individuals (200-600 pairs)	Freshwater and brackish water bodies, more than three meters deep.
Birds	White-cheeked Pintail	About 1,500 individuals (200-600 pairs)	Mangrove, brackish and freshwater swamps
Birds	Black Swift	Unknown. Uncommon breeding resident	Mountains, less frequently lowlands and coastal areas; nests on cliffs associated to waterfalls.
Birds	Limpkin	Unknown. Uncommon on Hispaniola.	Grassy freshwater wetlands, wooded floodplains, upland wet forest, freshwater wetlands, reservoirs.
Birds	Least Bittern	About 200-300 pairs. Fairly common locally in Puerto Rico, very rare in the Virgin Islands	Dense emergent vegetation of freshwater swamps, often with cattails, but also occurs in mangrove channels.
Birds	Puerto Rican Nightjar	About 1,500 individuals	Restricted to dry, semi-deciduous forests with continuous canopy in the Southwestern portion of the island. Fairly common during breeding season (usually from April through end of May, but it could extend up to mid June).
Birds	Antillean Nighthawk	Fairly common during breeding season (April through August).	Open areas in lowlands and interior valleys. Nests on the ground and rooftops of buildings. Migrates south during winter months.
Birds	Snowy Plover	About 70 individuals (30 pairs)	Sandy beaches, brackish lagoon borders with extensive salt flats, mud flats.
Birds	American Golden Plover	Unknown; uncommon transient migrant during the fall between August and October	Coastal grassy areas including golf courses and sod farms, herbaceous wetlands, mud and salt flats.
Birds	Piping plover	About 5-25 during winter	Mud and salt flats, sandy beaches.
Birds	Wilson's plover	500-700 individuals	Primarily on borders of salt ponds, mud flats and sandy beaches.
Birds	Plain Pigeon	About 3,00 individuals	Secondary forests of east-central Puerto Rico.
Birds	White-crowned Pigeon	About 2,500-3,000 individuals, appears to have increased in recentdecade.	Coastal plains, moist forests, mangroves in the north, west and east of the Island, common on Vieques, Culebra and Mona Islands, inter island movement common.
Birds	Key West Quail-Dove	Unknown	Coastal thickets, dry and moist forests with dense vegetation ascending to higher elevations in the Maricao mountains.
Birds	Ruddy Quail-Dove	Unknown	Moist to wet forest and shade coffee plantations at all elevations, occurs locally on coastal thickets and dry forests.
Birds	Bridled Quail-Dove	Unknown	Dense mountain forest with thick understory Coastal forests, also locally in coastal forests local on Eastern PR and Vieques.

Birds	Yellow-billed Cuckoo	Unknown	Uncommon summer breeding migrant. Forested areas, including shade coffee plantations at all elevations.
Birds	Puerto Rican Lizard-Cuckoo	Unknown	Haystack hills of the north coast, shade coffee plantations, all mountainous areas with thick forests, dry coastal forest in the vicinity of Guánica Forested areas throughout the island, apparently most abundant in the karst region, where it may be easily found in coastal thickets. Less frequently detected in the Eastern part of PR, though a common resident in the Luquillo and Cayey mountain ranges. Restricted to the island of PR, excluding satellite islands.
Birds	Elfin Woods warbler	About 300 pairs	Dense underbrush in mountain forests (between elevations of 370 and 1,030 m). Species known only from two populations, El Yunque National Forest and Maricao State Forest and adjacent private lands.
Birds	Yellow warbler	Unknown. Decreasing in Puerto Rico in general.	Primarily mangroves and coastal scrub forest. Present in most cays and satellite islands where trees are present.
Birds	Grasshopper Sparrow	Unknown	Coastal plains and open fields, highly associated with sod farms.
Birds	Adelaide's Warbler	Unknown	Dry coastal scrubland and thickets and moist forests ascending to mid elevations.
Birds	Prairie Warbler	Unknown, the entire population winters primarily in West Indies and southern Florida.	Dry costal forest thickets, pastures with scattered trees, mangroves and gardens.
Birds	Puerto Rican bullfinch	Unknown	Particularly dense mountains, forested areas, but also dry coastal thickets and infrequently in mangroves.
Birds	Puerto Rican Tanager	Unknown, common locally	Primarily undisturbed mountain forests, at middle to high elevations, most records are for the Luquillo and Cayey mountains on the eastern half of the island and for the Toro Negro and Guilarte forests in central PR, as well as the Maricao Mountains in the west, but also on disturbed secondary growth forests.
Birds	Puerto Rican Spindalis	Unknwon; Common and widespread	Woodlands, forests, gardens, plantations with fruiting plants, parks, towns and urban area at all elevations.
Birds	Black-whiskered Vireo	Unknown; Common breeding resident.	Forest of all types, and at all elevations, also woodlands and mangroves. Most of the populations migrate to unknown areas in South America during fall and winter. Tall understory and gardens.
Birds	Puerto Rican Vireo	Unknown; Common in the mountains, less common in eastern PR, also on coastal forests and mangroves.	Secundary forests throughout the island. Uncommon in eastern Puerto Rico.
Birds	Bicknell's Thrush	Unknown locally; may be 50,000 worldwide	Almost entire population winters in the Greater Antilles. Prefers moist and wet forested areas, usually in the mountains, between September and April.
Birds	Golden-winged Warbler	Unknown. Rare visitor to the West Indies	Mountain forests, shade coffee plantations, coastal thickets.
Birds	Bay-breasted Warbler B	Unknown; Rare fall transient, Populations rise and fall due to availability of budworms in breeding range.	Forest edge and secondary growth stands.

Birds	Golden-winged Warbler	Unknown. Rare migrant	Secondary forests and thickets.
Birds	Prothonothary Warbler	Unknown; Uncommon winter resident in mangroves and forested wetlands in Puerto Rico.	Forested wetlands, mangroves and rivers, ascending high elevation along rivers and streams.
Birds	Worm-eating Warbler	Unknown; Rare to uncommon winter resident in Puerto Rico.	Forested lowlands, especially in drier areas. More frequent in Vieques than rest of Puerto Rican territory.
Birds	Swainson's Warbler	Unknown; Rare winter resident, difficult to observe.	Dense forest and thickets associated to streams and rivers.
Birds	Canada Warbler	Unknown; Rare winter resident in Puerto Rico.	Forested areas with dense understory.
Birds	White Ibis	Unknown; Christmas Bird Count for Arecibo data shows an increase in numbers since 2004.	Coastal wetlands in northern Puerto Rico, rarely reported anywhere else in Puerto Rico's territory. Breeds very locally in western mangroves of Caño Tiburones. First breeding confirmed in 2005.
Birds	Glossy Ibis	Unknown; Population appears to be expanding islandwide. Christmas Bird Count for Arecibo data shows an increase in numbers since 2002	Coastal wetlands, freshwater lagoons. Breeds locally on isolated mangroves between Arecibo and Hatillo. Roosts known also for Lajas (Cartagena Lagoon). Regular in Humacao Nature Reserve. Frequent on wetlands and flood plains along north coast after heavy rains.
Birds	American Oystercatcher	About 20-30 pairs; pairs are territorial and long-lived.	Coastal, prefers beaches and offshore islands and cays. Breeds on offshore cays or isolated rocky outcrops, sometimes associated to breeding tern colonies.
Birds	Cave Swallows	Unknown; Endemic Puerto Rico subspecies, part of the population may be migratory. Common year round	Principally over open areas such as hay fields, wetlands, and in towns. As name implies, breeds in caves and cliffs but it has adapted to nest under bridges and abandoned or roofed, open buildings.
Birds	Caribbean Martin	Unknown; The population leaves the island during fall and part of winter. Locally common during the spring and summer.	Principally over open areas near forest edges in lowlands and mountain valleys close to towns. Breeds in abandoned Puerto Rican Woodpecker tree or palm cavities, crevices in cliffs and in man-made crevices in buildings or concrete posts. It has adapted to nest under bridges in association with Cave Swallows using the mud nests of the latter as a nesting platform.
Birds	Yellow-shouldered blackbird	About 1,000 individuals	Mangroves in south and southwestern Puerto Rico. Mona Island Natural Reserve.
Birds	Puerto Rican Oriole	Unknown; Endemic to Puerto Rico. May be decreasing due to cowbird parasitism.	Forested areas, citrus orchards, gardens and urban areas. Strongly associated to royal palm distribution, where it prefers to build their nests. Will use other palm species as well, if royal palms are not available.
Birds	Roseate Tern	About 2,000 individuals (600-800 pairs)	Far offshore during most of the year, waters off PR during breeding season, nests on isolated sandy cays and rocky islets.
Birds	Brown Noddy	About 1,000-2,000 pairs	Far offshore, on coastal waters off PR during breeding season, nests on isolated rocky islets of Cordillera Reserve and also Culebra, Mona, and Monito islands.
Birds	Bridled Tern	About 300 individuals (75-120 pairs)	Offshore for most of the year, near coastal waters during the breeding season, nests on sandy beaches, saltflats and other open flat coastal areas, including rooftops.
Birds	Brown Pelican	About 2,000 individuals (60-150 breeding pairs)	Harbors, cays, reservoirs, lagoons and estuaries.

Birds	Red-billed Tropicbird	"About 50-75 pairs. Common in the Virgin Islands. Uncommon and very local resident in Culebra Island and the Cordillera Reefs Natural Reserve between Fajardo and Culebra Island.	Pelagic during the non-breeding season; nests on crevices on isolated coastal cliffs and off-shore cays
Birds	Magnificent Fragate Bird		Pelagic during the non-breeding season; nests on sea cliffs and off-shore cays.
Birds	White-tailed Tropicbird	About 150-250 breeding pairs. Uncommon and very local resident in isolated coastal cliffs in Puerto Rico, Desecheo, Guajataca, Cayo Conejo, Cayo Luis Peña, Mona and Monito Islands and the cays in the Cordillera Reserve between Fajardo and Culebra Island.	Pelagic during the non-breeding season; nests on crevices on isolated coastal cliffs and off-shore cays.
Birds	Puerto Rican Woodpecker	Unknown. However common in Puerto Rico and in Vieques Island.	Forested areas throughout Puerto Rico from coastal thickets to mountain forest. Most common on hills and lower mountain areas including shade coffee plantations
Birds	Pied-billed Grebe	About 300-500 pairs; common species in PR, rare to uncommon in Vieques and Culebra	Artificial and natural ponds, lagoons, reservoirs, large rivers and estuaries. Some North American migrants may winter locally.
Birds	Audubon's Shearwater	About 25 pairs. Uncommon in the Caribbean	Pelagic during non-breeding season. Nests on offshore cays of the Cordillera Reefs Reserve between Fajardo and Culebra Island, Mona and Monito.
Birds	Least Grebe	About 50-150 pairs	Small ponds or margins of brackish and fresh water bodies.
Birds	Puerto Rican Parrot	About 194 individuals in the wild and in captivity.	Moist and wet forests in the Luquillo mountains; reintroduced into the Río Abajo State Forest in Utuado. It will be reintroduced to the Maricao State Forest.
Birds	Caribbean Coot	About 1,000 individuals (200-400 pairs).	Brackish or freshwater swamps, marshes with sparse vegetation.
Birds	Yellow-breasted Crake	Unknown, appears to be an uncommon resident in certain wetlands but absent in apparent suitable habitat.	Freshwater marshes, pond edges, flooded fields, swamps and canals with short vegetation.
Taxon	**Common Name**	**Abundance or Population Estimates**	**Recent Distribution**
Reptiles	Puerto Rican Bank Boa/Virgin Island Boa	Unknown	Trees with continuous canopy in Subtropical dry. In Cayo Diablo of the Cordillera Reefs Natural Reserve, is apparently naturally occurring (as opposed to introduced), and is one of the densest reported populations of West Indian boas, with recent estimates of 100–150 individuals per hectare (Tolson 1996, USFWS 2009).
Reptiles	Mona Island Boa	Unknown	Trees with continuous canopy in Subtropical dry forest.
Reptiles	Puerto Rican Boa	5.6 individuals' ha-1 in forests from coastal northern karst	Islandwide up to 1,150 m of elevation.

		(limestone) belt	
Reptiles	Green Sea Turtle	Unknown	Marine grass prairies, and coral reefs, nest on sandy beaches.
Reptiles	Hawksbill Sea Turtle	Unknown. About 275 juveniles and 800 reproductive individuals in Mona Island coral reefs	Coral reefs, nests on sandy beaches.
Reptiles	Leatherback Sea Turtle	Unknown	Open water of the North Atlantic Ocean
Reptiles	Puerto Rican Slider	4.4–5.6 individuals' ha-1	Ponds, reservoirs and rivers.
Reptiles	Monito Island Gecko	Unknown. Mean density of 0.45 individuals/m2 on adequate habitats.	Under rocks and tree trunks on the rocky plateau.
Reptiles	Desecheo Island Gecko	Unknown.	Subtropical Dry forest, under leaf litter, rocks, and tree trunks.
Reptiles	Pandura's Gecko	Unknown.	Under leaf litter, rocks, and tree trunks.
Reptiles	Mona Island Iguana	About 2,500 individuals	Grass and bushy areas in the Subtropical dry forest.
Reptiles	Culebra's Giant Lizard	Known from Culebra, Vieques, St. John, and Tortola	Mature forest –canopy.
Reptiles	Dry Forest Lizard	Unknown	Grass and bushy areas in the Subtropical dry forest.
Reptiles	Puerto Rican Giant Lizard/Giant Anole	Unknown	Upland forests and karst.
Reptiles	Southern Garden Lizard	Unknown	Grass and bushy areas in Subtropical dry forest.
Reptiles	Puerto Rican Galliwasp		
Reptiles	Puerto Rican Twig Anole, Pygmy Anole	Unknown	Upland forests.
Reptiles	Southern Ground Lizard	Unknown	Subtropical dry forests.
Reptiles	Slippery Back Skink	Unknown	Subtropical dry and moist forests, under leaf litter.
Reptiles	T. platycephaluls		
Reptiles	T. rostellatus	Unknown	Subtropical dry forest, under rocks and tree trunks.
Reptiles	T. granti		
Reptiles	T. hypomethes	Unknown	Subtropical dry forest, under rocks and tree trunks.
Taxon	**Common Name**	**Abundance or Population Estimates**	**Recent Distribution**
Amphibians	Puerto Rican Crested Toad	Unknown	Rock crevices.
Amphibians	Eneida Coqui/Mottled Coqui	Unknown. Probably extinct.	Forest elevations between 300-1,152 m, road slopes, and mossy tree trunks of less than 1 m high, on the ground or on palm leaves and trunks, tree ferns or bushes
Amphibians	Golden Coqui	Unknown. Probably extinct.	Forest bromeliads
Amphibians	Web Footed Coqui	Unknown. Probably extinct.	Elevations between 45-630 m, mountains, rocks, and rocks associated with rivers, in holes between rocks near waterfalls, and rocks surface sprayed by water.
Amphibians	Plain Coqui	Monthly mean relative abundance, between July 2005 and July 2006, was 473 ± 186.8 individuals' ha-1 in its type locality. Estimates of relative abundance, however, can be as high as 816.7 ± 319.3 individuals' ha-1 during	Wet grassy lowlands in the Toa Baja Municipality.

		the rainy months between July and November.	
Amphibians	Cave Coqui	According to Joglar et al. (1996), relative abundance for the guajón seemed to decrease during winter when precipitation and air temperature decreased. Burrowes (1997) studied the guajón at a cave system in the Cuchilla de Panduras, where a total of 130 individuals were marked at the site, resulting in a mean population size estimate of 96 individuals, and a mean of 20 new individuals entering the population every six months. Another mark-recapture study conducted by Vega-Castillo (2000) showed mean Population size of 436 individuals in a rocky stream in Humacao, and 390 individuals for a rocky stream at Las Piedras.	Caves, crevices and grottoes, between 91-303 m in elevation.
Amphibians	Warty Coqui	Unknown.	Open areas, and in the periphery of moist-dense forests with wide leaves, under leaf litter, tree trunks, and roots.
Amphibians	Richmond's Coqui	Unknown. About 100 individual/ha in occupation area.	Elevations between 40 and 158 m
Amphibians	Puerto Rican Mountain Coqui/Forest Coqui	Unknown. Around 800 individuals/ha in occupation area.	High montane forest, over 180 m in elevation.
Amphibians	Grass Coqui	755.6 individuals' ha-1 in wet grassy lowlands in Sabana Seca, Puerto Rico.	Open meadows, young sugarcane fields, grasslands in Río Piedras, forests in Trujillo Alto, open areas along roads at low elevation areas (Caguas, Gurabo, Juncos, Las Piedras, Humacao), at sea level in Toa Baja, elsewhere in higher elevation areas (Luquillo Mountains, Sierra de Cayey, Central Mountain Range). Predominantly absent from most xerophytic regions in PR.
Amphibians	Cricket Coqui	Unknown	Mesic forests, along forest edges or openings; diurnal retreats to bromeliads and under moss on rocks.
Amphibians	Hedrick's Coqui	Unknown	Elevations between 457 and 1,158 m, dense moist forests with broad leaves, tree trunk cavities and cracks, and tree branches.
Amphibians	Mona Island Coqui	Unknown	Found on walls of shallow caves containing water, sinkholes, under galvanized sheets covering water reservoirs, bromeliads and vegetation.
Amphibians	Burrowing Coqui	Unknown	Altitudinal distribution above about 674 to 1,045 m Under moss, rocks, and roots in elfin forest in Sierra de Luquillo.
Amphibians	Wrinkled Frog	Unknown	Altitudinal distribution 308 to 1,189 m.

			Mesic upland forest, on the ground under rocks, dead trunks, and forest debris.
Taxon	**Common Name**	**Abundance or Population Estimates**	**Recent Distribution**
Freshwater Fishes	American Eel	>2,596.1/ha	Island wide (Kwak et al 2013).
Freshwater Fishes	Bigmouth Sleeper	>8,000/ha Data suggest that it is a relatively common species.	Island wide (Kwak et al 2013).
Freshwater Fishes	Sirajo Gobby	>3,534/ha	Island wide (Kwak et al 2013).
Freshwater Fishes	Spotted Algae Eating Gobby	>3,534/ha	Island wide (Kwak et al 2013).
Freshwater Fishes	Burro	24/h	Island wide (Kwak et al 2013).
Freshwater Fishes	Short-tail River Pipefish	Unknow	Unknow
Freshwater Fishes	Fat Sleeper	4/ha	Island wide (Kwak et al 2013).
Freshwater Fishes	River Goby	>3,000/ha	Island wide (Kwak et al 2013).
Freshwater Fishes	Mountain Mullet	>18,000/ha Data suggest that it is a relatively common species.	Island wide (Kwak et al 2013).
Taxon	**Common Name**	**Abundance or Population Estimates**	**Recent Distribution**
Saltwater Fishes	Tarpon Snook	No formal stock assessment has been performed on this species.	Western Atlantic: southern Florida (USA), Mexico, and the West Indies to Brazil (Robins and Ray, 1986).
Saltwater Fishes	Mexican Snook	Ault et al. 2013. Sustaining Coral Reef fisheries of Puerto Rico. Workshop Technical Report. Univ. of Miami. 74 pp.	Western Atlantic: eastern Mexico and Greater Antilles to Venezuela and Porto Alegre in Brazil (Cervigón et al., 1992).
Saltwater Fishes	Common Snook	Formal stock assessment has not been performed.	Western Atlantic: southern Florida (USA), southeastern coast of the Gulf of Mexico, most of the Antilles and Caribbean coast of Central and South America extending southward to Rio de Janeiro, Brazil; also North Carolina and Texas, USA (Ojeda 1994).
Saltwater Fishes	Nurse Shark	Expert knowledge of severe fishing impacts on spawning aggregations.	Marine; brackish; reef-associated; depth range 0 - 130 m (Compagno 1984).
Saltwater Fishes	Tarpon	Formal stock assessment has not been performed. IUCN status: Vulnerable	Most common in coastal lagoons and rivers (Zerbi and Joyeux 2001)
Saltwater Fishes	Spotted Goatfish	Formal stock assessment has not been performed due to the scarcity of specimens for study.	Ault et al. 2013.
Saltwater	Yellow Goatfish	No formal stock	US to Brazil

Fishes		assessment has been performed on this species.	
Saltwater Fishes	Goliath Grouper	Formal stock assessment has not been performed.	Western Atlantic: Florida, USA to southern Brazil, including the Gulf of Mexico and the Caribbean (Sadovy et al 2013).
Saltwater Fishes	Nassau Grouper	Formal stock assessment has not been performed, due to endangered status and subsequent lack of sufficient specimens.	Western Atlantic: Bermuda, Florida, Bahamas, Yucatan Peninsula and throughout the Caribbean to southern Brazil (Sadovy et al 2013).
Saltwater Fishes	Red Grouper	Formal stock assessment has not been performed. Only 19 red grouper were measured by DNER biologists in the commercial fishery from 1988 to 2010. IUCN status: Near Threatened.	Marine, reef associated species, from US to Southern Brazil (Appeldoorn and Sanders, 2015).
Saltwater Fishes	Black Grouper	Between 2007 and 2017, only 7 specimens were measured by DNER biologists, including commercial and recreational fisheries. IUCN Near Threatened.	Western Atlantic: Bermuda and Massachusetts, USA to southern Brazil, including the southern Gulf of Mexico and the Caribbean (Ault et al 2013).
Saltwater Fishes	Sea Horse	No formal stock assessment has been performed on this species.	Small populations known at Escambron, Caja de Muertos, Parguera, Crashboat. (Mote Environmental Services, Inc. 2002).
Saltwater Fishes	Bonefish	Formal stock assessment has not been performed.	Western Atlantic: North Carolina, USA to Florida, Bahamas, Gulf of Mexico, Antilles and Caribbean to Brazil. Several populations in PR have been fished to extinction or nearly extinct. Range has been reduced significantly (Jacob et al 2015).
Saltwater Fishes	Permit	From 2006 to 2010, only 3 specimens were measured by DNER biologists.	Small schools have been seen in Luis Peña Reserve, Culebra. Solitary individuals have been sighted in Aguirre and Guanica/Parguera reef flats (Ault et al 2013).
Saltwater Fishes	Palometa	No formal stock assessment has been performed on this species.	
Saltwater Fishes	Cutless fish	No formal stock assessment has been performed on this species.	Fisheries Lab personnel report some limited recent captures by commercial fishers (Fisheries Research Laboratory, Joydas, P.R.)
Saltwater Fishes	Scalloped hammerhead shark	NOAA performed a stock assessment in 2016.	ESA
Saltwater Fishes	Smalltooth sawfish	There are no reliable commercial or recreational catch records known.	ESA
Saltwater Fishes	Greater Amberjack	Data available are insufficient to perform a stock assessment.	Ault et al 2013
Saltwater Fishes	Blue Runner	Life history parameters available are insufficient	

		to perform a stock assessment.	
Saltwater Fishes	Horse Eye Jack	Only 5 specimens measured by DNER biologists between 2008-2010.	
Saltwater Fishes	Caribbean Reef Shark	This species appears to be under heavy fishing pressure.	
Saltwater Fishes	Tiger Shark	Low fecundity and heavy fishing pressure	
Saltwater Fishes	Lemon Shark	Added due to vulnerability to capture (especially of juveniles) in shallow waters - reef flats. Fishing pressure in all reef flats of PR is very intense.	
Saltwater Fishes	Spotted eagle ray	Species added due to insufficient data on life history required to perform a length-based stock assessment. Species is being fished at 14.7X the sustainable rate	
Saltwater Fishes	Coney	Species is being fished at 14.7X the sustainable rate.	Ault and Smith 2015.
Saltwater Fishes	Rock Hind	Only 11 specimens of this species have been measured by DNER biologists from 2000 to 2010; only 3 from 2008 to 2010.	Specific distribution in PR is undetermined. General Range is: Massachusetts, USA and Bermuda to the Gulf of Mexico, the Caribbean and southern Brazil (Ault et al 2013).
Saltwater Fishes	Hogfish		
Saltwater Fishes	Mangrove Snapper	Only 1 specimen was measured by DNER biologists from 2008 to 2010.	
Saltwater Fishes	Caribbean Red Snapper	No specimen of this species was measured by DNER biologists from 2000 to 2010.	Specific distribution in PR is undetermined. General range is Western Atlantic: throughout most of the Caribbean Sea from Cuba southward to northeastern Brazil (Allen 1985).
Saltwater Fishes	Lane Snapper	Length-based stock assessment.	Specific distribution in PR is undetermined. Most abundant around the Antilles, on the Campeche Bank, off Panama and the northern coast of South America (Ault et al 2013).
Saltwater Fishes	Mutton snapper	Length-based stock assessment.	Specific distribution in PR is undetermined. Most abundant around the Antilles, the Bahamas and off southern Florida (Ault and Smith 2015).
Saltwater Fishes	Vermillion Snapper	Length-based stock assessment.	Specific distribution in PR is undetermined. Western Atlantic: Bermuda and North Carolina, USA, to São Paulo, Brazil, including West Indies, Gulf of Mexico and Caribbean Sea (Ault and Smith 2015).
Saltwater Fishes	Gray Snapper	Length-based stock assessment.	Specific distribution in PR is undetermined. Western Atlantic: Massachusetts south along U.S. coast, Bermuda, the Bahamas, and throughout the Gulf of Mexico and Caribbean Sea (Ault and Smith 2015).
Saltwater	Silk Snapper	Length-based stock	Specific distribution in PR is undetermined.

Fishes		assessment.	Western Atlantic: North Carolina, USA and Bermuda to São Paulo, Brazil. Most abundant around the Antilles and the Bahamas (Ault and Smith 2015).
Saltwater Fishes	Dog Snapper	Length-based stock assessment.	Western Atlantic: Massachusetts, USA to São Paulo, Brazil, including the Gulf of Mexico and the Caribbean Sea (Ault and Smith 2015).
Saltwater Fishes	Cubera Snapper	No formal stock assessment has been performed.	
Saltwater Fishes	Crevalle Jack		
Saltwater Fishes	Jolthead Porgy		
Saltwater Fishes	Rainbow Parrotfish	IUCN status : Near threatened. Too few specimens measured for a length-based stock assessment.	Western Atlantic: Bermuda, Florida (USA), and the Bahamas to Argentina Ault, J.S. and S.G. Smith. 2015).
Saltwater Fishes	Blue Parrotfish	Only 2 specimens were measured by DNER biologists from 2000 to 2010, and those were both in 2000.	Specific distribution in PR is undetermined. General range is Western Atlantic: Maryland in the USA, Bermuda and Bahamas to Rio de Janeiro, Brazil, including the West Indies (Ault et al. 2013
Saltwater Fishes	Midnight Parrotfish	1988 to 2010, only 19 specimens were measured by DNER biologists in the commercial catch. None were measured in the recreational catch.	Western Atlantic: Bermuda, southern Florida (USA), and Bahamas to Rio de Janeiro, Brazil (Ault et al. 2013).
Saltwater Fishes	Princess Parrotfish		
Saltwater Fishes	Queen Parrotfish	Only 2 specimens of this species were measured by DNER biologists from 2008 to 2010.	Specific distribution in PR is undetermined. General range is Western Central Atlantic: Bermuda, Florida (USA), and Bahamas to northern South America; throughout the Caribbean Sea (Ault and Smith. 2015).
Saltwater Fishes	Redtail Parrotfish	Only 2 specimens of this species were measured by DNER biologists from 2004 to 2010.	Specific distribution in PR not determined. Western Atlantic: Caribbean Sea.
Saltwater Fishes	Stoplight Parrotfish	Length-based stock assessment.	Western Atlantic: southern Florida (USA), Bermuda, Bahamas, and throughout the Caribbean Sea to Brazil (Ault and Smith. 2015).
Saltwater Fishes	Reef Croaker		
Saltwater Fishes	Barred Grunt		
Saltwater Fishes	White Grunt	Length-based stock assessment. The species is being fished at 5.08X the sustainable rate	Ault and Smith, 2015.
Saltwater Fishes	Black Grunt		
Saltwater Fishes	Smallmouth Grunt		
Taxon	**Common Name**	**Abundance or Population**	**Recent Distribution**

		Estimates	
Invertebrates	Lobed Star Coral	756 km2 of coral reef and colonized hardbottom in shallow waters. (Kendall, et al., 2001) (https://coastalscience.noaa.gov/projects/detail?key=182)	0 - 9 meters depth (Jorge García personal communication).
Invertebrates	Mountainous Star Coral	757 km2 of coral reef and colonized hardbottom in shallow waters. (Kendall, et al., 2001) (https://coastalscience.noaa.gov/projects/detail?key=182)	9 - 24 meters depth (Jorge García personal communication).
Invertebrates	Boulder Star Coral	758 km2 of coral reef and colonized hardbottom in shallow waters. (Kendall, et al., 2001) (https://coastalscience.noaa.gov/projects/detail?key=182)	24 - 43 meters depth (Jorge García personal communication).
Invertebrates	Pillar Coral	759 km2 of coral reef and colonized hardbottom in shallow waters. (Kendall, et al., 2001) (https://coastalscience.noaa.gov/projects/detail?key=182)	1 - 20 meters depth (Humann & Deloach, 2002).
Invertebrates	Rough Cactus Coral	760 km2 of coral reef and colonized hardbottom in shallow waters. (Kendall, et al., 2001) (https://coastalscience.noaa.gov/projects/detail?key=182)	0.6- 37 meters depth (Humann & Deloach, 2002).
Invertebrates	Staghorn Coral	761 km2 of coral reef and colonized hardbottom in shallow waters. (Kendall, et al., 2001) (https://coastalscience.noaa.gov/projects/detail?key=182)	0.3- 49 meters depth (Humann & Deloach, 2002).
Invertebrates	Elkhorn Coral	762 km2 of coral reef and colonized hardbottom in shallow waters. (Kendall, et al., 2001) (https://coastalscience.noaa.gov/projects/detail?key=182)	0.3 - 17 meters depth (Humann & Deloach, 2002).
Invertebrates	Boulder brain coral	763 km2 of coral reef and colonized hardbottom in shallow waters. (Kendall, et al., 2001) (https://coastalscience.noaa.gov/projects/detail?key=182)	0.6 -53 meters depth (Humann & Deloach, 2002).
Invertebrates	Fused staghorn	764 km2 of coral reef	0.3 - 27 meters depth (Humann & Deloach,

		and colonized hardbottom in shallow waters. (Kendall, et al., 2001) (https://coastalscience.noaa.gov/projects/detail?key=182)	2002).
Invertebrates			Unknown
Invertebrates			Unknown
Invertebrates			Unknown
Invertebrates			Unknown
Invertebrates			Unknown
Invertebrates			Unknown
Invertebrates	Threerowed Sea Cucumber		Unknown
Invertebrates	Furry Sea Cucumber		Unknown
Invertebrates	West Indian Sea Cucumber		Unknown
Invertebrates			Unknown
Invertebrates			Unknown
Invertebrates			
Invertebrates			
Invertebrates			Recorded in Cerro Gordo, Aguada, and Orocovis
Invertebrates			Nest in wood, location unknown
Invertebrates			
Invertebrates	Long Spined Sea Urchin		
Invertebrates	Puerto Rican Harlequin Butterfly		
Invertebrates	Mona's Cave Shrimp		
Invertebrates	Mona/Monito/Little-land Crab		
Invertebrates	Purple Land Crab		
Invertebrates	Common Land Crab		
Invertebrates	Mangrove Crab		
Invertebrates	Mangrove Root Crab		
Invertebrates	Fiddler Crab	Limited information available	
Invertebrates	Fiddler Crab	Limited information available	
Invertebrates	Fiddler Crab	Limited information available	
Invertebrates	Fiddler Crab	Limited information available	
Invertebrates	Swamp Ghost Crab	Subject to unquantified harvest	
Invertebrates	River Shrimp	Subject to unquantified harvest	Kwak, et al. 2007
Invertebrates	River Shrimp	Subject to unquantified harvest	Kwak, et al. 2007
Invertebrates	River Shrimp	Subject to unquantified harvest	Kwak, et al. 2007
Invertebrates	River Shrimp	Subject to unquantified harvest	Kwak, et al. 2007
Invertebrates	Shrimp	Subject to unquantified harvest	Kwak, et al. 2007
Invertebrates	Green Lobster	Subject to unquantified harvest	Human & Deloach 2002
Invertebrates	Buruquena	Subject to unquantified harvest	Kwak et al. 2007
Invertebrates	Octopus	Concern about overharvest	Josupeit 2008
Invertebrates	Queen Conch		Human & Deloach 2002
Invertebrates	West Indian Topshell		Human & Deloach 2002

Invertebrates	Magnificent Feather Duster		Human & Deloach 2002

CHAPTER 3. HABITAT REQUIREMENTS AND INFORMATION NEEDS FOR PRIORITY SPECIES.

Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in Element 1 are described in the following section. Each key habitat is classified by taxon.

Taxon:

Marine Mammals

Description of the locations of key habitats and community types essentials to conservation:

- Open ocean, possibly Puerto Rico trench, coastal water up to 3 miles.

Description of the relative condition of key habitats essentials to conservation:

Reef, Seagrass beds, coastal areas, estuaries, mangrove zones

Description of the community types essential to conservation:

Not available

References:

Risch et al., 2014; Waring et al., 2016.

Taxon:

Terrestrial Mammals

Description of the locations of key habitats and community types essentials to conservation:

- Cool chambers in caves, primarily associated to human settlements. Corredor El Yaguazo, Cataño. Vieques NWR, Vieques. Cueva Esqueleto

in Playa Sardidnera, Mona Island Natural Reserve. Hot caves. Cueva Murciélagos in Playa Uveros, Mona Island Natural Reserve. Cueva Murciélagos in Playa Uveros, Mona Island Natural Reserve. Shallow caves and cave like structures, such as abandoned tunnels and culverts under roads.

Description of the relative condition of key habitats essentials to conservation:

Not available

Description of the community types essential to conservation:

Not Available

References:

Not Available

Taxon:

Birds

Description of the locations of key habitats and community types essential to conservation:

- Increase connectivity along the Central Cordillera and the upper elevation forests from Guilarte to Toro Negro, the Cayey Mountains the south and west of Carite Commonwealth Forest, incorporating the Cerro El Gato Critical Wildlife Area.
- Increase connectivity 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.

- 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.

- For non-calcareous moist forest 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 serpertine 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.
- For dry limestone forest, 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.

- 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 Oscuras Natural Reserve Camp that abuts Santiago Military Reservation. 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. In the northeastern part of the island 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. Besides, protection on Culebra coral reefs could be enhanced by expanding the Canal Luis Peña Natural Reserve to the coral reefs surrounding Culebra or creating a new marine reserve.

- 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 Munóz 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 Natural 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 National Estuarine 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.

- Areas of promise for future conservation efforts of urban forest include large patches of unprotected urban forest near major metropolitan centers, and parcels that lie in close proximity to existing stewardship lands. 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, Trujillo Alto, and south along Route 1 towards Caguas; in Manatí and Vega Baja in the urban lands to the south of the Tortuguero Lagoon 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.

- 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.

- High priority conservation areas include linkages in the north between Caño Tiburones, Hacienda La Esperanza, Cambalache Commonwealth Forest, Tortuguero Lagoon, and Pantano 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 Cartagena Lagoon 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 Guajataca Reservoir 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.

- The majority of seabird colonies in Puerto Rico are located 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 Corredor and Seven Seas Natural Reserve; the coastline just south of the Pterocarpus Swamp Forest and Mandry and Santa Teresa Lagoons in the Humacao Natural Reserve; 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 Cabo 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 Tortuguero Lagoon Natural Reserves; the coastline north of the Pantano 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 negotiate a future conservation agreement.

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

Description of the relative condition of key habitats essential to conservation:
Approximately 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%)
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%)

Description of the community types essential to conservation:

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.

References:

Nytch et al., 2015.

Taxon:

Reptiles

Description of the locations of key habitats and community types essential to conservation:

- Trees with continuous canopy in Subtropical dry forests. Islandwide up to 1,150 m of elevation. Marine grass prairies, and coral reefs, nest on sandy beaches. Open water of the North Atlantic Ocean. Ponds, reservoirs and rivers. Under rocks and tree trunks on the rocky plateau. Subtropical Dry

forest, under leaf litter, rocks. Under leaf litter, rocks, and tree trunks. Grass and bushy areas in the Subtropical dry forest. Mature forest - canopy. Grass and bushy areas in the Subtropical dry forest. Upland forests and karst. Grass and bushy areas in Subtropical dry forest, under rocks and tree trunks.

Description of the relative condition of key habitats essentials to conservation:

Not available

Description of the community types essential to conservation:

Not availabe

References:

Not available

Taxon:

Amphibians

Description of the locations of key habitats and community types essentials to conservation:

- Rock crevices. Forest elevations between 300-1,152 m, road slopes, and mossy tree trunks of less than 1 m high, on the ground or on palm leaves and trunks, tree ferns or bushes. Forest bromeliads. Elevations between 45-630 m, mountains, rocks, and rocks associated with rivers, in holes between rocks near waterfalls, and rocks surface sprayed by water.

- Wet grassy lowlands in the Toa Baja Municipality.
- Caves, crevices and grottoes, between 91-303 m in elevation.

- Open areas, and in the periphery of moist-dense forests with wide leaves, under leaf litter, tree trunks, and roots.

- Elevations between 40 and 158 m, on kigh montane forest, over 180 m in elevation.

- Open meadows, young sugarcane fields, grasslands in Río Piedras, forests in Trujillo Alto, open areas along roads at low elevation areas (Caguas, Gurabo, Juncos, Las Piedras, Humacao), at sea level in Toa Baja, elsewhere in higher elevation areas (Luquillo Mountains, Sierra de Cayey, Central Mountain Range). Predominantly absent from most xerophytic regions in PR.

- Mesic forests, along forest edges or openings; diurnal retreats to bromeliads and under moss on rocks.

- Elevations between 457 and 1,158 m, dense moist forests with broad leaves, tree trunk cavities and cracks, and tree branches.

- Found on walls of shallow caves containing water, sinkholes, under galvanized sheets covering water reservoirs, bromeliads and vegetation.

- Altitudinal distribution above about 674 to 1,045 m. Under moss, rocks, and roots in elfin forest in Sierra de Luquillo.

- Altitudinal distribution 308 to 1,189 m. Mesic upland forest, on the ground under rocks, dead trunks, and forest debris.

Description of the relative condition of key habitats essentials to conservation:

Not available

Description of the community types essential to conservation:

Not available

References:

Not available

Taxon:

Freshwater Fishes

Description of the locations of key habitats and community types essentials to conservation:

Islandwide

Description of the relative condition of key habitats essentials to conservation:

Habitat reduction due to loss of riparian connectivity (dams and culverts) and water pollution.

Description of the community types essential to conservation:

Inland water bodies with ocean connectivity

References:

Kwak et al 2013.

Taxon:

Saltwater Fishes

Description of the locations of key habitats and community types essentials to conservation:

- Inhabits coastal waters, estuaries and lagoons, penetrating into freshwater; usually prefers very low brackish water or freshwater

- Occurs in mouths of rivers and the littoral zone; spawns on banks; Connectivity of rivers and coastal lagoons with the sea is critical to snook conservation.

- Prefers shallow sand flats, in channels, and around coral reefs; young may be found among prop roots of red mangroves. Spawning aggregations known at Mona, Parguera (depleted), and Aguirre.Coastal lagoons and connectivity to the sea are key habitat elements.
- Sandy areas of lagoons and seaward reefs.

- A solitary species occurring in shallow, inshore areas. Found on rock, coral, or mud bottoms. Juveniles found in mangrove areas and brackish estuaries. Large adults may be found in estuaries. Adults appear to occupy limited home ranges with little inter-reef movement.

- Occurs from the shoreline to at least 90 m depth. Usually close to caves. Juveniles are common in seagrass beds.

- Adults occur mainly over rocky and muddy bottoms. Uncommon around coral reefs. Usually rest on the bottom. Juveniles may be found in shallow water, but adults are usually taken from depths of 70-330 m.
- A solitary species inhabiting rocky and coral reefs .
- Seagrass beds, octocorals, mangrove roots, coral reefs, sargassum, artificial structures.
- Inhabits shallow coastal waters, estuaries and bays, over sand and mud bottoms.

Description of the relative condition of key habitats essentials to conservation:

- Many rivers become seasonally blocked by sand bars, limiting access to snook spawning and nursery habitat. Nearshore habitats are the most impacted by humans and human activities in PR. Most coastal lagoons are highly contaminated. Nearshore marine environments tend to be the most impacted, and most intensively fished.

- Key habitats for this species include spawning aggregation sites. Seagrass beds, where juveniles can be found, are impacted by human activities.

- Juveniles are especially vulnerable in shallow waters. The habitat occupied by this species makes it vulnerable to spears and fish traps.

- Habitat degradation is a threat. Reef flats are degraded. Nearshore environments in general are highly impacted. Coral reefs of Puerto Rico are in need of active restoration.

Description of the community types essentials to conservation:

- Snook require good water quality, with abundant crustaceans and small fish. Health coral reefs and seagrass beds are important for the conservation of these species.

References:

Erdman, 1976; Compagno, 1984; Zerbi et al., 2001; Ault et al. 2013; FishBase; Heemstra and Randall, 1993; Sadovy et al., 2013; Heemstra and Randall 1993; Lourie et al., 1999; Whitehead, 1990; Matos-Caraballo, D. et al. GCFI:58 (2007)

Taxon:

Marine Invertebrates

Description of the locations of key habitats and community types essentials to conservation:

Not available

Description of the relative condition of key habitats essentials to conservation:

Temperature between 70-85°F, water movement to replenish plankton and oxygen supplies, water clarity that allows light penetration, salinity, and hard substrate for attachment.

Description of the community types essential to conservation:

- Natural disturbances such as hurricanes and loss of reef herbivores such as Caribbean's Long Spined Urchin (*Diadema antillarum*), and anthropogenic impacts such as the increase of sedimentation and nutrients run-off, overfishing (Humman & Deloach, 2002), as well as mechanical impacts.

References:

Humann & Deloach, 2002.

Most of the information related to the species included on the Species of Greatest Conservation Need (SGCN) list was compiled as part of the revision conducted between 2002 and 2003 of Puerto Rico Regulations No. 6765 and 6766. The Fisheries and Wildlife Bureau (now known as the Research, Habitat Conservation and Biodiversity Bureau) staff produced an initial draft of this list, which was later revised by the scientific community, the general public, stakeholders and interested non-governmental organizations. The final product was a broad and updated compilation, more comprehensive than the USFWS list of threatened and endangered (T/E) species for Puerto Rico.

Information regarding the natural history of priority species, including habitat requirements, demographics, activity patterns, and home ranges is needed in order to to develop appropriate conservation and management plans. DNER has been gathering habitat information and monitoring game species that are currently hunted (e.g., Scaly-naped Pigeon *Patagioenas squamosa*) or have the potential to be hunted (e.g., White-crowned Pigeon *Patagioenas leucocephala*) or are listed as T/E species in Puerto Rico. However, the long-term conservation of biological diversity in Puerto Rico will benefit from a comprehensive, spatially based bank of information of its wildlife and associated habitats. The Puerto Rico GAP Analysis, completed in 2008, provides such a tool. The Puerto Rico Biodiversity and Conservation Database Program, which is currently in development, will provide an up to date database of species distribution and status throughout Puerto Rico. Additional approaches are currently ongoing within DNER or through interagency and academic collaborations.

Forest composition, structure and function (from DRNA 2010).

The Holdridge life zone model is used to facilitate comparisons of ecological information around the world (Holdridge, L.R.1967). Life zones are broad bioclimatic units of land that can be further subdivided into associations based on the combination of soils, vegetation, and microclimates within them. There are six Subtropical Holdridge Life Zones present in Puerto Rico (Figure 3) (Ewell and Whitmore 1973). At 62%, the Subtropical moist forest life zone contains the most land in mainland Puerto Rico. (Brandeis et. al. 2007). The Lower montane wet forest and the Lower montane rain forest zones combined are only slightly over 1% of land cover. Land area in the dry forest zone is almost 14%, and the combined wet forest and rain forest zones account for about 23% of land cover.

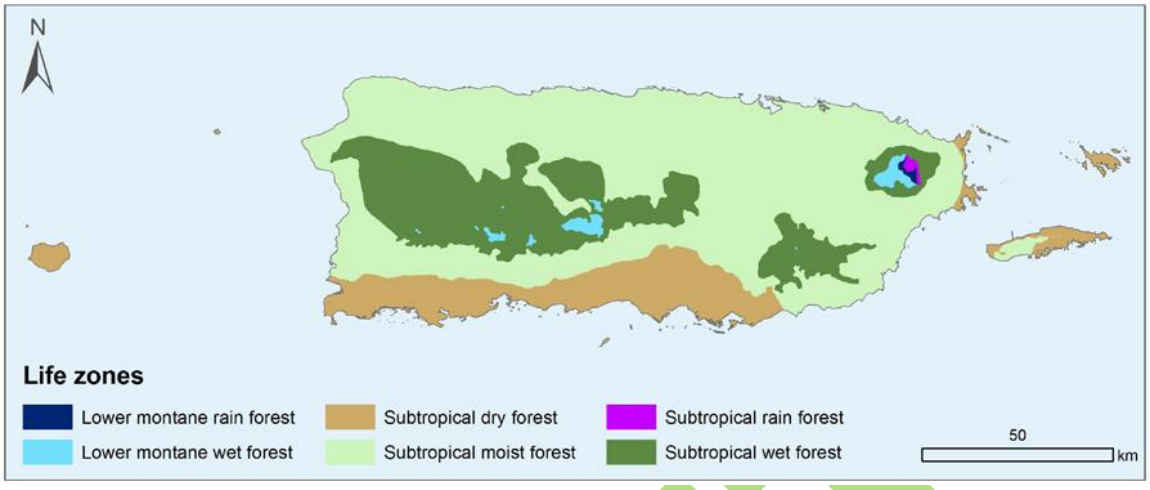


Figure 3. Land distribution among the Subtropical forest life zones of mainlad P.R. (Brandeis 2007).

Figure 3 depicts the proportion of each life zone in forest cover as of 2003 (Brandeis et. al. 2007). The Lower Montane Wet and Rain Forest group has the highest percentage of forest cover but, as indicated in figure 4 above, it has the smallest land area. The moist and dry forest zones together account for three quarters of the land area in Puerto Rico but each has less than 50% forest cover.

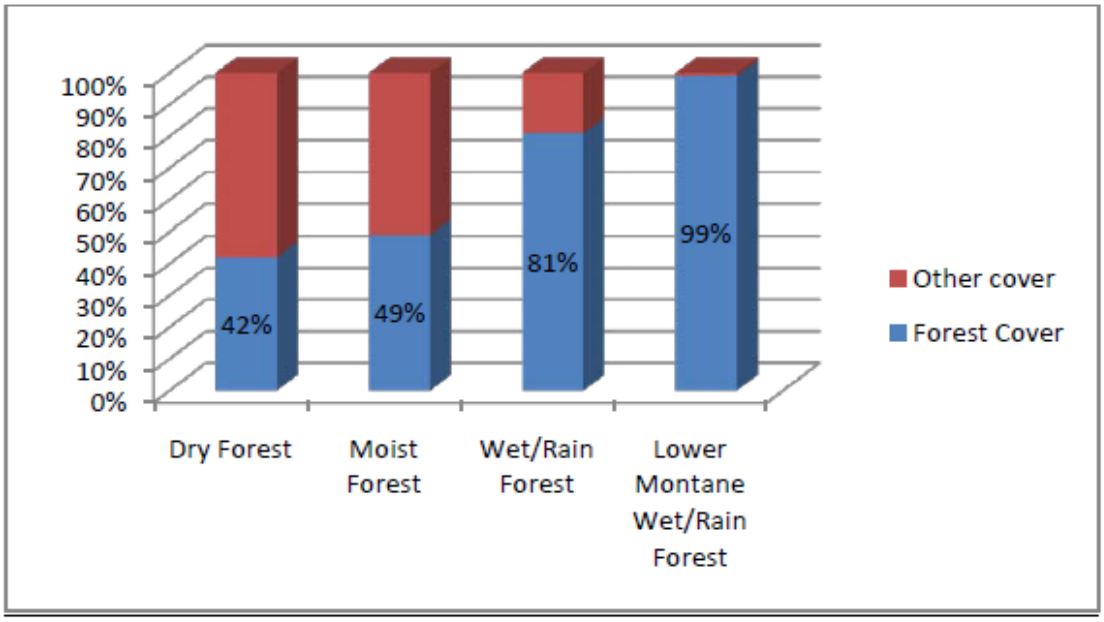


Figure 4. Percent forest cover within each subtropical life zones group in mainland P.R. in 2003 (Brandeis et al. 2007).

An estimated 68% of Puerto Rico is comprised of young secondary forest, 12% is mature forest; and land reverting to forest accounts for 18% of the total forest cover. Subtropical moist forest had the most land in the reversion category. The lower montane group had no reverting forest; the wet and rain forest had 30.4%; and dry forest had 12.5% reverting forest (Brandeis et al. 2007).

The mixes of native and non-native naturalized species are creating novel plant and animal communities. Many of today's forests are far from maturity, so definitive successional pathways, and the ultimate composition and structure of future forests is conjecture. We are gathering evidence that these novel forests provide public benefits. They support wildlife, mitigate species extinctions, and provide ecosystem services such as soil stabilization, temperature regulation, nutrient transformation, and water and carbon cycling (Lugo 2004). For example, the African tulip tree is a pioneer species that colonizes abandoned lands and facilitates the establishment of native trees species under its canopy (Lugo and Helmer 2004, Brandeis 2006).

There is no field inventory of forest vegetation communities in Puerto Rico, some general taxonomic principles are informing remote sensing inventories such as the work produced by Kennaway and Helmer (2007), summarized in Table 4.

Table 4. Satellite image mapping zones in P.R. and associated vegetation formations (Kennaway and Helmer 2007).

Satellite image mapping zone [1, 2]	**Woody vegetation formations**[2]
Dry forest-Alluvial	Lowland dry semi-deciduous forest or woodland/shrubland Tidally and semi-permanently flooded evergreen sclerophyllous forest
Dry forest[3]-Volcanic, Sedimentary, Limestone	Lowland dry semi-deciduous forest or woodland/shrubland Lowland dry mixed evergreen drought-deciduous shrubland with succulents

Dry and moist forests –Serpentine	Lowland dry and moist, mixed seasonal evergreen sclerophyllous forest with succulents
Moist forest-Alluvial	Lowland moist evergreen hemi-sclerophyllous srubland Lowland moist seasonal evergreen forest or forest/shrub Lowland moist coconut palm forest Seasonally flooded evergreen forest Tidally and semi-permanently flooded evergreen sclerophyllous forest
Moist forest-Volcanic and Sedimentary	Lowland moist seasonal evergreen forest or forest shrub Lowland moist semi deciduous forest[4]
Moist forest with rainfall<1500 mm yr^{-1} Northern Limestone [5]	Lowland moist semi-deciduous forest or forest/shrub
Moist forest with rainfall>1500 mm yr^{-1}-Northern Limestone[5]	Lowland moist and wet, seasonal evergreen and semi-deciduous forest and forest/shrub
Wet and lower montane wet forest-Serpentine	Submontane and lower montane wet evergreen sclerophylous forest or forest/shrub[6]
Wet and rain forest, lower montane wet and rain forest-Volcanic, Sedimentary and Alluvial	Submontane wet evergreen forest Active sun/shade coffee, submontane/lower montane wet evergreen forest/shrub, other agriculture Submontane/lower montane wet evergreen forest/shrub, active/abandoned shade coffee Lower montane wet evergreen forest[7] -tall cloud forest Lower montane wet evergreen forest[7]-palm and elfin cloud forest Lower montane wet evergreen forest-elfin cloud forest

[1] Aggregated from Geoclimatic Zones in Figueroa Colón (1996), which overlay Holdridge life zone (Ewel and Whitmore, 1973) onto generalized geology (Krushensky, unpubl.). Volcanic refers to intrusive/plutonic and extrusive/volcanoclastic geology.
[2] Forest are subtropical sensu Holdridge (1967) and broadleaf unless otherwise indicated; lowland refers to forests from 0 to 400 m elevation. Both forest/shrub and woodland/shrubland refer to stands with a)25-60% covers of trees with distinct canopies and an under story of shrubs, seedlings, or saplings, or b) dense shrubs, seedlings or saplings, as indicated by a matrix of woody vegetation or a smooth canopy.
[3] The Dry Volcanic/Sedimentary/Limestone Zone included southern limestone areas in the drier part of the moist forest zone.
[4] Coastal areas in southeastern Puerto Rico
[5] Northern Limestone refers to limestone areas north of the Central Cordillera with well-developed karrst topography and areas at the Cordillera's southern edge.
[6] Includes forest in the rain forest zone sensu Holdridge (1967).
[7] Includes forest in the lower montane rain forest zone sensu Holdridge (1967).

Puerto Rico GAP Analysis

The Puerto Rico GAP Analysis (PR-GAP) is a spatially based project designed to provide comprehensive species/habitat information. The GAP analysis was developed as a proactive coarse-filter approach to protect biodiversity (Scott et al. 1987 and 1993). The PR-GAP provides an overview of the island's biological diversity, serving as a benchmark for landscape conservation approaches and

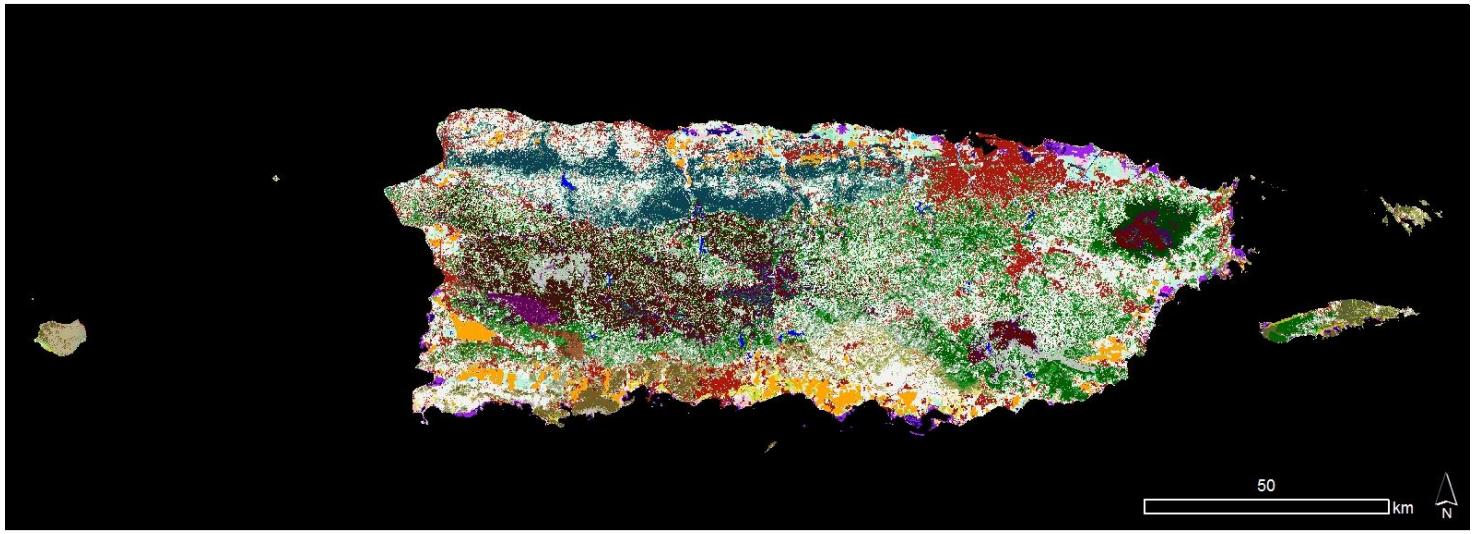
providing resource managers with a tool to establish conservation priorities (e.g., land acquisition). This project is a joint effort among the DNER, the U.S. Forest Service International Institute of Tropical Forestry (IITF), the North Carolina Cooperative Fish and Wildlife Research Unit (NCSU), and the U.S. Geological Survey, Biological Resources Division.

The GAP Analysis seeks to identify "gaps" (i.e., vegetation types or species not adequately represented in areas managed for long-term maintenance of natural systems) that may be filled through changes in land management practices. GAP researchers use terrestrial vertebrates and vegetation alliances as indicators of, or surrogates for, biodiversity (Austin and Margules 1986, Scott et al. 1993, National Gap Analysis Program 1994, Csuti and Kiester 1996, Noss and Cooperrider 1994, Jennings 1996). Digital maps containing these elements of diversity are overlaid in a GIS with maps of areas managed for biodiversity and land ownership to identify those that are underrepresented in the existing network of areas.

a. **Land Cover** – IITF, in coordination with DNER, developed a semi-automated process to create a Landsat-7 ETM+ image mosaic based on 2001-2003 satellite imagery that is 97.5% cloud and cloud-shadow free (Martinuzzi et al. 2003a). Initial classification includes mapping the extent of four classes of urban cover in Puerto Rico (Martinuzzi et al. 2003b). Urban cover comprises nearly 15% of the land surface of Puerto Rico, and the urban forest and low- and high- intensity urban land cover classes are important in both our habitat modeling, and in understanding the dynamics of land cover changes and threats to habitat sustainability and biodiversity. Vegetation descriptions have been compiled from the plant community, and later organized into a hierarchical structure along gradients of climate, substrate, and topographic position (Gould et al. 2003a). The analysis includes an updated map of the physiography of Puerto Rico (Gould et al.

2003b), and an analysis and a map of the landforms (slope position) of Puerto Rico (Martinuzzi et al. 2003c) (Figure 5).

According to Gould et al., (2008) land cover in Puerto Rico today consists of 53% forest, woodland and shrub land vegetation; 32% dry and wet grasslands and pasture; 3% herbaceous agriculture, 4% saline and freshwater wetlands, 1% barren land, 1% fresh water, and 10% developed land. This history of land use is typical of most Caribbean islands.



Abandoned dry forest plantation
Aquiculture
Artificial barrens
Coastal dwarf woodland and shrubland
Dry and moist serpentine woodland and shrubland
Dry cactus grassland and shrubland
Dry grasslands and pastures
Emergent herbaceous nonsaline wetlands
Emergent herbaceous saline wetlands
Fine to coarse sandy beaches, mixed sand and gravel beaches
Freshwater
Freshwater Pterocarpus swamp
Gravel beaches and stony shoreline
Hay and row crops
High-density urban development
Low-density urban development
Lowland dry alluvial shrubland and woodland
Lowland dry cactus shrubland
Lowland dry limestone cliffside semideciduous forest
Lowland dry limestone cliffside shrubland and woodland
Lowland dry limestone shrubland
Lowland dry limestone woodland and shrubland
Lowland dry noncalcareous shrubland and woodland
Lowland dry riparian forest
Lowland dry riparian shrubland and woodland
Lowland moist abandoned and active coffee plantations
Lowland moist alluvial shrubland and woodland
Lowland moist noncalcareous shrubland and woodland
Lowland moist riparian forest
Lowland moist riparian shrubland and woodland
Mangrove forest and shrubland
Mature primary elfin woodland and secondary montane wet noncalcareous evergreen cloud forest
Mature primary Palo Colorado and secondary montane wet noncalcareous evergreen forest
Mature primary Sierra Palm and secondary montane wet noncalcareous evergreen forest
Mature primary Tabonuco and secondary montane wet noncalcareous evergreen forest
Mature secondary dry and moist serpentine semideciduous forest
Mature secondary lowland dry alluvial semideciduous forest
Mature secondary lowland dry limestone evergreen forest
Mature secondary lowland dry limestone semideciduous forest
Mature secondary lowland dry noncalcareous semideciduous forest
Mature secondary lowland moist alluvial evergreen forest
Mature secondary lowland moist noncalcareous evergreen forest
Mature secondary moist limestone evergreen and semideciduous forest
Mature secondary montane wet alluvial evergreen forest
Mature secondary montane wet noncalcareous evergreen forest
Mature secondary montane wet serpentine evergreen forest
Moist grasslands and pastures
Moist limestone shrubland and woodland
Montane wet alluvial shrubland and woodland
Montane wet evergreen abandoned and active coffee plantation
Montane wet noncalcareous evergreen shrubland and woodland
Riparian and other natural barrens
Rocky cliffs and shelves
Salt and mudflats
Salt production
Salt water
Seasonally flooded herbaceous nonsaline wetlands
Seasonally flooded herbaceous saline wetlands
Wet serpentine shrubland and woodland
Woody agriculture and plantations: Palm plantations
Young secondary dry and moist serpentine semideciduous forest
Young secondary lowland dry alluvial semideciduous forest
Young secondary lowland dry limestone semideciduous forest
Young secondary lowland dry noncalcareous semideciduous forest
Young secondary lowland moist alluvial evergreen forest
Young secondary lowland moist noncalcareous evergreen forest
Young secondary moist limestone evergreen and semideciduous forest
Young secondary montane wet alluvial evergreen forest
Young secondary montane wet noncalcareous evergreen forest
Young secondary montane wet serpentine evergreen forest

Figure 5. Puerto Rico Land Cover 2015. Data obtained from DNER.

b. Species Modeling – The original list of 437 vertebrate species has gone through expert review and now the list consists of 426 vertebrate species known to occur across Puerto Rico or its offshore islands. A large proportion of Puerto Rico's vertebrate fauna is composed of species dependent upon aquatic and/or coastal-marine habitats. Therefore, DNER developed a relational database model with the understanding that the aquatic and marine species are important components of the landscape and have good potential for gap analysis after the completion of the terrestrial and marine GAP Analyses. A subset of 168 species was for inclusion in the terrestrial component of the gap analysis. This list contains those species considered endemic, resident, breeding migrants, and species of conservation concern that have become established through human introductions (e.g., Small Indian Mongoose *Herpestes javanicus*) or range expansion (e.g., Hispaniolan Parrot *Amazona ventralis*). The PR-GAP adopted a modification of the U.S. Forest Service's Forest Inventory and the Analysis hexagon grid of the Caribbean as the minimum mapping unit for creating species' geographic range maps. The smaller hexagon size (24 km^2) was considered as a valid scale for representing species distribution while considering the challenge of representing Puerto Rico's diverse and heterogeneous landscape. The Puerto Rico Ornithological Society assisted in the development of field survey methods for a Breeding Bird Atlas for Puerto Rico and to incorporate PR-GAP data, maps, and analyses into the Atlas. Peer revisions of species geographic range maps are currently in progress (Figure 6).

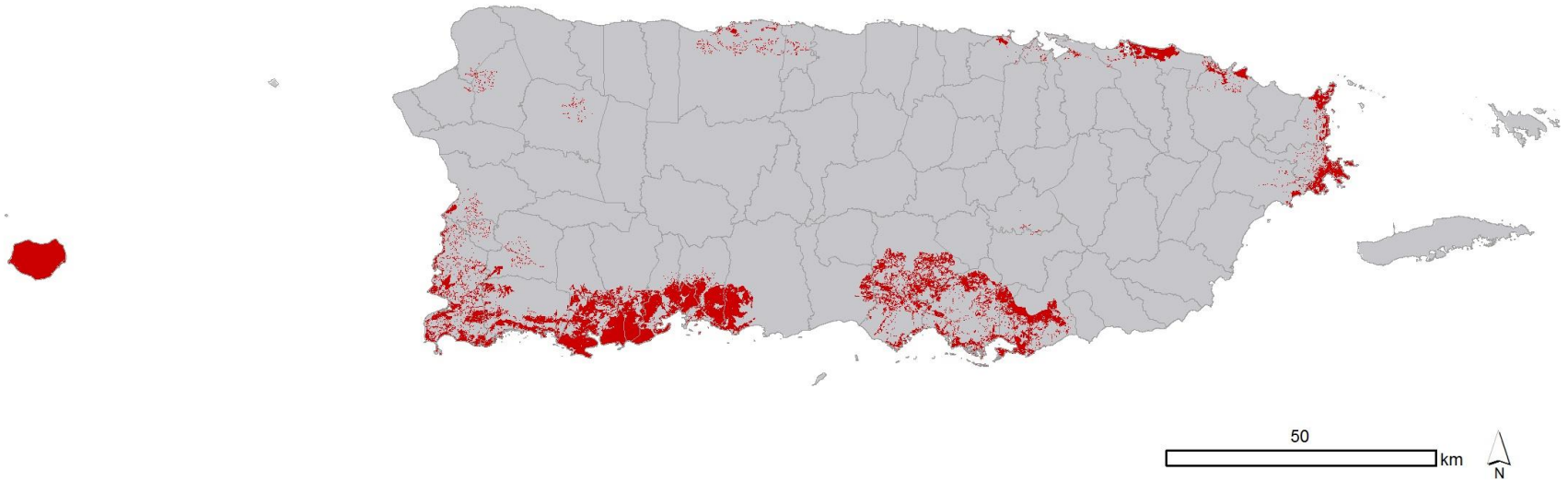


Figure 6. Example of a geographic range map for the endangered Yellow-shouldered Blackbird (Agelaius xanthomus). Data from DNER 2015.

c. Land Stewardship Mapping – DNER is currently establishing an interagency collaborative effort to update an existing, but incomplete, land stewardship data layer of Puerto Rico. To date, we have identified a total of 21 public land managers (Figure 7). Land management areas will be identified by contacting land managers to determine management policies, classifying land parcels into the management strategies used in the GAP program, and developing a land management geospatial database in order to facilitate the final GAP analyses.

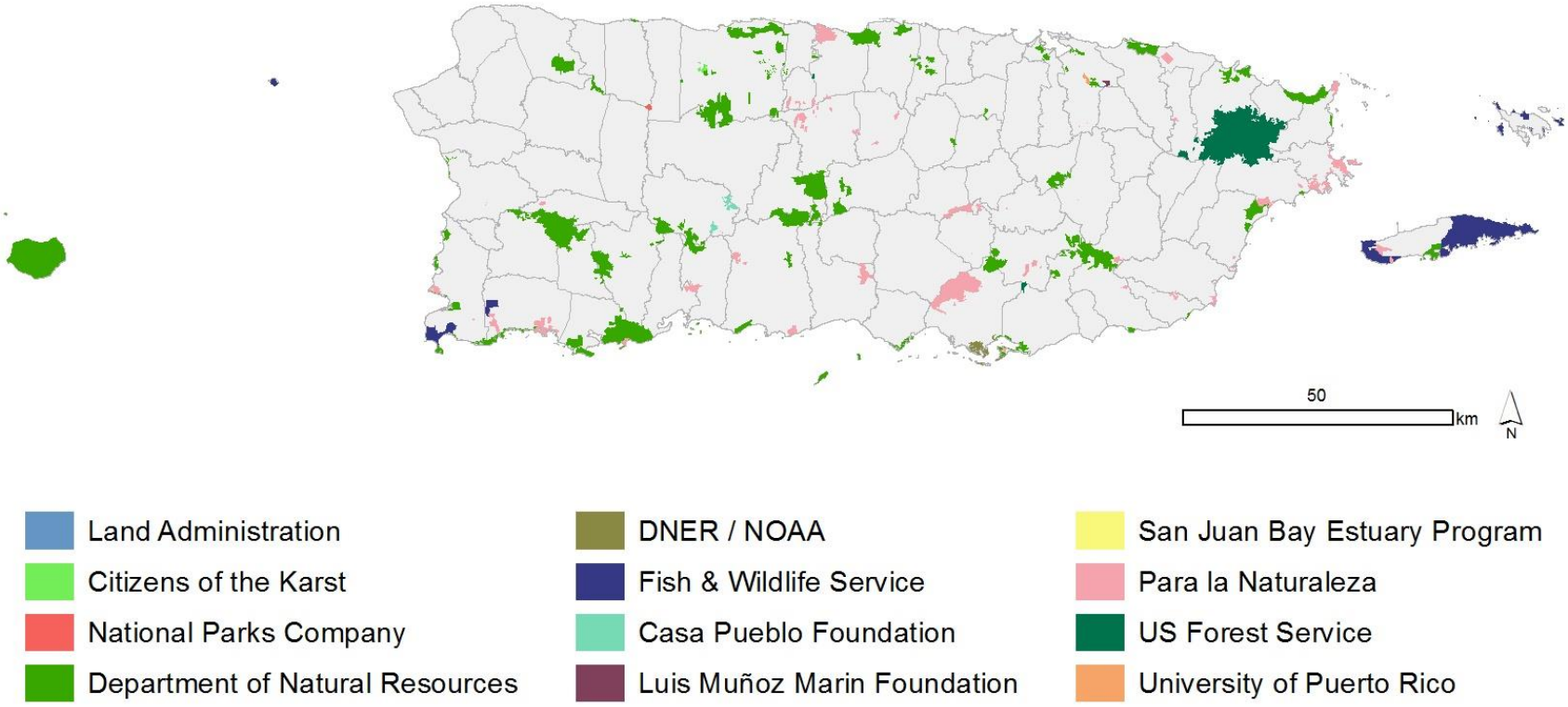


Figure 7. Puerto Rico Land Stewardship 2015. Data obtained from DNER.

For the development of the Puerto Rico State Wildlife Action Plan, GAP land cover, species and habitat distribution, as well as and vegetation classifications models were important data sets. Land stewardship, ownership, species richness data, species lists, predicted vertebrate distribution maps and habitat descriptions were also important, although more research is needed for individual species.

The information provided by the PRGAP helps land conservation decision makers to obtain biodiversity goals for land protection programs and activities. Those tools improve land management practices that support continued biodiversity on managed protected lands. The PRGAP will continue to provide vital information for our wildlife action plans.

Revision of the New Wildlife Law (Law 241 of 1999)

The Puerto Rico New Wildlife Law is currently under revision, and expected to be completed by fall 2018. The revised law will include a revised list of Species of Greater Conservation Need (SGCN) with updated statuses, and in some cases will include Critical Natural Habitat designations (see Figure 8) that have been made through information collected by DNER biologists, collaborators and partners.

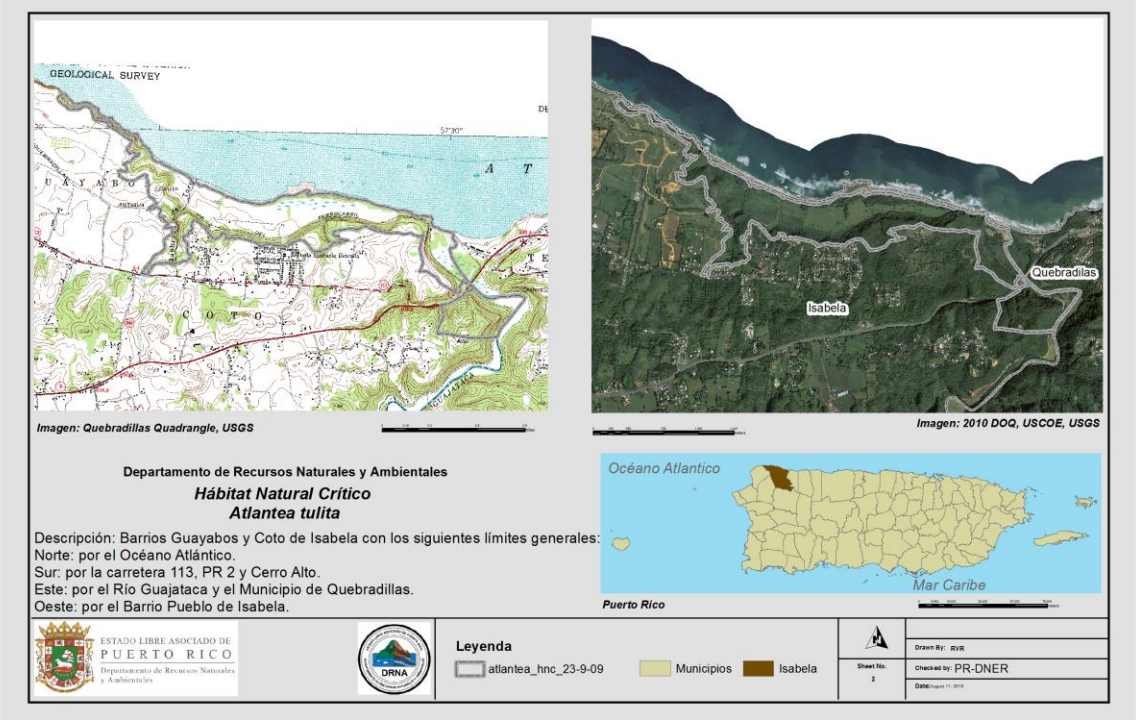


Figure 8. Critical Natural Habitat for the endangered Arlequin Butterfly (*Atlantea tulita*).

DNER Natural Heritage Program

DNER's Natural Heritage Program (NHP) used to maintain a conservation data center of species of concern or critical elements (Figure 9). The information was available to other DNER divisions, partners, and to the general public. The conservation data center used to employ a full-time manager who maintained updated maps of species distribution, and provided technical assistance for using the data bank. Relevant data was primarily obtained from other DNER units, federal institutions, and academia.

Critical elements are not limited to federally or locally listed species, according to the NHP. Species important to Puerto Rican heritage and culture, such as the Common Coquí (*Eleutherodactylus coqui*), and other endemics (e.g., the Mona Island Gecko *Sphaerodactylus monensis*) although abundant, are considered critical elements for this unit.

Since its inception, the NHP has used the Heritage Methodology from the NatureServe program in which critical elements (rare, threatened, endangered species and rare communities) are used as indicators for identifying important areas for the conservation of biodiversity. Using element occurrence information, PRNHP has delimited priority conservation areas for Puerto Rico, identifying 681,768 acres of land as important habitat for conserving biodiversity on the island. However, the PRNHP currently lacks the personnel and technical capabilities to effectively continue its operations. This is due to the ongoing fiscal crisis in Puerto Rico, which has led to budget cuts and loss of valuable personnel in all government agencies. This has led to the creation of the Puerto Rico Biodiversity and Conservation Database Program, a collaboration with the InterAmerican University, which will continue collecting and updating information, as well as creating a new database that meets the agency's and the general public's information needs.

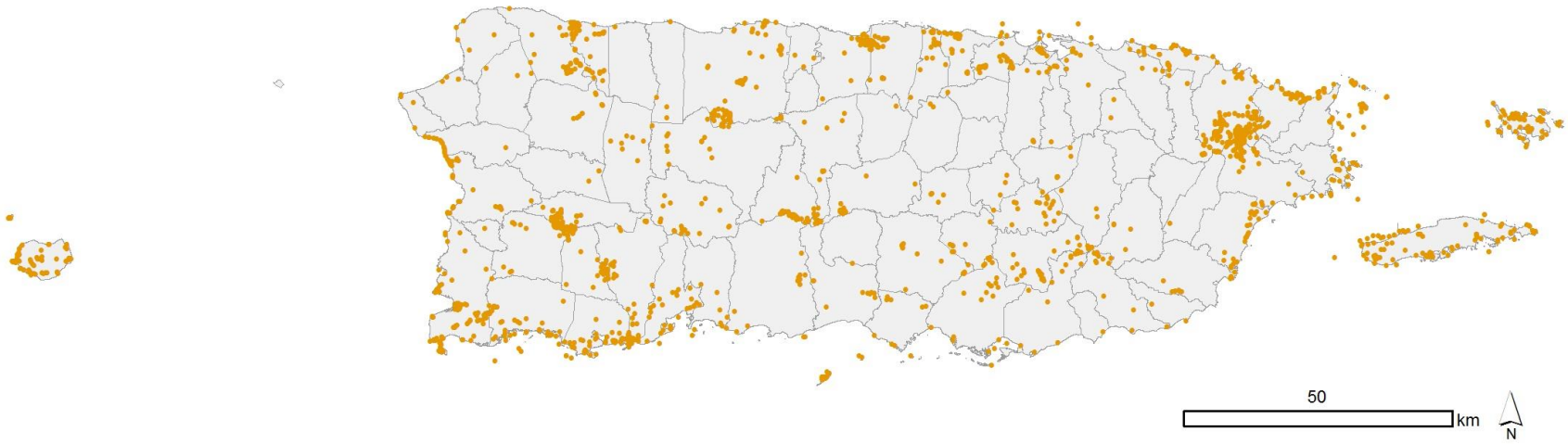


Figure 9. Distribution of Critical Elements in the Natural Heritage Program. Data from DNER 2015.

Puerto Rico Biodiversity and Conservation Database Program

The proposed Puerto Rico Biodiversity Conservation Database Program is currently in its development phase. Once completed, it will provide the services and up to date resources that are no longer available through the PRNHP. The program's approach also aims to expand on PRNHP's scope and reach by not only encouraging intra and inter agency collaborations, but also by providing training opportunities and resources to science students from the University of Puerto Rico and making all information public through a specialized website.

The Puerto Rico Biodiversity Conservation Database Program will collect, unify and provide valuable species and habitat information for research, conservation planning, decision-making, and educational purposes. Aspects of this program range from local to global-scale biodiversity conservation methods and practices. The program aims to become a public resource on all species and habitats of greatest conservation needs on the island. It will allow the DNER to create and analyze a comprehensive data set to refine previous conclusions about critical element abundance, rarity, location, and management needs. If successful, this program will become a keystone of the agency's State Wildlife Action Plan revision process, providing input for the planning and development of future State Wildlife Grants projects and collaborations with the agency's partners. DNER expects that the database's availability will complement and foster new research initiatives in Puerto Rico, especially benefitting students based at the University of Puerto Rico. The program plans to include university students in their field surveys and monitoring activities, as well as provide opportunities to work with the NatureServe Biotics 5 tabular and spatial data management system.

CHAPTER 4. IDENTIFYING STRESSOR/THREATS TO PUERTO RICO'S WILDLIFE

The Caribbean Region is one of the world's biodiversity hotspots (Myers et al. 2000). Historically, Puerto Rico's landscape has undergone widespread deforestation. In fact, by the 1930's only 6-15% of the surface area of the island was covered by forest. Forest conversion had profound effects on the resident avifauna, our largest group of terrestrial vertebrates. It is believed that forest destruction precipitated the extinction of the Culebra Island race of the Puerto Rican Parrot (*Amazona vittata gracilipes*), and the extirpation of the White-necked Crow (*Corvus leucognaphalus*) (Raffaele 1983, Snyder et al. 1987). The distribution of presently endangered species such as the Broad-winged Hawk (*Buteo platypterus brunnescens*), Sharp-shinned Hawk (*Accipiter striatus venator*), and the Puerto Rican Nightjar (*Caprimulgus noctitherus*) has been restricted by to habitat destruction (Raffaele 1983). The distribution of other more common forest dependent species such as the Puerto Rican Tanager (*Nesospingus speculiferus*) has also been limited by accelerated forest conversion. Nevertheless, the species-habitat relationships for many species are not as straightforward; hence, more integrated approaches to conservation are necessary.

Many members of island bird communities tend to be ecological generalists and opportunistic species (Ricklefs and Cox 1978, Abbot 1980, Terborgh 1980, Blondel 1985). These attributes can lead to unsuspected ecological resiliency in many instances (Lugo 1988). Indeed, it has been postulated that these traits may have ameliorated extinction rates of resident avifauna in Puerto Rico during the 20th century (e.g., Brash 1987). In addition, some agricultural activities such as the cultivation of shade coffee in the mountains may have served as surrogate refugia for some of the more plastic flora and fauna.

Towards the latter part of the 20th century, forested acreage increased in Puerto Rico to approximately 35% (Birdsey and Weaver 1982). This trend was driven

primarily by a socio-economic transition from an agrarian to an industrialized economy. Although gains in forested habitats may have been beneficial to many elements of the island's biodiversity, Puerto Rico's increasing human population is reversing this trend through rapid urbanization (López et al. 2001) and deforestation pressures. The human population of Puerto Rico increased almost 3.7 times from 1899 to 1992, causing an increment in the number of settlements (Cruz-Báez and Boswell 1997). In 2010, the island's population was estimated at 3.7 million people with a density of 1,112 persons per square mile (U.S. Census Bureau 2010). A significant part of urban expansion on the island has been the product of a suburbanization process, or the outward physical expansion of urban areas toward rural areas (Cruz-Báez and Boswell 1997).

The following is a list of the main stressors and threats to the Puerto Rico's wildlife:

Development and forest fragmentation

Humans depend on natural systems for survival. The primary impact of development is that built up areas displace forests and other vegetation with inert materials that do not provide the environmental, economic, and social benefits discussed in the sections above (Martinuzzi, et. al 2007). Eleven percent (95,342 ha) of Puerto Rico is composed of urban/built-up surface that is distributed throughout the island but tends to concentrate in coastal plains and valleys and follows transportation routes to the very interior of the island. In Puerto Rico, one-quarter of the rich soils that are suitable for agriculture have been developed.

Forest cover remained relatively constant between the 1980 and 1990 inventories and then increased dramatically between the 1990 and 2003 inventories from 32 to 57% (Birdsey and Weaver 1982, Franco et. al. 1997, Brandeis et. al. 2009). A 25% increase is substantial even after a portion of this increase is attributed to changes in inventory methods and definitions. Forest is defined in the 2003 inventory as any area with mature trees providing ten percent canopy cover or, having ten percent coverage in tree seedlings, (the equivalent

of 1,500 seedlings per hectare). This is, intentionally, a more encompassing definition of forest than used previously. It is intended to capture forests developing on old farm fields and pastures. Forest covered 85 percent of Vieques, and 88 percent of Culebra. The spatial distribution of forest cover is shown in Figure 10.

Forest fragmentation can involve a simultaneous decrease in the average size of habitat patches, an increase in the average distance between patches, and an increase in edge effects and habitat degradation. As a general rule, large fragments have more wildlife species and can sustain larger wildlife populations than small fragments. As the amount of fragmentation increases, species populations may become isolated, and the migration of individuals and populations between areas of suitable habitat becomes more difficult.

The intense changes and pattern in land use in Puerto Rico has impacted a significant number of geographic zones associated with the recharge areas of the main aquifers in Puerto Rico and has the direct consequences of soil erosion and sedimentation of water bodies and reservoirs (DRNA 2008-a). Likewise, it affects the quality of the resource and contributes to the deterioration of the environmental conditions necessary to sustain aquatic biodiversity.

Site location consultations filed at the Puerto Rico Planning Board show the trend for *urban sprawl*, with urban activities dominating the territory and threatening watershed functions that support mainly the Río Grande de Loíza, Río La Plata, Río Piedras-Río Puerto Nuevo, Río Guaynabo-Río Bayamón, Río Cibuco, Río Grande de Manatí, Río Grande de Arecibo, and Río Guanajibo basins.

The increase of population densities in rural land puts pressure on the young forests and open space on the urban fringe (Martinuzzi et al 2007). Most of the new development inquiries in the non-zoned areas of Puerto Rico are occurring in the land use designation “Common Rustic Land”. This land use zoning designation is the most permissive classification of the Municipal Territorial

Plans. An additional overlay of this zoning with the wildland urban interface areas shows that a large portion of the open space on the island is facing development pressure or that the concerned land has not been yet designated under specific land use zoning. These areas shall be considered priorities, particularly those portions overlapping Forest priorities (high, medium or low) areas according to Southern Forest Land Assessment.

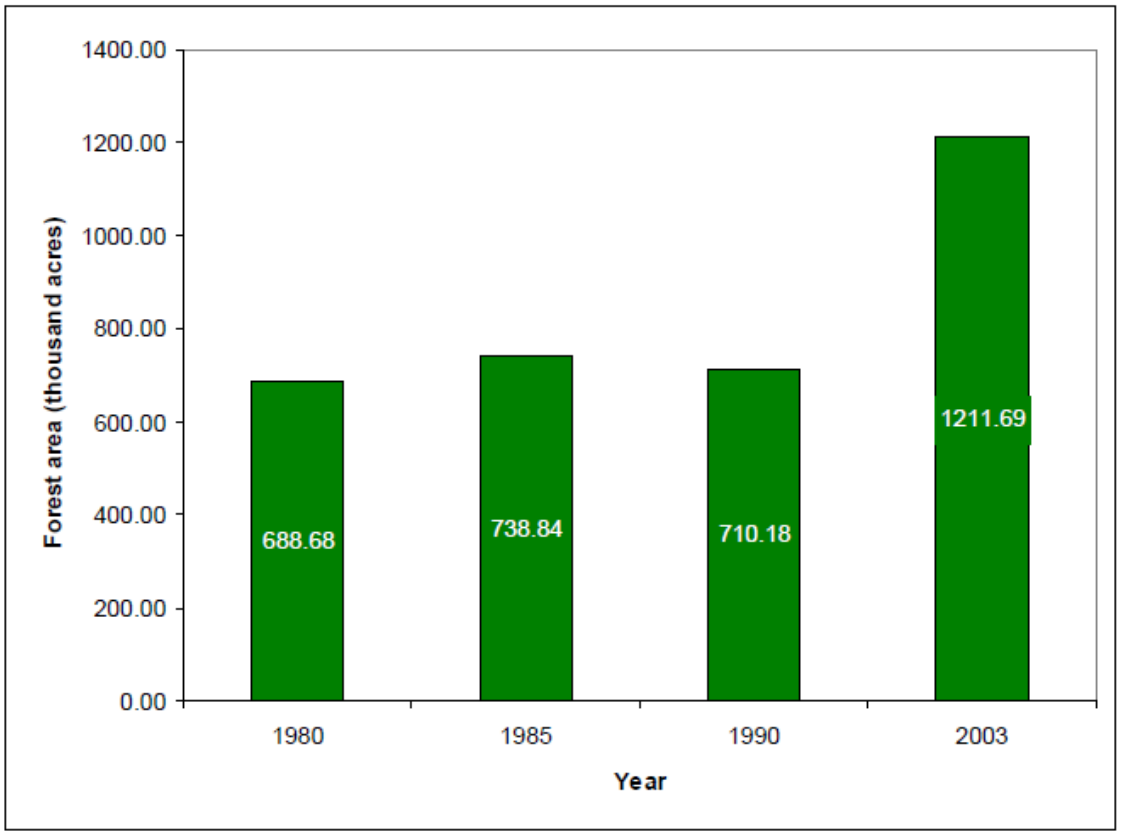


Figure 10. Forest area on the main island of P.R. as measured by forest inventories in 1980, 1985, 1990, and 2003. (Birdsey and Weaver 1987, Franco et al. 1997, Brandeis 2007).

Wildfires

Managing wildfires is an important global and local issue given interactions among people, fire and wildlife habitats. While studies have shown fire has effects on ecosystem structure and functioning, uncertainties prevail on the particular effects to ecosystem services due to feedback loops involving multiple

factors such as land cover, invasive species and climate change (Gould et al., 2008).

Understanding the ecological and social consequences of wildfires in Puerto Rican natural ecosystems is fundamental and key for important conservation and management actions to be planned. As people set the majority of fires in Puerto Rico, fire prevention efforts need to reach private forest owners (Gould et al., 2008). Research and monitoring of fires in our region has not been a high priority. Most fires and the highest potential for fire occur in the dry forest zones. Climate change, extended drought and human-induced landscape fragmentation have the potential to greatly expand fire-prone areas to moist and wet tropical forests and even non-forested landscapes traditionally fire-free (Gould 2008). The Caribbean Fire Ecology and Management Symposium held in San Juan, Puerto Rico in 2007 sent a clear message that in the New World Tropics, human activities and fire are intricately linked; consequently, forest fragmentation will increase the likelihood of fire.

Hurricanes

Tropical forests are shaped by natural disturbances of varying forces and frequency (Hartshorn 1978; Lugo 2000). Flooding and landslides are secondary disturbances associated with hurricanes. Hurricanes are one of several natural disturbances that contribute to the dynamics, structure, and function of forest ecosystems (Borman & Likens 1979; Pickett and White 1985).

Known effects of hurricanes on Caribbean forests include defoliation, tree mortality, falling of trees by uprooting and snapping, variation of food supplies for animal populations and direct damage to a proportion of their individuals, modifying microclimate, modifying seeds and seedling bank dynamics (Tanner et al. 1991). These effects varies based on environmental gradients, topographic location, stand characteristics, tree size, and species characteristics such as wood density (Tanner et al 1991; Basnet et al 1992). Hurricanes are a crucial

factor controlling species composition and important aspects of ecosystem dynamics in our region (Tanner et al; 1991; Lugo 2000; Flynn et al 2010). Their effects have been theorized as a major determinant of distribution patterns of tree species in tropical forests affected along their pathways (Basnet et al., 1992). A strategy in urban areas is to establish green infrastructure with the goal of mitigating the potential for wind damage, flooding, and mass wasting (Lugo 2000). Decades are required for both urban and natural systems to recover from the passage of a single category 4 or 5 hurricane. Hurricanes Hugo in 1989, and Georges in 1998 struck the natural forested regions of Puerto Rico with varying effects.

Hurricanes have removed foliage or caused tree mortality over hundreds of acres of forested land on subtropical wet or moist, lower montane wet, and rain forest life zones. Urban forest resources were not exempt as trees fell onto power lines, houses, vehicles, and roads. Habitat loss and fragmentation has increased the threat that stochastic events like hurricanes and tropical storms pose to plants and animals on the island (e.g., Wiley and Wunderle 1993). For example, half the population of the Puerto Rican Parrot (*Amazona vittata*) (ca. 35 individuals) disappeared when Hurricane Hugo struck the island in 1989 (Wiley and Vilella 1998; Vilella and García 1995).

Climate change

Climate change refers to any significant change in the measures of climate lasting for an extended period, and includes major changes in temperature, precipitation, or wind patterns, among others that occur over several decades or longer (EPA 2015). The recent and ongoing rise in average global surface temperatures, known as global warming, is causing changes in climate patterns. Global warming, primarily caused by increasing concentrations of greenhouse gases in the atmosphere, is only one aspect of climate change (EPA, 2015). However, the effects of human induced climate change have the potential to devastate many areas of the world, including islands with substantial portions of its coastal plain composed of lowlands close to current sea level. The predicted

intensity of change and the timeframe over which change will occur depends on the model. However, most of the models agree that climate will result in impacts to forests along the coastlines. The expected changes, presented so far by the United Nations Environmental Program (UNEP 2008) include:

- deteriorating coastal conditions as, for example, beach erosion and coral bleaching, affecting fisheries and touristic coastal scenarios.
- floods, storm surge, erosion and other coastal hazards, exacerbated by sea-level rise, threatening fundamental infrastructure, settlements and facilities that support the livelihood of island communities.
- reduction in freshwater resources to the point where they cannot meet demand during drought periods.
- increased invasion by non-native species as result of higher temperatures, particularly on middle and high latitude islands.
- economic losses from reduced agricultural yields (shortening of the growing seasons and droughts).
- loss of mangrove forests and coral reefs as a consequence of sea level rise.
- coral bleaching and acidification of the ocean;
- damage to terrestrial forests caused by extreme events.
- reduction of the size of freshwater aquifers or lenses and of general water resource availability due to decreased rainfall and salt water intrusion.
- inundation on coastal settlements and arable land on the coast.
- reduction in tourism due to increased frequency and extreme severe weather.
- hurricanes and tropical storm winds could reach more than 170 miles per hour, with the ability to devastate entire landscapes (Reilly 1991).

Human induced climate change is one of the most critical issues facing biodiversity and natural resource management in the world today. Land and ocean surface temperatures have warmed, the spatial and temporal patterns of

precipitation have changed, sea level has risen, and we are experiencing more intense storms. These changes, particularly warmer regional temperatures, have affected the timing of reproduction in animals and plants and/or migration of animals, the length of the growing seasons, species distributions and population sizes, and the frequency of pest and disease outbreaks. Climate change is projected to affect all aspects of biodiversity; however, the projected changes have to take into account the impacts from other past, present, and future human activities. The effects of climate change, in terms of rising sea levels, increasing mean atmospheric and sea surface temperatures and changes in rainfall and weather patterns, are likely to be particularly severe for the ecological systems of the Caribbean islands and small island states (Puerto Rico Climate Change Council 2013).

Climate change is already affecting some aspects of society, the economy and natural ecosystems of Puerto Rico, and these effects are expected to increase. Not all of these changes will be gradual. When certain tipping points are crossed, impacts can increase dramatically. Past climate is no longer a reliable guide to the future. This affects planning for public and private infrastructure, tourism and industry, water resources, energy and all other social and economic systems.

An analysis for the PRCCC shows that since 1948 the Caribbean Basin has seen decreasing precipitation (-0.01 to -0.05 mm/day/year), with a greater drying trend for the Eastern Caribbean. For Puerto Rico, one analysis of weather station data from the period of 1948 to 2007 found no clear trends in total annual rainfall for the island as a whole, another analysis showed decreases in rainfall for the island as a whole, while another analysis found decreases in rainfall from -0.01 to -0.1 mm/day/year. Regionally, within the island, there are indications that the Southern Region of Puerto Rico has experienced positive trends in annual rainfall while the western and a portion of the northern region shows decreases. Additionally, seasonal trends with observations show negative trends in summer and positive trends in winter (Puerto Rico Climate Change Council 2013).

The expected sea level rise will significantly affect certain forests in Puerto Rico, mainly within the coastal zone. A 30.5 cm rise in sea levels could have detrimental effects on coastal forests areas, including mangrove systems and other coastal swamps characteristic of lower saline intrusion such as bloodwood swamps (*Pterocarpus officinalis*) and pond apple swamps (*Annona glabra*). All these coastal forests act as nurseries for fish, habitat for other wildlife, and sediment filters for runoff. Available data suggests that under current conditions, sea level could rise from 48 cm (1.3') (Pfeffer and O'Neel, 2008) to 880 cm (27.7') (Carlson et al. 2008) over the next hundred years. The more conservative IPCC estimates project 40-102 cm over next 100 years. Sea level rise could have a domino effect in FEMA flood zones, and push future development into the central volcanic parts or karstic zones of Puerto Rico.

Climate change is likely to exacerbate many of the existing threats to forest ecosystems. Climatic warming and drying and the increase in invasive species will make forests more vulnerable to wildfires. Evidence of this has already been reported on the Island, where wildfires are increasing in frequency and occurring in areas where such fires have never been recorded before (Robbins et al. 2009).

The main effect of climate change on Puerto Rico's ecosystems and species will be synergistic in that already stressed systems will be exposed to additional stressors that push them over their limit of existence, resulting in widespread loss of habitat, unfavorable changes to structure and function, or diminished services to Puerto Rico's society. Some ecosystems and species will adapt to changing environmental conditions better than others (Puerto Rico Climate Change Council 2013).

Climate change may alter the life zones of the island with shifts from rain, wet, and moist zones to drier zones. This includes the loss of the subtropical rain, moist, and wet forests and appearance of tropical wet, moist, dry, and very dry forests (Henareh Khalyani et al., 2016). New ecological conditions may result in

new ecosystems and new communities. For example, present trees that require soil moisture throughout the year may be replaced by other tree and shrub species (Henareh Khalyani et al., 2016).

While some species may potentially migrate to more favorable conditions in Puerto Rico (e.g., Colorado trees, swamp cyrilla), species already reaching the upper limits of their range may not be so fortunate, and could be diminished or lost from Puerto Rico altogether due to the lack of suitable environmental conditions (e.g., dolphinfish, yellowfin tuna). Others may not have the ability to relocate and may become globally extinct, like the Coquí Duende, the Cricket Coqui, and the forest-dwelling Puerto Rican Upland Sphaerodactylus. On the other hand, new species or community assemblages could occur in Puerto Rico that may benefit society as they might provide new ecosystem services (Puerto Rico Climate Change Council 2013).

Puerto Rico has been identified by the World Bank among the nations with higher carbon dioxide emissions per person in Latin America and the Caribbean compared to world average emission. Climatic warming is mainly caused by increasing carbon dioxide emissions in our atmosphere. Forests store carbon dioxide therefore decreases in forest cover increase the amount of carbon dioxide in other parts of the cycle.

Climate change requires a monitoring mechanism or protocol to categorize management applications and setting priorities can focus on adapting to the climate change process. Given the importance role forests play in sequestering carbon, expanding forest cover is a pausible response to climate change. Carbon credit trading is one way that private landowners may participate and prosper while contributing to mitigation efforts. Currently, there is no active market for carbon on the island.

The Department of Natural and Environmental Resources (DNER) through the Puerto Rico Coastal Zone Management Program (PRCZMP) serves as

coordinator of the Puerto Rico Climate Change Council (PRCCC). The PRCCC was created in 2010 to conduct the assessments and develop adaptation strategies to current and potential impacts of climate change and sea level rise on coastal communities, infrastructure, ecosystems, habitats, and populations of coastal and marine species. Over 180 PRCCC members from partner organizations, as well as researchers from Federal and Commonwealth agencies, universities, independent researchers and investigators, non-governmental and community-based organizations contributed and continue investigating, evaluating, assessing, and contributing to develop and catalog the best scientific, technical, and communities' knowledge to support decision making at the public and private sectors and each individual member of our population. PRCCC first comprehensive assessment was completed with assistance from four working groups: Geophysics and Chemistry, Scientific Knowledge, Ecology and Biodiversity, Economy and Society and Communicating Climate Change and Coastal Hazards. The report *Puerto Rico's State of the Climate Report 2010-2013 – Assessing Puerto Rico's Social-Ecological Vulnerabilities in a Changing Climate* integrates assessments for different climate and ocean conditions and delineates a course of action to address the effects and impacts as well as to develop adaptation strategies and build resilience for coastal communities, critical infrastructure, and biodiversity.

Prior to 2010 and immediately after the Intergovernmental Panel on Climate Change (IPCC) issued its 4th Assessment Report in 2007, the Government of Puerto Rico established a high-level Commission to address climate change mitigation and adaptation in Puerto Rico (Executive Order 2008-09). Although the Commission discussed and recommended public policies no specific vulnerability-impact assessments nor adaptation strategies were deviced or implemented in Puerto Rico. Before 2008, most climate variability and change impacts on biodiversity and society were assessed and adaptation strategies recommended by scientists and resource managers from the Academia, Federal and Commonwealth agencies. Notable work has been conducted by

researchers in the fields of amphibian ecology, marine science, and coastal hazards.

In 2010, the PRCCC met for the first time and committed to develop a comprehensive report on the potential effects and impacts of climate change based on publications and direct participation of the most knowledgeable researchers and practitioners in the field, collecting the best available science and scientific knowledge, coming to agreement on key drivers of ecosystem changes and ways Puerto Rico's ecology and biodiversity may be affected and impacted, as well as identifying research gaps, information needs, and adaptation strategies.

The adaptive capacity of Puerto Rico's flora and fauna, and therefore the status and threats to each of the systems is intrinsically related to each ecological system's vulnerabilities. The following climate conditions were assessed: air and sea surface temperatures, precipitation, extreme events (e.g., downpours, droughts), sea level rise, tropical storms and hurricanes, and ocean acidification. PRCCC report presents the results of the vulnerability assessments conducted on sub-tropical forests, coral reefs, seagrasses, beaches, amphibians and reptiles, fishes, marine mammals, among other.

The PRCCC Ecology and Biodiversity working group assessed the impacts of changing climate conditions on Puerto Rico's biodiversity. The United Nations Convention on Biological Diversity defines biodiversity as the variability among living organisms from all sources including, among others, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Biodiversity is highly stressed worldwide. Human activities globally and in Puerto Rico have caused and are likely to continue causing losses in ecosystems and habitats, potentially inducing species losses. The introduction of non-native species, disease and pests, and speciation by hybridization may be a signature

of the Anthropocene. Claims that wildlife conservation is losing the battle to protect biodiversity in the Era of Man also known as the Anthropocene have been highly controversial, and so is the position that changes induced by humans may bring increased animals and plant diversity and distribution as they respond to warming temperatures. These are signs of recognizing climate change impacts on global biodiversity.

The losses of biodiversity directly impact society as we also lose ecosystem services, such as clean water, air pollution abatement, carbon dioxide sequestration, natural protection against storm surges, floods, and hurricanes, prevention of landslides, erosion and sedimentation control, as well as recreation and tourism opportunities, among others.

The PRCCC report on Ecology and Biodiversity examined the effects and impacts of changing climate and ocean conditions on beach ecosystems, wetlands, coastal lagoons, sea birds, shore birds, forests, woodlands, amphibians, reptiles, coral reefs, submerged aquatic vegetation and seagrasses, coastal and pelagic fishes, bioluminescent bays, marine mammals, as well as intersecting issues. Vulnerability assessments were conducted through literature review, expert meetings, PRCCC summits and Working Group's workshops.

The PRCCC members continue collaborating and exchanging information through the pr-cc-listserv@googlegroups.com, workshops, and annual summit meetings. The PRCZMP as Executive Secretariat of the PRCCC has initiated the update of The State Puerto Rico's Climate aiming to publish it in 2018. The PRCZMP has also completed the Puerto Rico Guide to Climate.

Change Adaptation (in print) is currently conducting pilot ecosystem-based adaptation plans at five of the 44 coastal municipalities of Puerto Rico. These plans are envisioned to build resiliency in those communities using a triple bottom line approach: economics, social, and environmental. Focused on stakeholders, the process will be conducted in four steps in each community: (1)

Community Resiliency Report Cards, (2) Engage with stakeholders to develop master plan scenarios for the community, (3) Scenario Stress Testing, and (4) Reach consensus on master plan.

The Convention on Biological Diversity calls for action to combat climate change and its impacts, recognizing that Climate change is a threat to human well-being and development in all countries. The Millennium Ecosystem Assessment identifies it as one of five global drivers of biodiversity loss. Climate change is already forcing biodiversity to adapt through either shifting habitat, changing life cycles, or the development of new physical traits in species. Climate change is also projected to reduce economic growth and reduce the livelihood assets of vulnerable people, especially those dependent on biodiversity and ecosystem services for access to food, water and shelter. It will have impacts on these basic needs to all people. Further, climate change will increase the vulnerability of populations to perturbations such as drought, flood and disease. While biodiversity plays a major role in mitigating and adapting to climate change by contributing to long-term sequestration of carbon, and reducing the impacts of extreme events such as droughts and floods, it is also highly vulnerable to the effects of climate change.

The DNER continues leading biodiversity conservation efforts through its Fisheries and Wildlife Bureau (now known as the Research, Habitat Conservation and Biodiversity Bureau) and promoting adaptation and building resilience through its Coastal Management Division. Current islandwide collaboration takes place through the Caribbean Landscape Conservation Cooperative and the PRCCC, among others.

Invasive species

Biological invasions are considered one of the major threats to the conservation of biodiversity (Mack et al. 2000; Levine et al. 2003; D'Antonio et al. 2004). At a global scale, plants are among the most widespread invasive organisms as they

are frequently introduced for agriculture, agroforestry and ornamental purposes (Daehler 2003; D'Antonio et al. 2004; Pys˘ek et al. 2012).

In 1999, Executive Order Num. 13112 was signed by President Bill Clinton, with the purpose of preventing the introduction of invasive plant and animal species, providing resources for their control, and diminishing their main economic and ecological impact. Under this Executive Order, federal agencies could not authorize, nor provide funding or accomplish any action considered capable of causing or promoting the introduction or dispersion of invasive species to the United States of America (USA), unless all reasonable measures that diminish risks are considered first. This Order is applicable to Puerto Rico and requires action by several federal or Commonwealth agencies.

These following terms are commonly used when discussing exotic organisms and invasive species:

- Native – Organisms found within what is considered their natural range.
- Endemic – Similar to native but usually refers to a more specific geographic range.
- Exotic – Exotic species are organisms taken from their natural range and transported to a new area. This only pertains to organisms moved by humans, such as in cargo ships or planes. It does not include natural migrations like birds or fish that travel great distances.
- Naturalized – An organism that is able to reproduce itself unassisted in their new habitat is considered naturalized.
- Invasive – An organism that grows or spreads aggressively in its new environment and causes environmental and/or economic harm.

Islands have long been considered to be particularly vulnerable to biotic invasions. Usual predictions concerning the number of invasive plant species per island group are based on factors such as: area and isolation, habitat diversity

and human development. Comprehensive data to date on the global distribution of invasive plant species in natural areas of oceanic islands has shown that island area, latitude, isolation from continents, number of present non-native species with known invasion history, and native species richness do not seem to be retained as significant factors in the multivariate models (Kueffer et al 2009).

The 1,032 species of alien plants reported for Puerto Rico and United States Virgin Islands (PR and USVI) represent about a third of total plant diversity on these islands. This proportion is relatively high when compared to other islands of the Greater Antilles (Rojas-Sandoval and Acevedo-Rodríguez 2014). For instance, alien plant species represent about 12% of the total plant diversity in Cuba, 18.4% in Hispaniola and 21.4% in Jamaica (Acevedo-Rodríguez and Strong 2012; González et al. 2012). These differences are even more noteworthy in PR and USVI as they are the smallest land mass within the Greater Antilles. In general, the origin and quantity of alien plants in PR and USVI may be explained by historical and ecological (but not exclusively) factors. First, the historic role of PR as a port of call for Europe-American trading routes during colonization and expansion (between 1500's and 1890's; Dietz 1986) facilitated the introduction of numerous alien species, mostly from continental America but also from Africa, Asia, and Europe. Second, the extensive rates of human mediated disturbance to which natural ecosystems in PR and USVI have been subjected (Rojas-Sandoval and Acevedo-Rodríguez 2014).

The alien flora in PR and USVI is very diverse and includes a wide range of taxonomic groups. Poaceae and Fabaceae are the families with the highest numbers of naturalized and invasive species, a fact that is not surprising –these families are among the more diverse plant families of the world, as well as among other Caribbean floras (Acevedo-Rodríguez and Strong 2012).

Other examples of invasive species include introductions of domestic cats (*Felis catus*). This has resulted in detrimental effects, including extinctions, on native prey populations (Ebenhard 1988). In PR, there are a number of exotic species

already established whose negative effects on native fauna have been documented (Camacho-Rodríguez et al. 1999, García et al. 2001 and 2002).

Nonetheless, there are many other introduced species (e.g., Lionfish [*Pterois* spp.], Green iguana [*Iguana iguana*], Australian Red Claw crawfish [*Cherax quadricarinatus*], Yellow-crowned parrot [*Amazona amazonica*], feral pigs [*Sus scrofa*] and goats [*Capra hircus*] on Mona Island, White-tailed deer [*Odocoileus virginianus*] on Culebra Island, and Bottlebrush trees [*Melaleuca quinquenervia*]) that potentially affect the native flora and fauna of Puerto Rico. Exotic bird species may also be vectors of diseases that could negatively affect native fauna, especially those classified as vulnerable or endangered (Camacho-Rodríguez et al. 1999). However, the impact of these species has not been comprehensively quantified. Due to the potential establishment of exotic animals imported as pets, DNER Regulation No. 6765, dictates how all wildlife species introductions and breeding are managed. This document presents several lists that establish the following criteria:

1. Low Risk Species that can be imported without a permit.
2. Established Exotic Species that can be captured for exportation.
3. Exotic species that can be bred with or without authorization.

Predatory and competitive impacts of biological invasions are well documented, as well as the success of invading exotics due to having escaped their natural enemies and not because of novel interactions with their new neighbors (Callaway and Aschehoug 2000; Jenkings and Pimm 2003). Plant diversity patterns, plant community structure and forest regeneration patterns have been interpreted as strongly affected in the Luquillo Mountains of Puerto Rico due an invasive tropical tree species introduced over 180 years ago into the Island (Brown et al 2006). In contrast, perspectives and paradigms based on such data seem to be threatened by new concepts and observations. Searches through recent ecological literature found that facilitative interactions between invasive and native species occur in a wide range of habitats, and can have cascading

effects across trophic levels, for example, restructuring communities and leading to evolutionary changes; recent evidence suggests that several mechanisms that exemplify how exotic species can facilitate native species (Rodríguez 2006), having important implications for management, eradication and restoration. The change in species composition taking place due to invasiveness might not be seen as a chaotic process, but instead as a directed process responding to fundamental changes in the conditions of the planet (Lugo 2004).

Pests and diseases

The Agricultural Extension Service of the University of Puerto Rico in Mayagüez has compiled a list of native and non-native insect species that at certain life-cycle stages, adversely affect organs of native or naturalized tree or shrub species occurring on forested ecosystems or urban forest systems (Martorell 1945; Almodovar 2008). Table 5 shows a list of the species considered pests in Puerto Rico forests and their host woody plants.

Table 5. Native and non-native insects' species in P.R., considered harmfull to local tree or shrub species.

Insect scientific name	Insect common name	Tree or shrub species affected, present in Puerto Rico
Apate monacha	The apate borer	*Bixa orellana; Bucida buceras; Casuarina equisitefolia; Delonix regia; Inga vera; Eugenia jambos; Linociera domingensis; Melia azedarach; Persea americana; Picramnia pentandra; Salix chilensis*
Aspidotus destructor	The coconut scale	*Cocos nucifera; Annona glabra/ Barringtonia speciosa; Grevillea robusta; Mammea americana; Persea americana; Phoenix dactylifera; Psidium guajava; Terminalia catappa*
Chlorida festiva	The mango borer	*Albizzia lebbeck; Casuarina equisetifolia; Mangifera indica; Stahlia monosperma*
Chrysomphalus aonidum	The Florida red scale	No information available
		Albizzia lebbeck; Andira jamaicensis;

Diapprepes abbreviatus	Sugarcane weewil	*Byrsonima spicata; Cedrela mejicana; Cedrela odorata; Ceiba pentandra; Chrysophyllum cainito; Coccoloba uvifera; Cordia alliodora; Delonix regia; Ficus stahlii; Guaicaum officinale; Inga vera; Lagerstromia speciosa; Melicocca bijugata; Thespessia grandiflora; Persea americana; Psidium guajava; Swietenia macrophylla; Swietenia mahogani; Tamarindusindica; Terminalia catappa*
Eulepte concordalis	The oak leaf-weeber	*Tabebuia argentea; Tabebuia heterophylla; Tabebuia lucida; Tabebuia rigida; Tabebuia schumaniana; Crescentia cujete; Spathodea campanulata*
Exophthalmus roseipes	The green bug	*Andira inermis; Chrysobalanus icaco; Coccoloba uvifera; Conocarpus erectus; Dalbergia ecastophyllum; Elaodendrum xylocarpum; Hymanea courbaril; Inga vera; Inga laurina; Terminalia catappa*
Homaledra sabalella	The palm leaf-webber	*Cocos nucifera; Prestoea montana*
Iceria motserratensis	No official common name	*Byrsonima spicata; Callophyllum calaba; Casearia sylvestris; Casuarina equisitefolia; Chrysophyllum argenteum; Cocos nucifera; Ficus nítida; Inga vera; Inga laurina; Mammea americana; Psidium guajava; Samanea saman*
Megalopyge krugii	Flannel moth	*Andira inermis; Byrsonima spicata; Cocos nucifera; Delonix regia; Erythrina glauca; Ficus laevigata; Guaiacum officinale; Guarea trichiloides; Guazuma ulmifolia; Inga vera; Inga laurina; Nectandra sintenisii; Ormosia krugii; Psidium guajaba; Rhizophora mangle; Sciacassia siamea; Spondias purpurea; Terminalia catappa; Triplaris*

		caracasana
Nasutitermes costalis	Common termite	*Albizzia lebbeck; Albizzia procera; Andira inermis; Artocarpus communis; Bucida buceras; Bursera simarouba; Callophyllum calaba; Canagium odorata; Capparis portoricensis; Casuarina equisetifolia; Cecropia peltata; Cedrelaodorata; Ceiba pentandra; Coccoloba uvifera; Cocos nucifera; Colubrina arborescens; Crescentia cujete; Delonix regia; Eucalyptus robusta; Ficus elástica; Inga vera; Petitia domingensis; Prestoea montana; Roystonea borinquena; Swietenia mahogani; Terminalia catappa*
Oiketicus kirbyi	Bagworm	*Casuarina equisetifolia; Casearia sylvestris; Ceiba pentandra; Chrysophyllum cainito; Cordia alliodora; Cupania americana; Guazuma ulmifolia; Thespesia populnea; Ochroma pyramidale; Petitia domingensis; Persea americana; Pisonea aculeata; Randia portoricensis; Terminallia catappa; Thuja orientalis; Tabebuia* spp.
Pachylia ficus	The ficus sphinx	*Ficus nitida; Castilla elastica*
Pectynophora gossypiella	The pink bollworm	*Thespesia grandiflora; Thespesia populnea*
Phyllophaga portoricensis	May beetle	*Coccoloba uvifeera; Schefflera morototoni; Lagerstromia speciosa; Bucida buceras; Cordia alliodora; Cordia sebestena; Grevillea robusta; Sterculia apétala; Sterculia foetida; Swietenia mahogani; Swietenia macrophylla; Terminalia catappa*
		Calatropis procera; Clibadium erosum; Erythrina poeppigiana; Fraxinus sp.;

Pseudalcapasis pentagona	West indian peach scale	*Gleditsia triacanthos; Mammea americana; Mangifera indica; Thespessia grandiflora; Hibiscus tiliaceum; Salix chilensis; Trema lamarkiana; Trema micrantha*
Pseudococcus adonidum	Mealybug	*Barringtonia speciosa; Callophyllum calaba; Erythrina glauca; Hibiscus tiliaceus*
Psychonoctua personalys	Mangrove stem-borer	*Eugenia jambos; Laguncularia racemosa;* *Rhizophora mangle*
Saissetia oleae	Black scale	*Andira inermis; Annona muricata; Cedrela mejicana; Cordia alliadora; Cordia sulfata; Crescentia cujete; Erythrina berteroana; Erythrina glauca; Erythrina poeppigiana;Ficus laevigata; Ficus nitida; Gleditsia triacanthos;* *Guarea trichiloides; Guazuma ulmifolia;* *Isandrina emarginata; Eugenia jambos;* *Lagerstromia speciosa; Manilkara bidentata; Thespesia grandiflora; Ocotea portoricensis; Petitia domingensis; Psidium guajava; Sciacia siamea; Sideroxylon foetidissimum; Spathodea campanulata; Spondias dulcis; Sterculia* *apétala; Swietenia mahogani; Tamarindus indicus; Tectona grandis; Terminalia catappa; Trema lamarckiana; Trema micrantha; Zanthoxylum flavum*
Selenothrips rubrocinctus	Cacao thrips	*Anacardium; occidentale; Bixa Orellana;* *Chrysobalanus icaco; Coccoloba laurifolia; Mangifera indica; Psidium guajava; Spondias bombim; Terminalia catappa; Zanthoxylum monophyllum*
Sericocerina krugii	Sea grape wasp	*Coccoloba uvifera*; other *Coccolobba* spp; *Triplaris surinamensis*
Xyloborus affinis	Ambrosia beetle	*Albizzia lebeck; Cocos nucifera; Inga vera; Inga laurina*

The Harrisia cactus mealybug (HCM), (*Hypogeococcus punges*) is another invasive insect in Puerto Rico. The HCM was first detected in San Juan, Puerto Rico, fifteen years ago on an ornamental plant, *Portulaca oleracea* (Family: Portulacacea) and in plant material from Guánica in 2005 (Segarra-Carmona et al., 2010). The introduction of HCM in Puerto Rico causes concern due to its damaging effects to the structure of cactus communities, eliminating species, and severely compromising plant growth and reproduction of susceptible native species (La Quay-Velázquez et al., 2015). In Puerto Rico, heavy infestations with this invasive HCM have been observed on three native species of cacti, *Pilosocereus royenii*, *Melocactus intortus*, and the endangered *Leptocereus quadricostatus*.

Segarra-Carmona et al. predict that the eventual expansion of *H. pungens* range will soon include offshore islands, such as Mona, Desecheo, Vieques and Culebra, which now harbor the last remaining wild populations of endangered cacti (i.e., *Harrisia portoricensis* and *Leptocereus grantianus*). They believe that the introduction of *H. pungens* in Puerto Rico poses a heightened extinction threat to these endemic cacti and the organisms that depend on them.

There are major threats and stressors that currently affect Puerto Rico's wildlife (Table 6). Most of them are well known, such as urban development, but others are subtler, like the installation of power lines.

Table 6. Other threat categories and classes used for PRSWAP.

Threat Category	Threat Class
Habitat Conversion: Intentional conversion of natural habitat that is detrimental to wildlife use and survival by causing loss or degradation of wildlife habitat and available forage.	Housing and urban development
	Agricultural practices
	Recreational areas
	Intentional fires
	Illegal dumping areas
	Wetland filling

Invasive Species: Introduction and/or spread of unwanted exotic and native organisms into ecosystems that increases wildlife predation, competition, and reduced fitness or causes loss of wildlife habitat.	Invasive Plants Invasive animals and plants Pathogens
Transportation and Infrastructure: Development of corridors/passages that increase wildlife mortality and fragmentation of wildlife habitat.	Roads
	Pier and harbor
	Power lines, aqueducts, gas ducts
	Wind power plants
Abiotic Resources Use: Extraction or use of rocks, minerals, and water that causes direct or indirect negative impacts to wildlife habitats.	Land cover removal for construction material (e.g., sand, limestone, other rocks)
	Water use
	Drilling (wells)
Consumptive Use of Biological Resources: Harvest or use of plant and animal populations in a manner that negatively impacts wildlife distributions and fitness, or the ecosystem.	Forest and woodland management
	Grazing
	Collection
	Illegal hunting and fishing practices
Non-consumptive Resources Use: Activities that have an incidental, but negative impact on wildlife and their habitats.	Motor-powered recreation
	Non-motorized recreation
Pollution: Introduction and spread of unwanted matter and energy into ecosystems from point and non-point sources that cause increased mortality of wildlife and degradation of their habitats and available foraging opportunities.	Solid waste
	Waste or residual materials
	Chemicals and toxins
	Eutrophicants substances
	Noise pollution

One example, which provides a measure of the consumptive use of biological resources in Puerto Rico, is the DNER Marine Fisheries Program. Marine fish species data is collected through two main programs: The Commercial Fisheries Statistics Program (PEPCO, by its acronym in Spanish), managed by the Fisheries Research Laboratory of DNER in Joyuda, and the Marine Recreational Information Program (MRIP), managed by NOAA Fisheries. DNER also collects marine fisheries statistics through projects in its Sport Fish Restoration, which complements MRIP by collecting additional data on marine recreational fisheries through intercept interviews and monitoring marine fishing tournaments. Data collection on commercial fisheries began in the 1960's, and marine recreational fisheries data collection began in 2000. Data from these sources are used by

DNER for length-based stock assessments (in collaboration with Dr. Ault and Dr. Smith of U. Miami/RSMAS), and as the scientific basis of fishing regulations. In addition, in some cases they provide the justification for including species in the PRSWAP.

In the case of native freshwater fish species, DNER monitors fisheries in streams through its Sport Fish Restoration Program through a long standing collaboration with North Carolina State University, which studies both the amphidromous and catadromous riverine fish species and their habitats. Data from this project is used as the basis for fisheries regulations to conserve the species and as justification for improvements to stream connectivity, to increase their access to suitable stream habitat. These data sources are used in educational and informational activities and have resulted in numerous scientific and technical publications.

Descriptions of problems which may adversely affect species identified in Element 1 or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and enhance conservation of these species and habitats, are described in the following table:

Table 7. Descriptions of known or probably problems may adversely affect the SGCN.

Taxon	Descriptions of problems known to adversely affect the species	Descriptions of problems which may adversely affect the species (suspected)	References
Marine Mammals	Entaglements, ship strike, Boat traffic, habitat degradation, harrassment, long line fisheries. Boat traffic, habitat degradation, harrassment, overfishng of key prey species.	Pouching	Jensen et al., 2004. Garrison 2007. Hamer et al 2012. Purves et al., 2004. Baird & Gorgone, 2005.
Terrestrial Mammals			
Birds	Historical habitat loss and fragmentation, invasive predators and competitors, habitat conversion, deleterious interactions with humans, catastrophic natural events.	Pouching, genetic drift	Niche et al., 2015
Reptiles			
Amphibians			
Freshwater fishes	Habitat loss and illegal harvest (glass eel or juvenile), legal	American eel (*Angullla rostrata*) is a catadromous fish which migrates from river to the ocean to	Cooney and Kwak 2013

	and illegal harvest (ceti) and high commercial and cultural value	spawn and completes its life cycle. The construction of dams and small structures in the rivers limits and prevents the migrations of this fish. This fish has a highly commercial value in the oriental cuisine and it is sold at a very high market price." *Gobiomorus dormitor* is an amphidromous fish whose larvae must drift from river to the ocean to completes its life cycle. The construction of dams and small structures in the rivers limits and prevents the migrations of this fish. Sirajo Goby is an amphidromous fish whose larvae must drift from river to the ocean to complete its life cycle. The construction of dams and small structure in the rivers limits and prevents the migrations of this fish. This fish is highly commercial sought in the Rio Grande de Arecibo watershed. *Sicydium punctatum* is an amphidromous fish whose larvae must drift from river to the ocean to complete its life cycle. The construction of dams and small structures in the rivers limits and prevents the migrations of this fish. This fish has a high commercial value in the Rio Grande de Arecibo watershed. *Pomasasys crocro* is an amphidromous fish whose larvae must drift from river to the ocean to completes its life cycle. The construction of dams and small structure in the rivers limits and prevents the migrations of this fish. Dormitator maculatus is an amphidromous fish which has to migrate from river to the ocean to completes its life cycle. The construction of dams and small structure in the rivers limits and prevents the migrations of this fish. Awaous banana is an amphidromous fish which has to migrate from river to the ocean to complete its life cycle. The construction of dams and small structure in the rivers limits and prevents the migrations of this fish. Mountain Mullet (*Agonostomus moniticola*) is an amphidromous fish whose larvae must drift from river to the ocean to complete its life cycle. The construction of dams and small structure in the rivers limits and prevents the migrations of this fish.	.
Saltwater fishes	Many important species, incluing most groupers and snappers, form seasonal spawning aggregations, which are targeted by commercial fishers. At this life stage, the species are highly vulnerable to overfishing and spearfishing - commercial and recreational. The spawning aggregations at known sites, at known times of the year. Other important species, such as some parrotfish, forms SPAGS, and sleep at night on the reef in a mucus cocoon. This makes them highly vulnerable to	Overfishing of spawning aggregations is likely the most serious threat. Some SPAGS may have been affected by habitat degradation or water quality issues. The relatively large size of some species (up to 1m) make them a target for commercial and recreational fishers.	Ojeda et al., 2007. Allen, 1985. Parenti and Randall, 2000. Cervigón, 1994. Robins and Ray, 1986. Ballantine et al., 2008.

	overfishing. Overfishing by nets, traps, spears, and impacts from habitat degradation all affect saltwater fish.		
Marine Invertebrates	Natural disturbances such as hurricanes and loss of reef herbivores such as Caribbean's Long Spined Urchin (Diadema antillarum), and anthropogenic impacts such as the increase of sedimentation and nutrients run-off, overfishing (Humman & Deloach, 2002), as well as mechanical impacts.		Humann & Deloach, 2002.
Terrestrial Invertebrates			
Plants			

Other threats, related to Puerto Rico's essential habitats, can be found in DNER's Critical Wildlife Areas publication (Ventosa-Febles et al., 2005). In each Critical Wildlife Area described, there is a section of threats related to each habitat.

The complete document is available at:
http://drna.pr.gov/historico/oficinas/arn/recursosvivientes/costasreservasrefugios/pmzc/publicaciones/CWA_July2005.pdf

CHAPTER 5. CONSERVATION STRATEGIES FOR PRSWAP

Puerto Rico GAP Analysis

Protecting natural areas and lands is a crucial conservation tool for DNER. The Puerto Rico Gap Analysis Project conducted an inventory of protected areas and an evaluation of the degree of their management for conservation purposes using information from federal and state agencies, the Conservation Trust of Puerto Rico and the Puerto Rico Planning Board. (Gould et. al, 2008). The project identified 90 stewardship areas, 77 of which have some type of management for conservation. Among areas, 59% of the stewardship areas are managed by commonwealth agencies, 30% by federal agencies, and 11% by non-government agencies (Figure 11). Another key finding was that management plans for many areas either do not exist or have not been updated to provide direction for the island's current condition (e.g. reduced timber production, focus on forest restoration, and increased development and urbanization pressures).

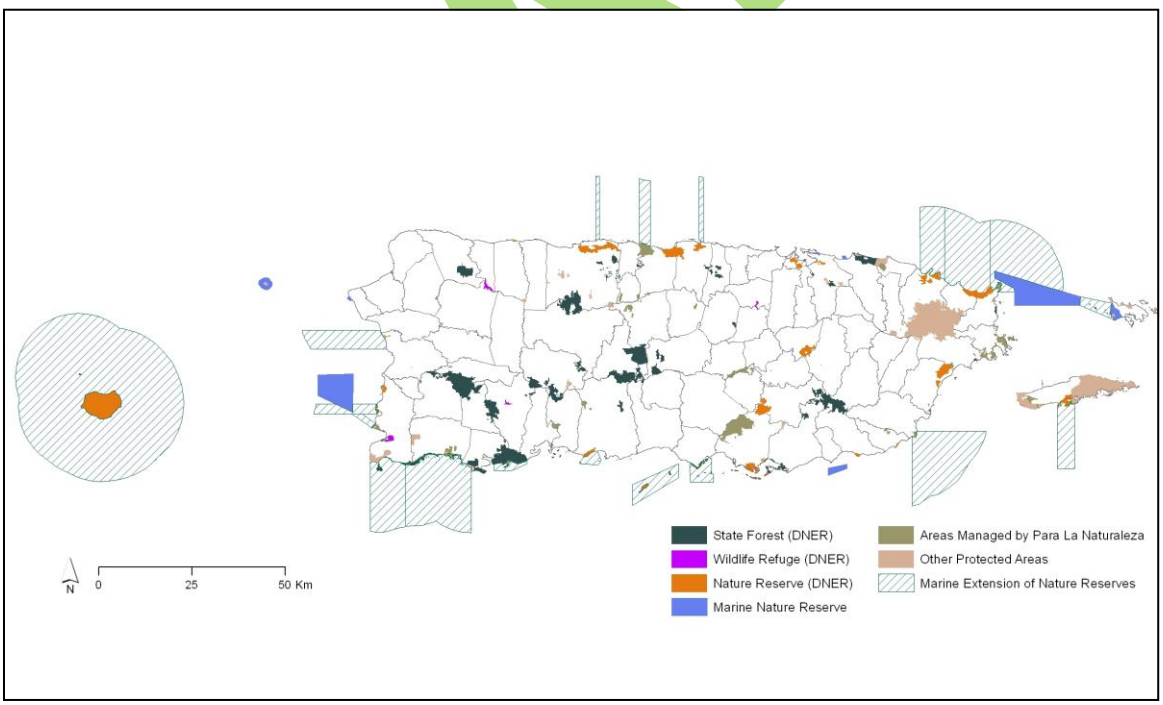


Figure 11. Location of land currently (2014) protected by Federal or Commonwealth designation, or proclamation or as private reserves of non-government organizations.

The Sportfish Gap Analysis Project

The Sportfish Gap Analysis Project aimed to develop a comprehensive set of databases on Puerto Rico's freshwater and marine recreational fisheries resources in order to assess the conservation status of species and habitats. The Sportfish Gap Project included four components: habitat description and mapping; protected areas and conservation priorities; species distributions and conservation status; and analyses of gaps in species conservation protection. The Project provided information on marine and terrestrial protected areas stewardship, species natural history accounts and bibliographic information, species occurrences and habitat characterization. The species included in the report are those identified by DNER staff as priority for recreational fisheries.

An extensive geospatial database was compiled for the habitat mapping component. This included all available habitat related information, as well as modified or developed new data in order to integrate geospatial information. This allowed the PR GAP to develop predicted habitat models for species. For PR GAP's marine component, in addition to the existing layers of information, new layers, such as slope and rugosity, were developed using bathymetry. Eleven (11) new layers were developed for the freshwater component of the project, integrating hydrographic and landscape features for species distribution modeling purposes.

For protected areas and conservation priorities, a comprehensive database documenting terrestrial and marine protected areas for Puerto Rico was developed. This geospatial layer was used for analyzing conservation "gaps".

A total of 29,571 records for 66 marine species were obtained during the species distribution and conservation status component. Ocurrence maps were completed for each species and, a complete report was created for ten species. For freshwater, brackish and marine species, a total of 582 occurrence records was obtained and eight occurrence maps were completed.

Development of a Strong Private Lands Program

During the past ten years, it has become increasingly evident that private landowners play a critical role in the conservation of fish and wildlife resources, particularly of listed species. The US Forest Service has several programs that provide technical and financial assistance to non-industrial private landowners and communities (Table 8). The Department of Natural and Environmental Resources' Natural Protected Areas Bureau is the primary state administrator for most USFS Cooperative programs, with one exception; the Puerto Rico Fire Service is designated as the primary agency responsible for implementation of the State Fire Assistance and Volunteer Fire Assistance Program.

Table 8. USDA Forest Service Cooperative Programs available in P.R.

Program	Purpose
Forest Stewardship	-Provides technical assistance, through State forestry agency partners, to nonindustrial private forest owners to encourage and enable active long-term forest management. A primary focus of the Program is the development of comprehensive, multi-resource management plans that provide landowners with the information they need to manage their forests for a variety of products and services. -Promotes the conservation of soil, water, flora and fauna through the protection and effective management of private forest land. -Promotes greater participation of owners in the programs. -Develops projects that are aimed at improving water quality through the protection and conservation of watersheds and forest areas.
Urban and Community Forestry	-Provides technical and financial assistance to communities, public and private entities and municipalities on the management of urban forest resources to promote a sustainable ecosystem. -The program has an Advisory Council composed of representatives of various sectors of society, whose primary function is to advise the director of the DNER in the process of implementing the program. -Provide technical and financial assistance to communities, public and private entities and municipalities on the management of urban forest resources to promote a sustainable ecosystem.

Forest Legacy	-Promotes the protection of forest areas through the purchase of private land forest value that are under threat to be converted to non-forest uses and have features that warrant preservation and enrich natural areas. This goal can be achieved through the purchase of land or purchase conservation easements Puerto Rico competes with other states for funding of this program which requires a 25% matching of the state.
Community Forest Open Space Conservation	-The purpose of the CFP is to competitively award grants to enable local governments, Indian Tribes, and nonprofit organizations to establish community forests by acquiring and protecting private forest lands that will provide continuing and accessible community benefits. Community benefits provided by community forests established through this program include, but are not limited to: economic benefits through sustainable forest management; environmental benefits such as clean water and wildlife habitat; benefits from forest-based educational program, including vocational education program in forestry and serving as models to guide stewardship on private forest lands; and recreational benefits, including hunting and fishing. Public access to the community forests is required and intended to enhance public health and well-being.
Forest Health Management	-Works in partnerships to prevent, suppress and slow-the-spread of native and nonnative forest insects, pathogens, and invasive plants affecting urban, rural, and wildland forests.
Forest Health Monitoring	-Monitors the forests of the United States to determine detrimental changes or improvements to forest health that occur over time.
State Fire Assistance	-Provides financial and technical support directly to the states, to enhance firefighting capacity, support community-based hazard mitigation, and expand outreach and education to homeowners and communities concerning fire prevention. The program requires a 50-50 match by the state. The delivery system is through the State Forester.
Vounteer Fire Assistance	Provides financial, technical and other assistance to rural communities with a population of less than 10,000, matched on a 50-50 basis either by the state or community. The State Foresters and their staff deliver this program. Some benefits include: • Available funding to renovate equipment obtained through the Federal Excess Personal Property Program • Improved fire protection capabilities and capacity in rural areas to protect lives and other rural investments • Improved effectiveness of fire protection in wildland urban interface areas

	• Complements state and federal firefighting forces to optimize fire protection across ownerships • Complements the Rural Fire Assistance Program provided by the Bureau of Land Management

The US Department of Agriculture (USDA) and the US Department of Interior (DOI) have technical and financial assistance programs that are complementary for the Cooperative Programs described above. The cost incentive programs are most commonly used to establish, restore and manage forested lands (Table 9).

Table 9. USDA, NRCS, and the USFWS incentive programs available to non-industrial private landowners in P.R.

Environmental Quality Incentive Program, EQUIP	-Provides a voluntary conservation program for farmers, ranchers and owners of private, non-industrial forest land that promotes agricultural production, forest management and environmental quality as compatible national goals. EQUIP offers financial and technical help to assist eligible producers install or implement conservation practices on eligible agricultural land.
Wildlife Habitat Incentive Program, WHIP	-It is a voluntary program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land.
Partners for Fish and Wildlife, PFW	-Partners with landowners, municipalities, schools, and other organizations to restore habitats on private lands. The program provides technical assistance and matching federal funds to more than 90 projects to restore stream banks, uplands, wetlands, and other habitats used by wildlife in Puerto Rico and the Virgin Islands. Projects are designed to benefit fish and wildlife while meeting the needs and desires of private landowners.
Conservation Reserve Program, CRP	The Conservation Reserve Program (CRP) is a voluntary program for agricultural landowners. Through CRP, you can receive annual rental payments and cost-share assistance to establish long-term, resource conserving covers on eligible farmland.
Conservation Stewardship Program, CSP	A voluntary conservation program that encourages producers to address resource concerns in a comprehensive manner by: • Undertaking additional conservation activities • Improving, maintaining, and managing existing

	conservation activities.
Healthy Forests Reserve Program, HFRP	Assists landowners, on a voluntary basis, in restoring, enhancing and protecting forestland resources on private lands through easements, 30-year contracts and 10-year cost-share agreements.

The DNER Auxiliary Forest Program (AFP) was created by the Puerto Rico Forest Law of 1975, as amended, to promote conservation of private forested lands by providing tax exempt status to eligible properties enrolled in the program. Eligibility requirements include minimum area (more than 4.855 acres), a DNER inspection, and a signed contract between the landowner and DNER. Property data (owner information, property tax number, eligible area, etc.) is submitted to the local municipal tax agency (CRIM) once the contract is signed. Enrollment in the program is voluntary and can be renewed yearly upon request by the landowners and confirmation of eligibility.

Private conservation and management are necessary to preserve the ecological benefits of forests. It has been documented that as much as 82% of forests in Puerto Rico are held in private ownership (DNER 2000). In 2007, 67 landowners and 7259 acres were active in the Auxiliary Forest Program. By 2015, these numbers increased considerably to 254 landowners representing a total of 13,430 acres. Of this acreage, nearly 49% is forested, 12% contains grasslands and shrublands, 22% is classified as agroforestry, and 0.07% is in riparian environments (Figure 13). The distribution of the private forests enrolled in DNER AFP and FSP by 2015 is presented in Figure 12. The data was created using CRIM property tax maps and information compiled from available DNER Auxiliary Forest files and reflect the location of properties that are actively participating in these programs.

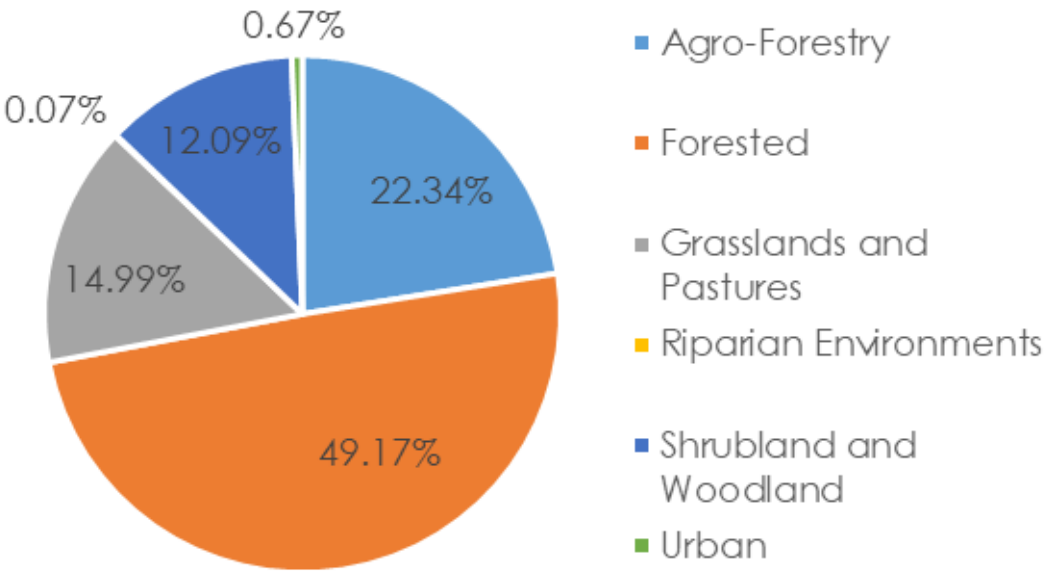


Figure 12. Land use classification on properties enrolled in the AFP by 2015.

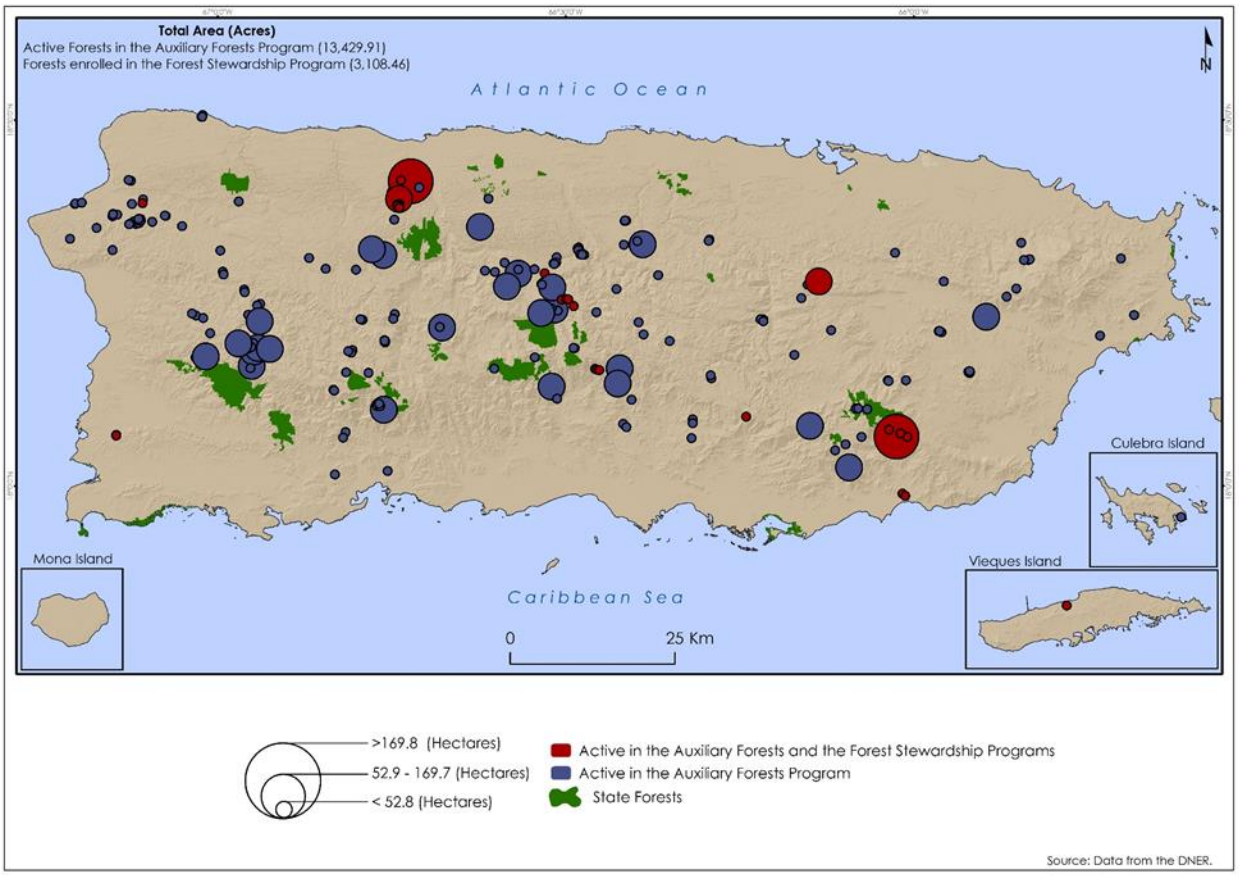


Figure 13. Location of private forests enrolled in DNER state auxiliary forest programs

The "Southern Forest Land Assessment" model was created by the Southern Group of State Foresters (SGSF) (National Association of State Foresters) and is based on the Spatial Analysis Project module of the Forest Stewardship Program. It combines a set of layers to generate a priority index for the Forest Stewardship Program (FSP). SGSF applied this module to Puerto Rico, to identify those areas that will be considered a priority for conservation for the Forest Stewardship Program. The DNER included the following layers:

- Forested land
- Forest Patches
- Riparian Areas
- Forested Wetlands
- Priority Watersheds

- Proximity to Public Lands
- Public Drinking Water
- Threatened and Endangered Species
- Slope
- Developmental Level
- Wildfire Risk
- Bosque Modelo
- Joint Priority Landscape of Humacao
- Joint Priority Landscape of Maricao
- Karst Area of Special Protection

After classification, the DNER established the relative importance of each layer by assigning it a weight. The model assesses the forest resource richness versus the forest resource threats and provides an index of priorities for the Forest Stewardship Program. The final map presents potential areas of concern, while offering a benchmark to assess program effectiveness in protecting such forest resources (Figure 14). The weights assigned to each layer were originally developed by the leaders of the Southern Region of the National Association of State Foresters.

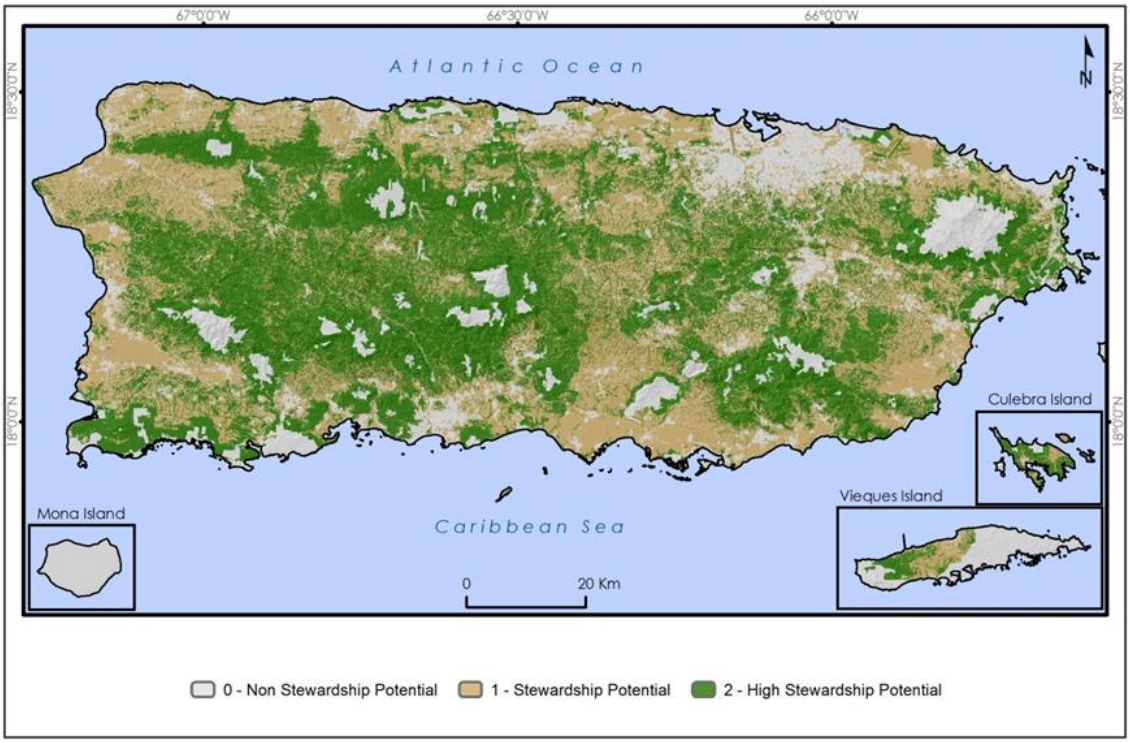


Figure 14. High priority landscape areas as indicated by the SFLA

All data information layers used had been previously published. The resulting maps reflect forest resource priorities according to the SFLA model, and provide a base for the spatial analysis and the identification of potential areas of concern, while at the same time providing a baseline to assess the program's effectiveness in protecting such resources. The results are organized by different Forest Stewardship Programs and DNER administrative region.

Table 10 presents the weight values used to determine conservation priorities.

Table 10. Geographic layers weighted according to importance in analysis

Layer	Weights
Forestland	11.1
Development Level	11.1
Riparian Areas	11.1
Wildfire Risk	2.5
Public Drinking Water	11.1
Priority Watersheds	11.1
Forest Patches	7.4
Forested Wetlands	0.8
T&E Species	7.4
Proximity to Public Lands	11
Slope	7.4
Bosque Modelo	2
Joint Priority Landscapes: Humacao	2
Joint Priority Landscapes: Maricao	2
Karst Area of Special Protection	2
Total	**100**

Strengthening of the Existing Natural Heritage Program

PR Law 150 of 1988 formally vested authority for habitat acquisition in the National Heritage Division. The National Heritage Division was authorized to administer the NHP, which was funded with an initial appropriation of $2,000,000 under the 1988 enabling legislation, and given the mandate for:

- Establishing criteria for state government acquisition of natural habitats within Puerto Rico.

- Developing a priority list of critical habitats for acquisition, according to these criteria.
- Acquisition, transfer and classification (e.g., Natural Reserve, Sanctuary, etc.) to state control of lands containing priority habitats.
- Developing and coordinating supplementary support, such as NGOs funding, for habitat acquisition and management.

The NHP workplan includes land acquisition projects and other technical studies as priority activities. The latter includes development of an ecological land-use management plan, development of a natural areas databank, assessing the feasibility of sourcing outside funding, identification of natural areas within state-owned properties and land-titling analyses. The NHP also establishes actual boundaries within formally designated state protected areas.

Identification of Waterfowl Focus Areas

Another conservation strategy is the identification of Puerto Rico's Waterfowl Focus Areas (PRWFA), as part of the Atlantic Coast Joint Venture (ACJV). ACJV is a partnership focused on the conservation of habitat for native birds in the Atlantic Flyway of the United States, from Maine to Puerto Rico and the Virgin Islands. The joint venture is a partnership of 17 states and 1 commonwealth: Maine, New Hampshire, Vermont, New York, Massachusetts, Rhode Island, Connecticut, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida and Puerto Rico. With the addition of Puerto Rico in 2001, the joint venture boundary evolved to match the entire U.S. Atlantic Flyway boundary.

The main purpose of the ACJV is 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. The joint venture was

originally formed as a regional partnership focused on the conservation of waterfowl and wetlands under the North American Waterfowl Management Plan of 1986. The ACJV has since broadened its focus to the conservation of habitats for all birds consistent with major national and continental bird conservation plans and the North American Bird Conservation Initiative (ACJV 2004).

Wetlands in Puerto Rico are threatened. As previously stated, the economy of the island has evolved from one based on agriculture to an economy sustained on urban development (i.e., construction) and industry. Nonetheless, human-made ponds initially constructed for irrigation purposes were abandoned and became a new habitat for waterbirds. These artificial ponds were deep enough to benefit waterfowl species such as Ruddy Ducks (*Oxyura jamaicensis*), and other diving species. Today, some of these ponds, mainly those in the south of the island, are critical habitat for the Ruddy duck, a vulnerable species in Puerto Rico, as well as for many other migratory species. Protection of these ponds is imperative in order to save this species from local extinction.

The Puerto Rico Waterfowl Focus Areas were selected based on the presence of wetlands and lagoons optimal for the occurrence of migratory waterfowl, and the intense use of these habitats by birds. This includes optimum habitat for bird species to feed and roost. Twenty primary areas were selected, including lagoons in Vieques and Culebra Islands. The areas were also selected according to their importance as habitat that supported migratory, rare, and endangered waterfowl such as Black Ducks (*Anas rubripes*), Blue-winged Teals (*Anas discors*), Masked Ducks (*Nomonyx dominicus*), West Indian Whistling Duck (*Dendrocygna arborea*), and White-cheeked Pintails (*Anas bahamensis*), among others. The study also included a list of other migratory, native, endemic, and exotic bird species reported in selected areas. Some key references were documents available at DNER, including literature about important lagoons on the island (Negrón-González 1986, Scott and Carbonell 1986, Ortiz-Rosas and Quevedo-Bonilla 1987), the status of the waterfowl (Chabert et al. 1984, Bonilla et al. 1992, NOAA et al. 2000), and the Critical Wildlife Areas documents

(Raffaele and Duffield 1979, Cardona and Rivera 1988, Ventosa-Febles et al. 2005a).

The PRWFA document identifies and describes what DNER classifies as main waterfowl areas in Puerto Rico (Figure 15 and Table 11, Ventosa-Febles et al. 2005b). DNER and other agencies that approve endorsements or permits need to be cautious that their actions do not jeopardize sites recognized as Waterfowl Focus Areas.

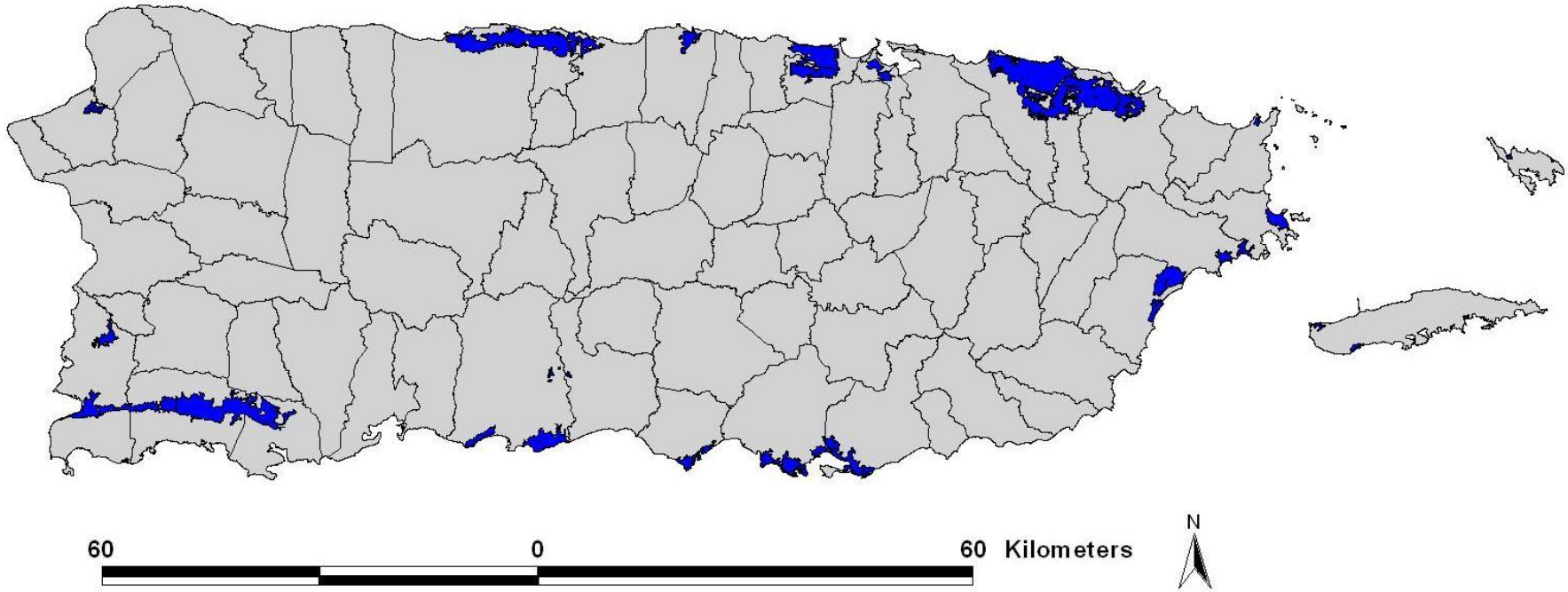


Figure 15. Puerto Rico Waterfowl Focus Areas (Ventosa-Febles et al. 2005b)

Table 11. Puerto Rico Waterfowl Focus Areas, Sub-Focus Areas and Municipalities

Focus Area	Sub-Focus Area	Municipality
Caño Tiburones	None	Arecibo and Barceloneta
Hacienda La Esperanza	None	Manatí
Cibuco Swamp	None	Vega Baja
El Mameyal	None	Dorado
Las Cucharillas Marsh	None	Cataño, Guaynabo and Bayamón
Torrecillas Lagoon	Piñones and Torrecilla Alta	Loíza
Aguas Prietas	None	Fajardo
Ceiba Mangrove Forest and Lagoons	None	Ceiba
Culebra Island Lagoons	Flamenco Lagoon, Zoni Lagoon and Cornelio Lagoon	Culebra Island
Vieques Island Lagoons	Kiani Lagoon Complex, Playa Grande Lagoon, Chiva Swamp and Yanuel Lagoon	Vieques Island
Humacao Natural Reserve	None	Naguabo and Humacao
Punta Arenas, Mar Negro, Bahía de Jobos and Punta Pozuelo	None	Salinas and Guayama
Punta Petrona	None	Santa Isabel
El Tuque/Punta Cucharas/ Salinas Lagoon	None	Ponce
La Esperanza/ Cabuyón Mangrove	None	Ponce
Serrallés Lagoons Complex	None	Ponce
Cartagena Lagoon	None	Lajas
Boquerón Wildlife Refuge	None	Cabo Rojo
Cuevas Lagoon	None	Cabo Rojo
Cayures	None	Añasco

Identification of Critical Wildlife Areas

Another conservation strategy is the identification and description of Puerto Rico's Critical Wildlife Areas (CWA). The CWA fulfills one of the most fundamental responsibilities of DNER: to provide comprehensive information on important wildlife and habitat resources in Puerto Rico and its offshore islands. This wildlife and habitat information is used by local governments, state and federal agencies, private landowners and consultants for land use planning purposes. This document seeks to protect critical wildlife habitat from degradation due to incompatible land uses. Wildlife species have different capabilities for coping, or adapting to human encroachment and urbanization, thus, careful planning is needed to ensure that important wildlife habitats are not destroyed and that wildlife/human conflicts are minimized or eliminated.

The first version of the CWA was in 1989. Currently, some of the original CWAs are degraded, and therefore lowered in rank or removed from the list. Others remain valuable to wildlife, and are singled out for management or conservation actions. Most Commonwealth forests, refuges, and reserves, as well as other areas, were included in the most recent (2005) CWA document (Table 10; Figure 16). Each Critical Wildlife Area was evaluated in relation to its faunal composition following the criteria used by Raffaele and Duffield (1979):

1) Is there 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?

Other categories for evaluating CWAs included the presence of species with limited distributions and/or game species. These categories are similar to those from Cardona and Rivera (1988):

1) Species considered endangered or threatened under the Federal Endangered Species Act of 1973, as amended.
2) Species considered endangered or threatened under the Regulation to Govern the Management of Threatened and Endangered Species in the Commonwealth of Puerto Rico (DRNA 2004).
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.

The latest version of the Puerto Rico CWA (2005) significantly improved its format (Table 12). For each area, the following information is provided: Area Description, Ownership/Protection, Special Recognition, Wildlife (Birds, Reptiles, Amphibians, Mammals, Fishes, and Invertebrates), Critical Plants, Threats, Conservation Recommendations, References, and Maps.

The municipality, boundaries, geographic location, and land cover (hectares) of each CWA were identified for each area description. Also, a description of the topography, life zone and plant associations are given for each area. The owner and/or administrator, and any actual or potential protection were identified in the Ownership/Protection section. In the Special Recognition segment, it was mentioned if the area was previously classified as a CWA or if it had any other recognition (e.g., Forest, Reserve, Important Bird Area, National Estuary, etc.). The area's present classification in terms of wildlife importance was included. The 1979 and 1988 documents were followed for classifying areas as of primary or secondary importance to wildlife.

Inventories available in literature, forest or land manager's wildlife checklist, and surveys conducted by project personnel, other DNER researchers or by the Puerto Rico Ornithological Society Inc. were documented. Agricultural or domesticated species were not considered wildlife. Scientific and common names were obtained from the Integrated Taxonomic Information System (ITIS 2005), from PR-GAP Terrestrial Vertebrates Species List (USFS 2004), and from NatureServe (2005). Wildlife considered in this document includes birds, reptiles, amphibians, mammals, fish, and invertebrates. Exotic species were also mentioned. Inventories of plants of special concern (rare, threatened or endangered) were included.

Past and current threats of each CWA, along with conservation recommendations, are included in the publication. A copy of the official document is available at the following address: http://drna.pr.gov/historico/oficinas/arn/recursosvivientes/costasreservasrefugios/pmzc/publicaciones/CWA_July2005.pdf.

The document identifies the main threats to the integrity of Critical Wildlife Areas, and recommend actions to protect and conserve wildlife habitat. The following methods were used: field observations, photo interpretation (IKONOS satellite images 2002), land manager interviews, and literature review. In the Reference section, a list of literature cited (published and unpublished) used for the documentation of each CWA is presented. Unpublished literature includes reports, memos, and checklist, among others.

To illustrate the importance of each area, two types of maps were prepared. The first map uses the USFWS National Wetland Inventories, the Puerto Rico Roads, and the Puerto Rico Forest and Reserve layers (Figure 17). The second map uses the corresponding IKONOS satellite imagery (using the same projection) of the CWA (Figure 18). Municipality boundaries, Priority Areas for Conservation, and other reference data are also shown.

Table 12. Puerto Rico Critical Wildlife Areas (2005) and their respective locality (Municipalities).

AREA	LOCALITY
1- Cucharilla's Marsh	Cataño
2- Buchanan Haystack Hills and Fort Buchanan Pond	Bayamón
3- Torrecillas Swamp System-Piñones-Vacía Talega	Carolina-Loíza-Canóvanas
4- Barrio Borinquen, Trujillo Alto Lake, Bairoa Lake La 25, and Gurabo River Mouth	Trujillo Alto-Caguas-Gurabo
5- Baja Swamp and Herrera River Mouth	Río Grande
6- Ensenada Comezón	Río Grande
7- Río Mar, North of Road # 968	Río Grande
8- Luquillo Mountains	Luquillo
9- San Miguel, La Paulina and El Convento Natural Area	Luquillo-Fajardo
10- Laguna Grande, Laguna Aguas Prietas and adjacent areas	Fajardo
11- Fajardo Coast Line	Fajardo
12- La Cordillera Natural Reserve	Fajardo
13- Flamenco Peninsula	Culebra
14- Flamenco Lagoon	Culebra
15- Cornelius Lagoon	Culebra
16- Resaca Mountain	Culebra
17- Resaca Beach	Culebra
18- Brava Beach	Culebra
19- Larga Beach and Zoní Lagoon	Culebra
20- Maillux Lagoon	Culebra
21- Puerto del Manglar	Culebra
22- Los Caños	Culebra
23- Cementerio Bay	Culebra
24- Culebra's Surrounding Islets	Culebra
25- Vieques west coast	Vieques
26- Ensenada Honda Mangrove	Vieques
27- Yanuel Lagoon	Vieques
28- Chiva Swamp	Vieques
29- Tapón Bay	Vieques

Table 12 (Continued). Puerto Rico Critical Wildlife Areas (2005) and their respective locality (Municipalities)

AREA	LOCALITY
30- Ferro Bay, Mosquito Bay, and Sombe Bay	Vieques
31- East tip of Vieques and Conejo Cay	Vieques
32- Roosevelt Roads Naval Base	Ceiba
33- Ceiba State Forest	Fajardo, Ceiba and Naguabo
34- Humacao Natural Reserve	Humacao
35- Pandura Mountain Range	Yabucoa-Maunabo
36- Palmas Pond	Arroyo
37- Carite State Forest	Cayey
38- Cerro El Gato and Associated Areas	Cayey
39- Cidra Lake	Cidra
40- Aguirre State Forest, Punta Pozuelo, Cayos Caribe and Mar Negro	Guayama-Salinas-Santa Isabel
41- Punta Arenas	Salinas
42- Salinas Training Area	Salinas
43- Punta Petrona Mangroves and Caracoles	Santa Isabel
44- Cabuyón Mangrove and Fríos Cays	Ponce
45- Caja de Muertos Complex	Ponce-Juana Díaz-Santa Isabel
46- Serrallés Lakes	Juana Díaz-Ponce
47- Toro Negro State Forest	Ciales-Jayuya-Orocovis
48- Las Salinas Lagoon, El Tuque	Ponce
49- Monte Guilarte State Forest	Adjuntas-Guayanilla-Peñuelas-Yauco
50- Punta Verraco, Cerro Toro and Punta Ventana	Guayanilla
51- Guayanilla Hills	Guayanilla
52- Guánica Lagoon	Guánica
53- Guánica State Forest	Guánica
54- San Jacinto Salt Flats and Tamarind Lagoon	Guánica
55- Susúa State Forest and Adjacent Lands	Yauco-Sabana Grande
56- La Parguera Natural Reserve	Lajas
57- Cartagena Lagoon	Lajas
58- Boquerón State Forest	Cabo Rojo

Table 12 (Continued). Puerto Rico Critical Wildlife Areas (2005) and their respective locality (Municipalities)

AREA	LOCALITY
59- Boquerón Wildlife Refuge	Cabo Rojo
60- Cabo Rojo Salt Flats and Adjacent Areas	Cabo Rojo
61- Punta Guaniquilla Natural Reserve	Cabo Rojo
62- Joyuda Lagoon Natural Reserve	Cabo Rojo
63- Cuevas Lagoon	Cabo Rojo
64- Sabanetas Swamp-Boquilla Channel	Mayagüez
65- Maricao State Forest	Maricao
66- Mona Island	Mona
67- Monito Island	Monito
68- Pozo Hondo Swamp	Añasco
69- Cayures Swamp	Aguada
70- Desecheo Island	Desecheo
71- Barrio Coto	Isabela
72- Guajataca Cliffs	Isabela-Quebradillas-Camuy
73- Guajataca State Forest	Isabela
74- Guajataca Reservoir	Quebradillas
75- Barrio Cocos and Bellaca Creek	Quebradillas
76- Carrizales Mangroves	Hatillo
77- Tiburones Swamp and La Tembladera Pond	Arecibo
78- Cambalache State Forest	Arecibo
79- Río Abajo State Forest	Arecibo and Utuado
80- Hacienda La Esperanza Natural Reserve	Manatí
81- Tortuguero Lagoon, Cabo Caribe Swamp and Rica Lake	Vega Baja
82- Cibuco Swamp	Vega Baja
83- Vega State Forest	Vega Alta
84- Lakes and Forests of Dorado	Dorado
85- Mogotes Río Lajas y Nevárez	Dorado-Toa Baja
86- El Mameyal	Dorado
87- San Pedro Swamp	Toa Baja

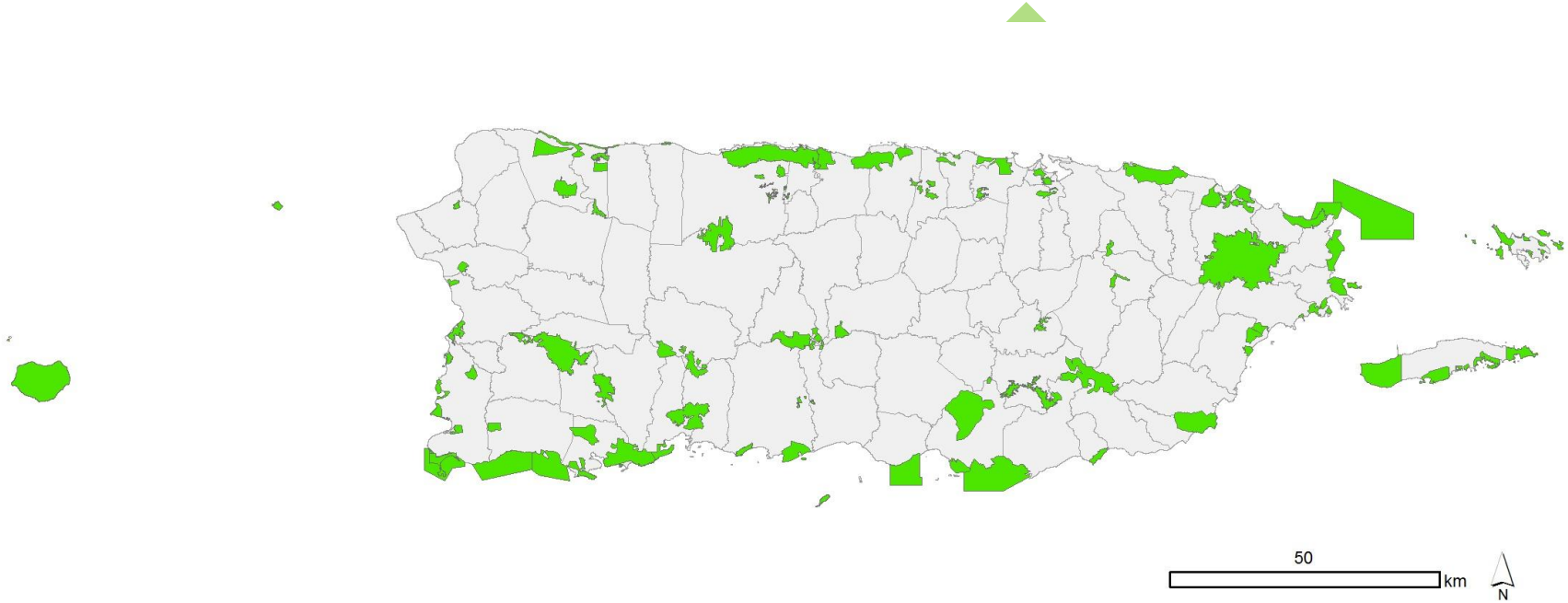


Figure 16. Puerto Rico Critical Wildlife Areas. From DNER 2015.

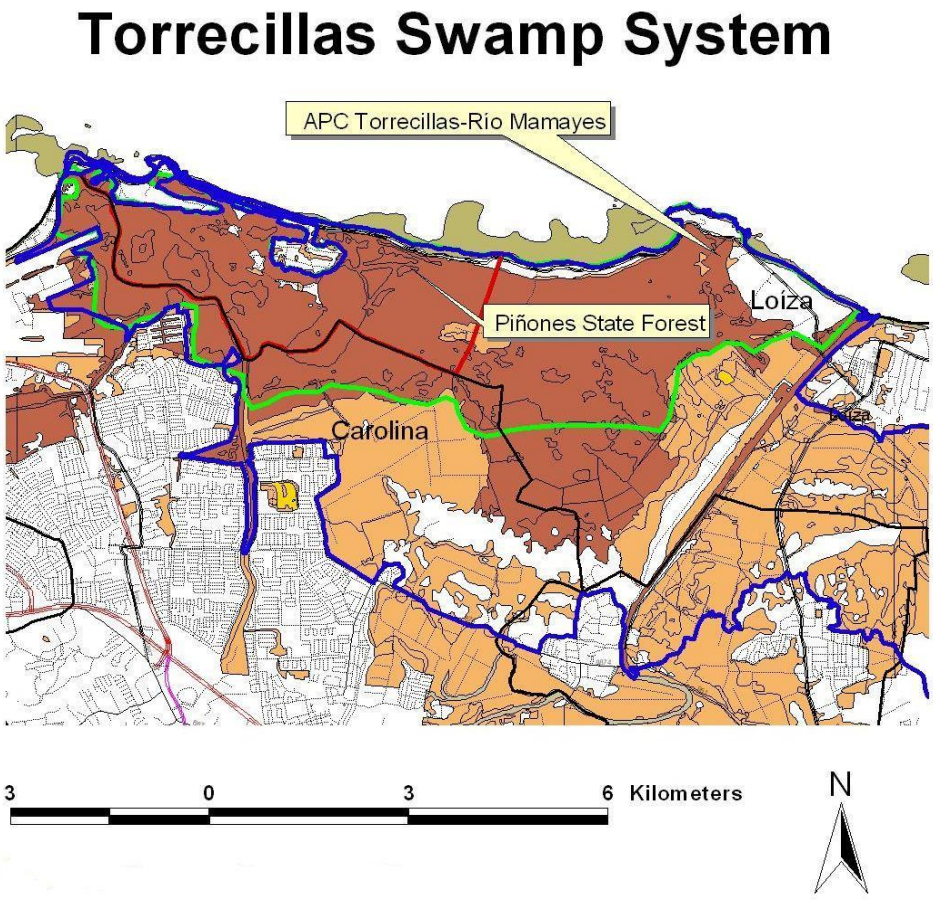


Figure 17. An example of a map included in the 2005 Critical Wildlife Areas document.

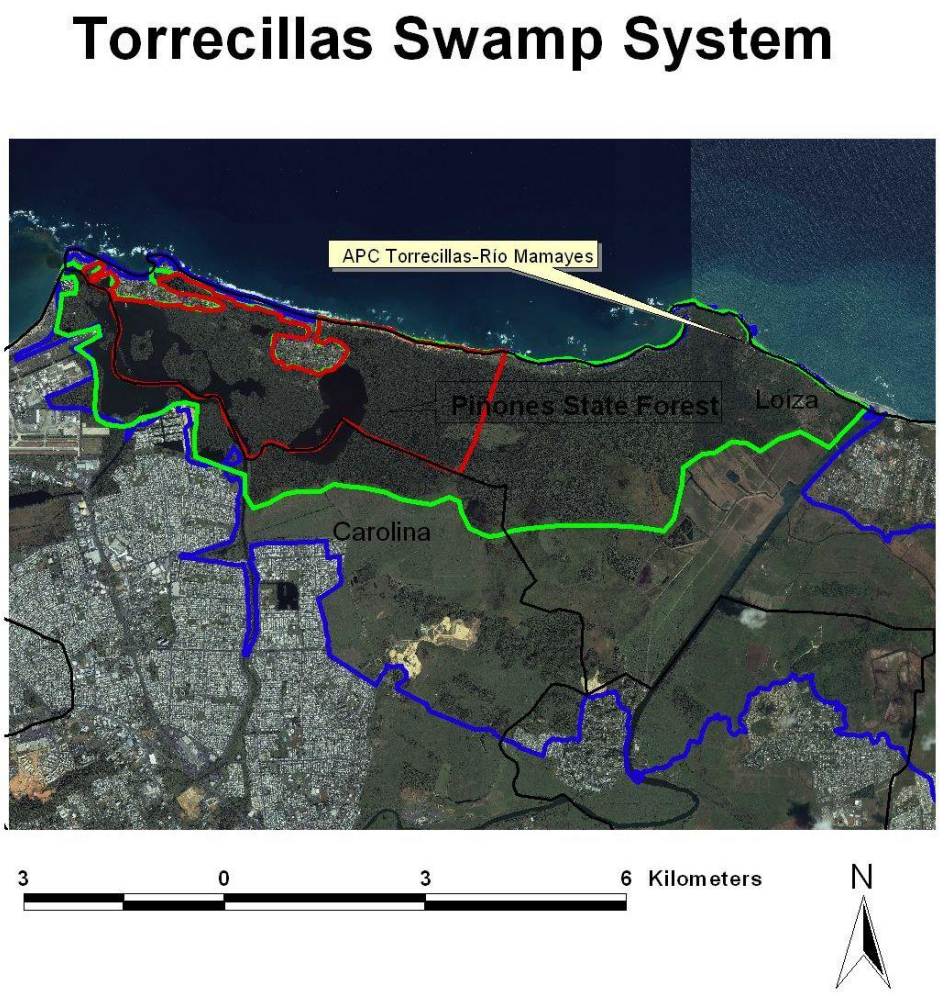


Figure 18. An example of a map included in the 2005 Critical Wildlife Areas document.

The latest version of the CWA was completed in 2005. This publication represents the third revision of the document originally published in 1979. It was a comprehensively updated version that has not required additional revision, since none of these areas have experienced significant changes on any of its biological or regulatory components.

Comprehensive Land Use Plan

Puerto Rico faces a considerable number of challenges for sustainable land use planning. As a small island in the Caribbean, land is a scarce and highly valuable resource. Measuring 8,870 square kilometers with a population density of almost

450 inhabitants per square kilometer (in 2010, the U.S. Census estimated the island's population at approximately 3.7 million), one of the highest population densities in the world and the fourth highest in America, Puerto Rico is running out space and out of time (Center for Sustainable Development Studies 2009).

According to the classifications of the U.S. Census in 2000, 50% of the island is urban and 50% is rural. The majority of this population (94%) lives in urban areas. This is a significant change from 1900-1930, when almost 80% of the island's population was rural (U.S. Census Bureau, 1900-1930, 2000). Industrialization in Puerto Rico followed the United States model of suburban growth in the 1940's and 50's, and this paved the way for an accelerated urbanization of Puerto Rican society. Urban sprawl became one of its more evident consequences and one of the greatest threats to sustainability on the island (Center for Sustainable Development Studies 2009).

The Puerto Rico Land Use Plan, a long-delayed master blueprint designed to guide all future development, zoning and land conservation efforts on the island for the foreseeable future, was finished in January 2014.

The vision as to what the plan should represent and accomplish has changed over time. At one point, the plan was intended to classify every piece of land in Puerto Rico as an area suitable for conservation or development into residential, commercial or industrial zones, and whether the jurisdiction of such-and-such area fell to the state government or municipalities. The latter issue has previously been a main point of contention, as previous drafts of the plan frequently contradicted municipal land use plans, also known as "planes de ordenamiento territorial", regarding the classification of certain lands. In many cases, decisions as to the intended use of certain areas were also based on outdated information regarding flooding and ecological sensitivity, among other issues.

The Land Use Planning Law (Law No. 550 of October 3, 2004) mandated the creation of this office, the development of the PRLUP, the creation of an Advisory Committee, and the creation of an Interagency Committee to develop the plan. In January 30th, 2014, the Puerto Rico Planning Board began the process and submitted the first draft of this Plan for public discussion, in a participatory process unprecedented on the island.

The goal of the 2014 PRLUP is to identify, evaluate and classify land uses for Puerto Rico in order to:

1. Give valuation to Puerto Rico, identifying the land according to their ecological, agricultural, equity landscapes, rural or urban.
2. Improve coordination of planning and development efforts by state agencies, public corporations and municipalities.
3. Encourage economic development and revitalization in municipalities, both urban and developable land as well as in rural settlements with the necessary infrastructure.
4. To preserve and promote at least 600,000 agricultural acres.
5. Prioritize planning the population increase for older adults and their needs, as well as the downward trend in the population.
6. Provide alternatives to accommodate housing needs and new developments, and engage without impacting agricultural soils, natural systems, watersheds, aquifers, heritage values and landscapes.
7. Encourage citizens to dwell in secure areas and that the necessary infrastructures are out of primary risk areas.
8. Establish guidelines and principles to be considered in local planning
9. To promote the equitable and sustainable development of Puerto Rico.
10. Take measures to adapt and mitigate climate change.

Land Classification and Categories for the PRLUP:

Categories:

1. Urban Land: Land consolidated by buildings and other structures, roads, water supply, electricity, and other infrastructure that serve it up. Most of the social, administrative, and economic activities take place in these lands.

2. Urban Fringe Land: Land suitable for urbanization and development according to the expected population growth in a period of time:
    a. Programmed: Land served by infrastructure. This land will be developed first.
    b. Not Programmed: Land not served by infrastructure.

3. Rustic Land (Rural): Land that should be protected from urbanization:
    a. Common: Land that may accommodate growth in the long run.
    b. Specially Protected: Land for conservation, agricultural use, etc.

Identifying areas of hydrological importance

The primary objective in this landscape is to maintain and/or restore sufficient forest cover to extend the lifespan of existing water supply reservoirs. The target zones are areas upstream of existing reservoirs (Figure 19) as well as Hydrological Reserves (Table 13). Management activity will focus on lands where reforestation or other forest management will improve sediment and erosion control. The analysis was conducted by DNER and the Office of the Land Use Plan of the Puerto Rico Planning Board. It considered precipitation intensity,

slope, soil types, aquifer recharge zones, and land use in the preparation of the base map. Alternative and much more expensive responses to loss of reservoir capacity include new construction, hydraulic engineering, and continuation of existing dredging operations (DNER 2008-a).

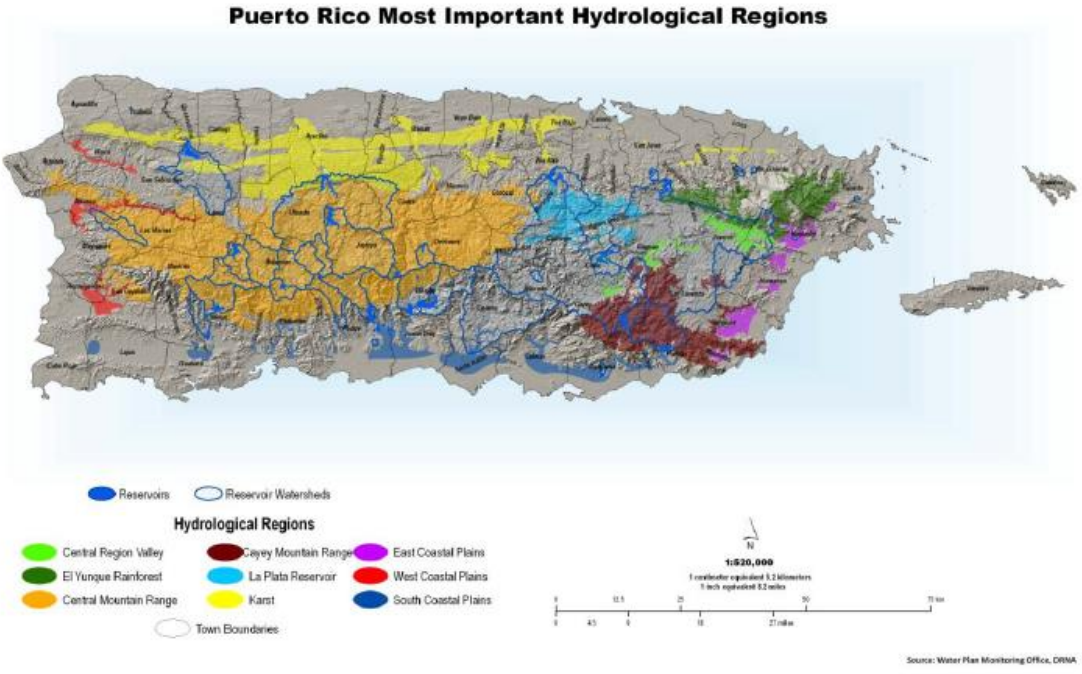


Figure 19. Hydrological regions in P.R. recommended for water quality protection by DNER and P.R. Planning Board (DNER 2008a)

Table 13. Hydrological Reserves in P.R.

I-Surface Hydrological Protection Areas	II-Groundwater Hydrological Protection Areas	III-Combined Hydrological Protection Areas (surface and groundwater
Cordillera Central Hydrological Reserve	Southern Coastal Plains Hydrological Reserve	Karst Hydrological Reserve
Sierra de Luquillo Hydrological Reserve	Eastern Coastal Plains Hydrological Reserve	Karst Hydrological Reserve
Sierra de Cayey Hydrological Reserve	Western Coastal Plains Hydrological Reserve	Karst Hydrological Reserve
La Plata Hydrological Reserve	Interior Plains Hydrological Reserve	Karst Hydrological Reserve

Conserving working forest landscapes

This goal encompasses the need to perpetuate the multiple values, uses and services provided by the Puerto Rico forest cover. These benefits may be protected or increased by implementing better conservation practices. The main objectives under this goal are:

- Identifying and conserving high priority forest ecosystems and landscapes in Puerto Rico currently under private control;
- Actively and sustainably managing private forested lands.

Table 14 shows the outputs, priority landscape, and the strategies in order to promote the forest landscape.

Table 14. Conserving Working Forest Landscapes (DNER 2010).

Outputs	Priority landscape	Strategies	Resources	Performance Measures
Recreation and Tourism	Public lands and surrounding private lands	-Continue land acquisition of key forested land by available mechanisms (USFS Forest Legacy Program) -Promote Conservation Easements on private forest land -Provide adequate conservation management to private forests through Forest Stewardship plans -Develop Forest and wildlife interpretation trainings	-USFS Forest Legacy Program -DNER PR Natural Heritage Program -DNER PR High Ecological Value Land Acquisition and Conservation Fund -USFS Forest Stewardship Program -NRCS Healthy Forest Reserve Program -USFWS State Wildlife Grant -PR Conservation Trust Land Acquisition Initiative	-High priority forest ecosystems and landscapes are protected from conversion (acres-annual and cumulative). -Number of acres in forest areas being managed sustainably as defined by current Forest Stewardship Management Plan -Number of interpretation trainings offered to private landowners and community members.
Wood products	Area around Toro Negro State Forest due to high risk of development.	--Continue land acquisition of key forested land by available mechanisms (USFS Forest Legacy Program) -Promote Conservation Easements on private forest land -Provide adequate conservation management to private forests through Forest Stewardship plans	-USFS Forest Legacy Program -DNER PR Natural Heritage Program -DNER PR High Ecological Value Land Acquisition and Conservation Fund -USFS Forest Stewardship Program -NRCS Healthy Forest Reserve Program -USFWS State Wildlife Grants Program -PR Conservation Trust Land Acquisition Initiative -PRIDCO PR Arts and	-High priority forest ecosystems and landscapes are protected from conversion (acres-annual and cumulative). -Number of acres in forest areas being managed sustainably as defined by current Forest Stewardship Management Plan (cumulative1) – through a Nationally consistent monitoring program.

			Crafts Development Program	
Agroforestry products, Wood, fruit, medicinal products, craft products, shade grown coffee	Rio Loco Watershed/Guanica Bay Watershed	-Develop management information on agroforestry practices suitable to the Río Loco Watershed at Guánica Bay Watershed -Develop nursery quality standards (Work with nursery growers to provide quality nursery stock)	-USFS Forest Stewardship Program -NRCS Healthy Forest Reserve Program -USFWS State Wildlife Grant	-Number of educational fact sheets, talks, and training sessions offered to landowners and community members. -Number of nursery growers participating. -Number of nurseries producing high quality nursery stock.
Control, forest health, wood products, mulch, wildlife, green infrastructure, Recreation, safety, energy conservation, air quality improvement	Urban Areas and wildland urban interface.	-Increase capacity of communities to manage trees (i.e. promote municipal tree boards) -Increase tree canopy cover and condition. -Acquire community open space to protect key forested areas -Hazard tree mitigation. -Increase use of native plant material (native tree propagation and use) -Develop educational programs, activities (i.e. demonstration forests projects) -Develop nursery quality standards -Introduce agroforestry concepts -Promote arboriculture in University curricula	-USFS U&CF Community Cost-share Grants -NGOs Education Programs -Tree City USA -PR Via Verde Program -DNER Reforestation Programs -USFS Community Forest and Open Space Conservation Program -International Society of Arboriculture -Municipalities -Universities -DNER -PR U&CF council -UPR Extension Service -PR Association of Professional Arborists -College of Architects and Landscape Architects. -PR Correctional and Rehabilitation Department	-Number of cities protecting urban forests after working with U&CF to develop management plans and ordinances. -Number of cities and communities managing their urban forest. -Number of Municipal Tree Boards. -Number of cities participating of the Tree City USA Program. -Number of ISA Certified Arborists (private and public sector). -Number of communities participating of the Open Space Community Forest Program. -Number of nursery growers improving nursery protocols. -Number of nurseries producing high quality nursery stock. -Number of demonstration projects using high quality plant material and native species. -Number of arboriculture courses offered at the University of Puerto Rico in Mayaguez, College of Agriculture

Protecting forests and wildlife

This goal pursues the recognition of real threats affecting forested lands and their wildlife, and to identify ways to control or substantially reduce any harmful effects. Main threats with strong capacity to affect present forest resources and wildlife in the island have been identified by the Puerto Rico Statewide Assessment of Forest Resources (DNER 2011) and are hereby presented in

Table 15, followed by the strategies recognized as of important value under the objectives of this goal.

Table 15. Threats and management strategies for P.R. forests and wildlife

Threats (risk map)	Resources affected/resource effects	Strategies	Resources	Performance Measures
Fire map showing fire occurrence information)	Biodiversity, wildlife habitat and populations, water quality, air quality esp. in urban environment, recreation experiences, coastal resources.	-Create a database to collect information on fire occurrences recording: (1) location, (2) type of vegetation, (3) number of acres affected, (4) resources used, and (5) resources needed -Develop and implement a Fire Danger Rating System for the areas with high wildland fires occurrences - Offer Fire prevention education to the communities within the areas with high wildland fire occurrences. Increase efforts on the forest-urban interface -Develop Community Wildfire Protection Plans and educational programs -Wildland Fire suppression -Use Prescribed Burning as a resource to control fire occurrences in areas with high fire incidence -Tree planting and resource restoration in areas affected by fires -Acquire, maintain, and preposition essential equipment and supplies for wildand fire suppression. -Develop an effective communication tool between partners involved in the suppression of wildand fires	-PR Fire Department Fire Prevention Program -DNER Forest Service Bureau -USFWS -USFS Cooperative Fire Program -USFS Volunteer Fire Program	-Number of acres treated to restore fire-adapted ecosystems that are (1) moved toward desired conditions and (2) maintained in desired conditions. -Total # of acres treated to reduce hazardous fuels on state and private lands through State Fire Assistance -Percentage of at risk communities reporting increased local suppression capacity as evidenced by: (1) The increasing number of trained and/or certified fire fighters and crews or (2) Upgraded or new fire suppression equipment obtained or (3) Formation of a new fire department or expansion of an existing department involved in wildland fire fighting.
Insect pests and disease	Loss and displacement of wildlife, decreased reproduction, stained wood, poor tree form, aesthetics, hazard trees, increased fire risk, fragmentation	-Establish a forest health monitoring program at the DNER Forest Service Bureau -Encourage early detection and rapid response from forest managers -Provide professional training to forest managers -Promote public education about possible detrimental effects on forest floristic components -Maintain adequate urban tree inventories and management practices -Promote Integrated Pest Management	-USFS Forest Health Monitoring Program -UPR Extension Service Forest Health Clinic and Diagnostics Lab -DNER Forest Health Program -UPRP -USFS	-Number and percentage of forest acres restored and/or protected from (1) invasive and (2) native insects, diseases and plants. -Percent of population living in communities developing or managing programs to plant, protect and maintain their urban and community trees and forests.
Development, Urban Sprawl, Fragmentation	Decreased and fragmented forest cover decreases	-Protect large contiguous forest areas and corridors to ensure connectivity by:	-USFS Forest Legacy program -USFS Forest	-Number of communities and percent of population served under an active

(consultation map, urban sprawl map).	the quantity and quality of all forest dependant values	Land acquisition -Conservation easements -Adequate land use zoning -Voluntary protection -Encourage planting trees to increase canopy cover and create green corridors -Promote proper land use planning and accurate zoning on forested areas -Promote professional training about assessing forest cover and its benefits on agencies involved in determining present and future land use -Increase program availabilities for the Eastern side of the Island by: (1) Increasing outreach, (2) Increasing Water Conservation (3) Enhancing Forest Diversity, (4) Enhancing all restored riparian habitats.	Stewardship Program Professionals who evaluate zoning, planning and permits -Municipalities -USFS Community Forest and Open Space Conservation Program -USFS U&CF Program -PR U&CF Council -International Society of Arboriculture -PR Association of Professional Arborists	urban forest management plan. -Percent of population living in communities developing or managing programs to plant, protect and maintain their urban and community trees and forests. -Number of acquisitions completed that are instrumental for corridor protection. -Number of communities participating of the Community Forest Open Space Program.
Hurricanes/storms (Island-wide)	Biodiversity, wildlife, urban forest, forest products, recreation experiences, coastal resources	-Urban forest inventory -Tree Management Plan development -Hazard tree mitigation -Tree selection	-USFS U&CF Program -PR U&CF Council -International Society of Arboriculture -PR Association of Professional Arborists -Tree City USA -ITree (adapted to tropics) -FEMA Programs -PR Conservation Trust	-Number of communities and percent of population served under an active urban forest management plan. -Percent of population living in communities developing or managing programs to plant, protect and maintain their urban and community trees and forests.
Climate change (sea level rise map)	Coastal forests and wildlife, salinization of fresh water swamps, increase in fires, more intense storms, salt water intrusion, biodiversity, forest products, decreased recreational experiences	-Corridors for tree migration -Increase carbon storage through increases in tree cover -Urban forest inventory -Tree Management plan development -Hazard tree mitigation -Tree selection	-USFS U&CF Program -USFS Forest Stewardship Program -USFS Forest Legacy Program -USFS Community Forest and Open Space Conservation Program -International Society of Arboriculture -PR Association of Professional Arborists -Tree City USA -ITree (adapted to tropics) -PR Conservation Trust –UPR Marine Science	-Population of communities benefiting from S&PF activities designed to contribute to an improvement in air quality. -Population of communities benefiting from S&PF activities that result in energy conservation.

			Department	
Flooding	Water quality, tree health, human safety, stream and bank erosion, erosion and sedimentation	-Forested wetland protection -Riparian buffer installations -Maintain and increase forest cover in catchment and groundwater recharge areas -Urban tree inventory and hazard mitigation	- USFS U&CF Program -USFS Forest Stewardship Program -International Society of Arboriculture -PR Association of Professional Arborists -PR Conservation Trust	-Percent of population living in communities developing or managing programs to plant, protect and maintain their urban and community trees and forests to mitigate the effects of flooding events.
Drought (See fire, see climate change)				
Invasive plants	Biodiversity, wildlife, displacement of native species	-Professional and public education -Promote native and other suitable species -Early eradication -Law enforcement -Early detection.	-Nursery growers and buyers, -DNER -Puerto Rico Forest Health Advisory Committee -USFS Forest Health Program -San Juan Bay Estuary Program -Puerto Rico Conservation Trust -PR Department of Agriculture	-Number and percent of forest acres restored and/or protected from (1) invasive and (2) native insects, diseases and plants (annual).
Invasive animals	WL habitat, egg predation, rare pant seedling recruitment	-Law enforcement -Public education	-DNER -San Juan Bay Estuary Program -Puerto Rico Conservation Trust -Lion Fish Control Program	-Number and percent of forest acres restored and/or protected from (1) invasive and (2) native insects, diseases and plants (annual

Enhancing benefits to the public associated with forests and wildlife

There are several objectives under this goal, which focuses on maximizing the profitable social, environmental and economic services trees and forests provide to the community. Objectives include:

- protecting and enhancing water quality and quantity;
- improving air quality and conserving energy;
- assisting communities in planning for and reducing forest health risks;
- maintaining and enhancing the economic value and benefits of trees;
- protecting, conserving and enhancing wildlife and fish habitats;

- connecting people to trees and forests, and engaging in environmental stewardship activities
- managing trees and forests to mitigate and adapt to global climate change.

Strategies of great value for these goals are summarized in Table 16.

Table 16. Enhance public benefits associated with forests and wildlife (DNER 2010).

Benefits	Priority area	Strategy	Resources	Performance measures
Water Quality Benefits	-Riparian areas around rivers and reservoirs. -Aquifer Recharge areas -Upland Catchments	-Continue encouraging reforestation -Maintain and manage existing forest	-DNER reforestation program -USFS Forest Stewardship Program -NRCS Healthy Forest Reserve Program -USFWS State Wildlife Grant -NRCS Wildlife Habitat Incentive Program	-Acres and percent of priority watershed areas where S&PF activities are enhancing or protecting water quality and quantity.
Coastal Resources	-Through all PR Coastal Zone (1 km from the sea) -Existing forested wetlands (i.e.mangrove and or swamps, etc.), -Coastal upland remnants	-Continue encouraging reforestation -Maintain and manage existing forest	-COE Wetland Banking -USFS Forest Stewardship Program -NRCS Healthy Forest Reserve Program -USFWS State Wildlife Grant -NRCS Healthy Forest Reserve Program	-High priority forest ecosystems and landscapes are protected from conversion (acres-annual and cumulative). -Number of acres in forested areas being managed sustainably as defined by current Forest Stewardship Management Plan
Wildlife habitat	-Coastal upland forest remnants -Mature forest habitats -Corridors that link mature forest areas (i.e. riparian areas along streams, -Corridors required under CommonwealthLaw Number 14 of 1999 -Threatened and Endangered Species habitat.	-Private forested land acquisition by several means including Forest Legacy Program -Encourage Conservation Easements -Promote voluntary private land conservation management. -Provision of proper management on public forested lands -Continue land acquisition programs to conserve mature forest -Promote and Encourage agroforestry practices(Sun coffee plantations to shade grown coffee)	-Forest Legacy Program -DNER PR Natural Heritage Program -DNER PR High Ecological Value Land Acquisition and Conservation Fund -USFS Stewardship Program -NRCS WHIP, EQUIP -US F&WS Partners for WL -Federal and State agencies management -NRCS Healthy Forest Reserve Program -NRCS Wildlife Habitat Incentive Program	-High priority forest ecosystems and landscapes are protected from conversion (acres-annual and cumulative). -Number of acres in forest areas being managed sustainably as defined by current Forest Stewardship Management Plan -Detectable increases in frequency numbers of priority critical species for WHIP. -Establishment of wild reproductive couples of Puertorrican Parrot in Maricao Commonwealth Forest. -Increase of

		-Establish Maricao Commonwealth Forest and a 5 mile buffer (including Susúa Commonwealth Forest)		riparian forests under conservation practices. -Reduction of predator numbers on Maricao Commonwealth Forests and its 5 mile buffer zone. -Increase the number of ecological corridors created between public and private forested land.
Plant biodiversity	Public forested lands	-Private forested land acquisition by several means including Forest Legacy Program -Promote voluntary private land conservation management.	-USFS Forest Legacy Program -USFS Community Forest and Open Space Conservation Program -Conservation Easement Commonwealth Law -DNER Puerto Rico Natural Heritage Program -DNER High Ecological Value Land Acquisition and Conservation Fund - NRCS Wildlife Habitat Incentive Program -NRCS Healthy Forest Reserve Program -USFS Forest Stewardship Program -USFWS State Wildlife Grant -NRCS Wildlife Habitat Incentive Program	-High priority forest ecosystems and landscapes protected from conversion (acres- annual and cumulative). -Number of acres in forest areas being managed sustainably as defined by current Forest Stewardship Management Plan
Carbon Sequestration	Private forested land	-Retain forest cover -Manage for forest health and growth -Forest products benefits to incentivize protecting and enhancing cover	-USFS Stewardship Program -USFS Forest Legacy Program -USFS Community Forest and Open Space Conservation Program -Conservation Easement Commonwealth Law -Forest Legacy Program -NRCS Healthy Forest Reserve Program	-Population of communities benefiting from S&PF activities designed to contribute to an improvement in air quality. -Population of communities benefiting from S&PF activities that result in energy conservation

Marine Mammals Rescue Program

The DNER established the Marine Mammal Rescue Program in 2007. The program leads and coordinates the actions from the different governmental and non-governmental entities during emergency situations involving marine

mammals, including stranding events and necropsies. The program is also in charge of establishing agreements with stakeholders interested in marine mammal conservation, maintaining a mortality database, implementing management actions to protect the marine mammals and their habitat. These include the deployment of buoys to regulate vessel speeds, the design and implementation of an outreach program, addressing emerging threats, overseeing compliance agreements between participating entities, evaluating and analyzing causes of death and maintain a sighting and population survey database. An important partner for the program is the Center for Manatee Conservation, which is currently leading the majority of manatee recovery actions with public and private funding.

Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions, are described in the following table:

Table 17. Conservation actions and Priorities

Taxon	What research studies or management actions are needed for conservation?	Which actions are ongoing for its conservation?	Which actions are needed or recommended for conservation, but not ongoing?	Why are all the actions needed or recommended for conservation, not ongoing?
Marine Mammals	Island-wide Marine Mammal Survey, with acoustics and genetics	None	Stock assessment	Lack of funds
Terrestrial Mammals				
Birds	Habitat connectivity. Identify high quality and resilient habitat that meets the needs of priority breeding and migratory birds. Guide planning and management actions to maintain or increase populations.	Private lands programs. GAP, CWA, NHP. Partnerships among Federal and local government agencies, NGOs and private citizens	Land Aquisition	Economic crisis
Reptiles				Personnel and

				budget limitations.
Amphibians				
Freshwater fishes	1) Dams removal 2) Addition of fish passageways.	1) Status survey continuation and pre-structure removal work. 2) Improvements to fishing regulations for inland waters, including daily catch quotas and size limits.	Expand and improve educational and informational efforts directed at stakeholder groups.	Personnel and budget limitations.
Saltwater fishes	Stock assessment. Impact of stream mouth blockage. Effect of existing fisheries regulations. Continued monitoring of the status of the populations. Population estimates are needed. Numbers of spawning individuals at known aggregation sites should be determined on yearly basis. Life history studies are needed. Stock assessment and monitoring is needed at the few reef flats that they still utilize in PR, Vieques and Culebra.	Some river fish sampling. Some recreational catch/effort surveys. Additional protection under fishing regulations is pending. Protected status in current Fishing Regulation. Additional studies are planned. Recreational catch and effort survey is on-going. Commercial harvest monitoring is on-going. Hydroacoustic studies are on-going to detect grouper SPAGs. Dr. Ron Hill is attempting to locate individuals and spawning aggregations of goliath grouper in USVI and PR.	Access to commercial fisheries data is lacking and needed. Improved fisheries enforcement. Expansion of current network of Marine Reserves to include more goliath grouper habitat. Enhanced fisheries enforcement efforts are needed. Further public education about the species. Biotelemetry studies are needed to determine movements and migrations, habitat use.	Lack of personnel/budget
Marine Invertebrates		More information on coral species' populations, recruiting	1- DNER and NOAA supports a long-term coral reef monitoring program since 1999. 2- Coral Farming in 15 sites around Puerto Rico.	
Terrestrial Invertebrates				
Plants				

Additional Conservation Initiatives

- Restoration and conservation of cay ecosystems – consists of eradicating invasive species and re-establishing connectivity between coastal forests.

- Restoration and conservation of mangrove forests – Restoring the connection between wetland habitat mosaics comprised of mangrove forests, coastal lagoons, salt ponds and mud flats. These actions promote a high diversity of migratory and resident sea birds, shorebirds, wading birds and songbirds.
- Restoration and conservation of coastal forests – the ecological restoration of coastal vegetation and sand dunes through the installation of sand accumulation barriers in areas where dunes used to exist, and the removal of invasive species, and re-vegetation of native coastal habitat.
- Restoration and conservation of aquatic resources – The following actions will be implemented: enhancement of aquatic habitats, rehabilitation of stream banks, establishment of native fish populations, controlling and eradicating invasive species, reestablishing connectivity between freshwater and marine habitats by removing physical barriers (i.e., dams, road crossing structures) or through the establishment of fish passages.

CHAPTER 6. HABITATS OF GREATEST CONSERVATION NEED

Terrestrial Habitats

Islandwide

Habitat loss and invasive species are a major threat to wildlife in terrestrial and aquatic ecosystems. The most important habitats for conservation have been identified by the Nature Conservancy's Ecoregional Plan for Puerto Rico, several US Fish and Wildlife Programs (e.g. Partners in Flight, Coastal Restoration) and DNER, through the Natural Heritage Program and the Critical Wildlife Areas Initiative. The DNER completed an island-wide comprehensive habitat analysis for this Wildlife Action Plan. This task was the final result of the Puerto Rico GAP Analysis Program (PRGAP). This project developed landcover and landuse maps representing Puerto Rico's landscape, and modeling animal species

distribution. The PRGAP incorporates remote sensing and GIS technology, satellite imagery, aerial photography, and geoclimatic and topographic data in order to map the land cover units for the Island. Each land cover unit description includes information and references on the composition, structure, and ecology of the dominant plant communities of that unit. Recently, Nitch et.al., (2015) used the PRGAP information for their comprehensive description of 11 habitats types important for the conservation of native and migratory birds in Puerto Rico and the U.S. Virgin Islands. Some of their information, pertinent to Puerto Rico, is included in the habitat descriptions on this plan. Table 6 presents the hierarchical vegetation classification for the PRGAP.

Caves

Puerto Rico has approximately 2,000 caves, which harbor a vast array of species that are totally dependent or are associated to the biotic and abiotic conditions found in the habitat they provide. The formation of caves and caverns in Puerto Rico occurs mainly due to the weathering of the limestone rock by underground water or water that filters through rocky ceilings. It is likely that a low percent of these 2,000 caves contain hot chambers, which are critical for the survival for 6 of the 13 bat species present in Puerto Rico.

DNER has been collecting information in collaboration with entities such as the Speleological Society of Puerto Rico (SEPRI), and the Inter-American University Biology Department, documenting caves and identifying those of greatest priority for conservation. Up to date geospatial data regarding location and distribution of caves throughout the island has been collected, and hot caves of greatest importance for the conservation of bats have been identified. The designation of caves as critical natural habitat (HNC) has been proposed by DNER. Figure 20 illustrates the cave distribution information obtained through these efforts.

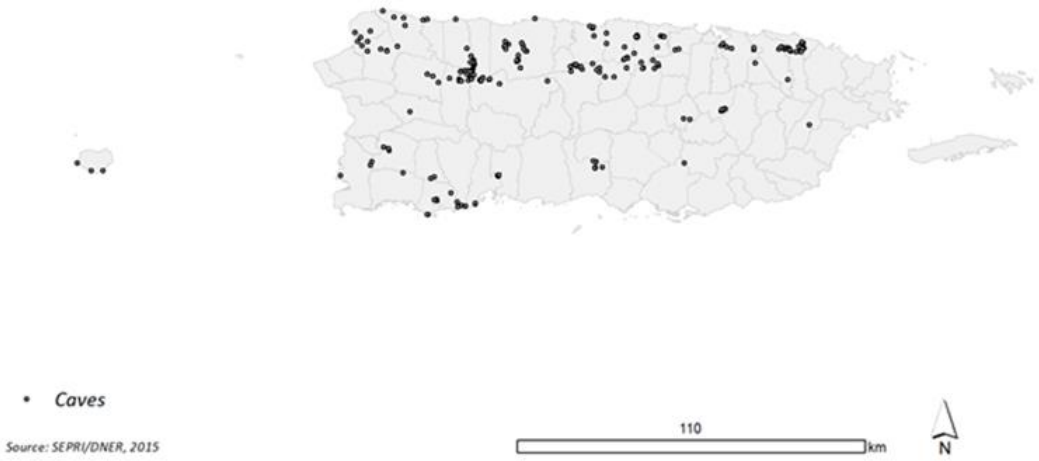


Figure 20. Caves in Puerto Rico. From SEPRI/DRNA, 2015.

Urban Forest

Urban forests are forested ecosystems characterized by a high concentration of human influences (Dwyer et. al. 2000). They capture significant levels of carbon and represent important economic benefits including tourism, nursery production, food production, pharmaceuticals for research as well as some wood and non-wood products (National Urban and Community Forestry Advisory Council 2008).

The types of trees and plant associations in urban forests vary with regional and local environmental conditions and human activities. Native, exotic and naturalized plants and animals, ground cover, buildings, and human activities affect the character and values associated with an urban forest. Vegetation within

urban environments is important in providing wildlife habitat, environmental services related to water, heat control, air quality, temperature regulation, and carbon storage. They provide oxygen, shade, food, and attributes important to human well-being. Recent studies reveal the psychological benefits of trees helping people adjust to their societies. (Kuo and Sullivan 2001). In addition, properties and neighborhoods with well developed tree cover are appraised higher. Nitch et. al., (2015) estimated that urban forest covers 27,500 ha (about 3%) of Puerto Rico. Forty-four avian species were included in their prioritization analysis of urban forest use.

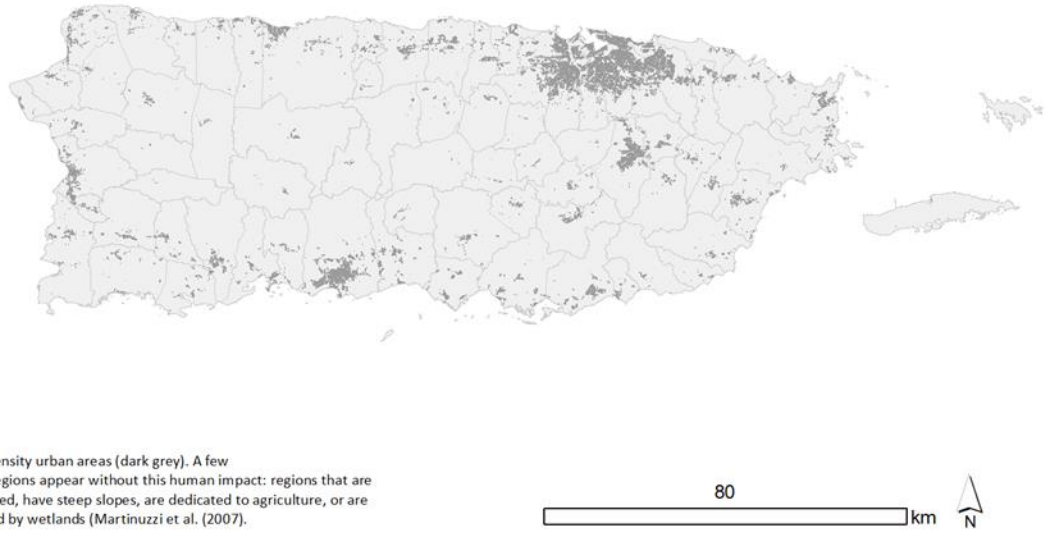
Martinuzzi et al. (2007) estimated developed land, land use, and urban sprawl across the Puerto Rico landscape and explained important distinctions among urban land classification schemes (Table 18). Depending on the classification, between 11 and 50% of Puerto Rico could be considered “urban”. They found that most urban areas exist on the coastal plains, lower hills and valleys, and that urban sprawl is occurring at low elevations, over flat topography and close to roads and existing urbanized areas (see Figure 21).

Table 18. Definitions of urban and related classifications and the percentage of land in each class in P.R. (Martinuzzi et al. 2007).

Classification	% in class	Definition
Urban/built-up cover or developed land	11%	Developed and non-vegetated surface that results from human activity (built structures, concrete, asphalt, buildings, barrens, roads, some of which occur in rural areas.)
Urban use setting	16%	Includes development and undeveloped lands that are part of the urban landscape and excludes development that is part of a non-urban setting. (urban centers, exurban agglomerations, industrial areas, large isolated residential complexes, port, airports, parklands and urban forests)
Census Bureau Urban Area	50%	Census block with a population density of at least 1000 people/ mi^2 (390 people/ km^2) plus surrounding census

		blocks with at least 500 people/mi^2 (195 people/km2)
Urban sprawl	40%	Low density construction and areas with significant land consumption

Source: US Census Bureau (2000). Urban and rural classification. http://www.census.gov/geo/ohim/hs01/mv1.htm.



High density urban areas (dark grey). A few open regions appear without this human impact: regions that are protected, have steep slopes, are dedicated to agriculture, or are affected by wetlands (Martinuzzi et al. (2007).

Figure 21. High density urban areas (dark grey). From Martinuzzi et al. 2007.

The 2010 Puerto Rico Statewide Assessment and Strategies for Forest Resources provides an array of strategies designed to address the priority issues identified to manage this resource in the near future. Some of the issues were fragmentation, water resources and strategies for conservation of watersheds, need for information about benefits or ecological contributions of public and

private forests, disturbances as hurricanes, fires, floods and pest species, invasive, and economic opportunities.

After the initial submission of the PRSWAP in September 2015, the National Priorities Section Puerto Rico Forest Action Plan was submitted. This document reports specific projects aimed at the conservation of forests, including urban forests. The map of high urban density areas (Figure 21), contains urban forests.

Freshwater Habitats

General

There are numerous rivers and streams on Puerto Rico's main island. There are reservoirs but no freshwater inland lakes. Seventy-eight percent of water in Puerto Rico comes from surface sources and 22% comes from groundwater sources. Fifty-five rivers discharge directly into the sea. Problems with freshwater ecosystems are a major environmental issue in Puerto Rico. Water pollution, siltation of reservoirs, and excessive withdrawals of fresh water from rivers are associated with the growing human populations of the Island. Unauthorized wetland filling is also a substantial and continuing problem (U.S. Department of the Interior 1994). Detailed descriptions of the freshwater communities in Puerto Rico are available (U.S. Army Corps of Engineers 1978).

According to the Gap Analysis Project, Puerto Rico has 34,000 ha (4%) of coastal wetlands, of which 42% are saline wetlands and 58% are freshwater wetlands. Among the freshwater wetlands, 74% (25,100 ha) are dominated by herbaceous vegetation and 92% (23,000 ha) are seasonally flooded. Of the herbaceous wetlands, 77% (19,300 ha) are not saline and 23% (58,000 ha) are salty. Forested coastal wetlands cover approximately 1% of the Commonwealth's territory, of which 6,700 ha are mangroves and 300 ha are bloodwood swamps also known as *Pterocarpus* forests (Gould, et al. 2008).

Rivers and Streams

Puerto Rico has about 1,200 rivers, streams, and creeks. None of the rivers are navigable by large vessels (Wiley and Vilella 1998). Only twenty of these rivers have a permanent minimum water flow of at least 0.28 cubic meters per second and are relatively important to the island's fishery. Major river systems are the Río Grande de Loíza (64 km), Bayamón (41 km), La Plata (73 km), Arecibo (64 km), Culebrinas (40 km), and Añasco (65 km). The profile of the streams changes radically from rapidly flowing in the steep mountains to slower and winding courses across the narrow coastal plain, creating habitats for fish and other aquatic wildlife. Many fishes migrate up or downstream to or from saltwater habitats (Wiley and Vilella 1998). Some rivers are dammed principally for water uptakes and thus have small impoudments along their courses. Most of the main rivers are either channeled or in process of channelization, mostly for flood control. These constructions obstruct the natural movement of native fishes which required this connectivity to complete their life cycle (i.e. diadromous) along the rivers, and together with pollution, are the major threats to these aquatic systems.

Riparian forest

Riparian areas are the lands adjacent to a body of water, stream, river, marsh, or shoreline. These areas form the transition between the aquatic and the terrestrial environment. A riparian area may include several riparian ecosystems. Riparian ecosystems include the soil, surface structure (woody debris, rocks, depressions), and the plant and animal communities. Because of their position in the landscape, riparian areas interact with the flow of surface and groundwater from upland areas, and play an important role in filtering runoff, reducing excess nutrients and other pollutants, and providing critical ecological values such as shade, food, and structural habitat. Species abundance and richness tends to be greater in riparian ecosystems than in adjacent uplands (Odum 1979). Although

healthy riparian vegetation of any kind is desirable, forests provide the greatest number of benefits and highest potential for reaching both water quality and living resource goals. As functional ecosystems, they have large energy, nutrient, and biotic interchanges with aquatic systems on one side and with upland terrestrial ecosystems on the other. Their linear nature and high edge-to-area ratios contribute to this functionality, which is why riparian areas are best evaluated and managed as parts of larger landscapes.

Streamside forests are important riparian areas, in fact local laws protect against development, on a 5 m strip to each side of rivers. Under natural conditions, these forests would protect most of the rivers and streams in the island, but deforestation associated with agricultural and urban expansion has drastically reduced their extent. In agricultural areas, many floodplain forests have been reduced to isolated fragments no longer capable of supplying the river with essential woody debris or an adequate organic food supply for healthy fisheries. The linkage between streamside forests and the health of fish stocks may stretch to ocean fisheries where the natural process of delivering large quantities of wood from the watershed to the sea has essentially been severed (Maser and Sedell 1994).

Riparian forests can help remove or ameliorate the effects of pollutants in runoff, and increase the biological diversity and productivity of aquatic communities by improving habitat and adding to the organic food base. Riparian forests can also play an important role in buffering urban and agricultural development. When conserved and managed as buffers, riparian forests can dramatically reduce the impacts of land use activities (Welsch 1991). In fact, studies show dramatic reductions from 30 to 98 percent in nutrients, sediments, pesticides, and other pollutants in surface and groundwater after passing through a riparian forest buffer (Lowrance et al. 1984).

Reservoirs

Puerto Rico has no natural inland bodies of fresh water (lakes), but 20 reservoirs, varying from six to 390 surface hectares, have been constructed as a source of potable water, irrigation, electrical power, and flood control (Figure 22). The associated reservoirs are the main surface water source in Puerto Rico (DNER 2008-a). During 2004, reservoirs provided 370 mgd of waters for domestic use and over 32 mgd for agricultural purposes. Jointly, reservoirs account for 55 per cent of fresh water extraction on the island. Thus, preservation of reservoir capacity is an important management objective.

Figure 22. Distribution of reservoirs in P.R. From DNER 2015.

The larger native shrimps, gobies, and mountain mullet may come into some of the reservoirs from the rivers. Several game fish, including Peacock Bass, Largemouth Bass, and Channel Catfish, have been introduced into Puerto Rican reservoirs (Wiley and Vilella 1998), representing the only important freshwater sportfishes.

Artificial Freshwater Bodies

Ponds are important habitats in Puerto Rico and, almost all of which are artificial and mostly intended for irrigation, livestock, or aesthetic reasons. Most go dry at

some point during the year. Fish are stocked in some of these ponds for sport fishing and for mosquito and weed control. Irrigation channels in sugarcane fields are also important habitats for fishes and aquatic invertebrates.

Lagoons

All of Puerto Rico's lagoons are shallow, usually with mud bottoms, and weedy over large stretches. If brackish or salty, they are surrounded by mangrove forests (Figure 23). Cartagena Lagoon, one of the most important wetland habitats in in Puerto Rico (Danforth 1926), has been greatly degraded by nearby agricultural practices. The lagoon has recently been acquired by the USFWS with the purpose of completing restoration activities. Other important lagoons include Joyuda, San José, Torrecillas, Tortuguero, Caño Tiburones and Piñones.

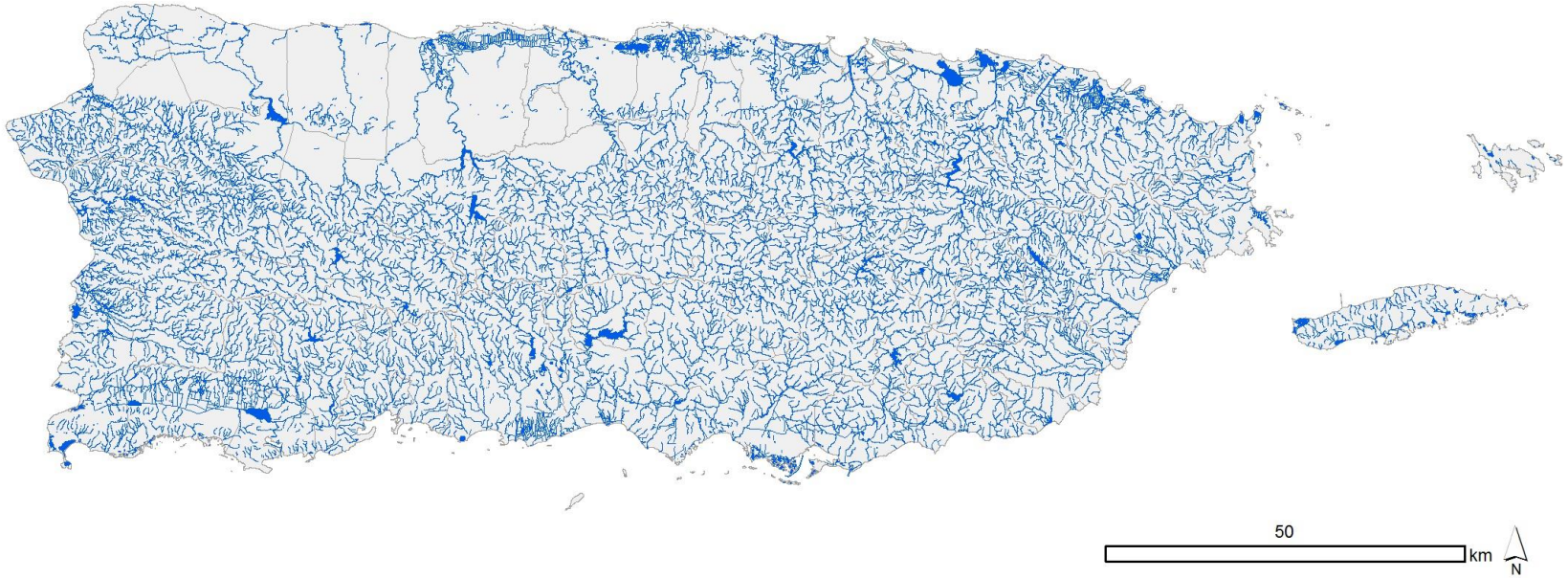


Figure 23. Puerto Rico freshwater habitats. From DNER 2015.

Mangrove forests

Mangroves are particularly important coastal forests due to their variety of functions and services they provide (Puerto Rico Coastal Zone Management Program 2009). Mangroves are found along the coast of Puerto Rico in wetlands subject to saltwater intrusion and provide many ecosystem services. They buffer coastlines against the onslaught of wind caused by weather events. They serve as wildlife refuges, fisheries, and nurseries for marine life and they serve as sources and natural filters to purify water. These characteristics distinguish mangroves as coastal systems of high ecologic and economic value. Between 70% and 90% of marine life with commercial or recreational value uses mangroves for at least part of their respective life cycles (DNER, 2003). Mangroves are also part of the habitat for native and migratory birds, including birds which are on the federal list of endangered species.

Mangroves can be degraded or destroyed by activities such as drainage, dredging, filling, sedimentation, and oil spills. Land filling, which affects hydrology, is most serious threat mangroves and adjacent lands currently face. Despite the massive destruction of these systems in the first decades of the 20th century, mangrove coverage is increasing due to new legal protections.

Saltwater Habitats

Coral Reefs

Coral reefs and rock reef communities are productive marine ecosystems, and are well represented in Puerto Rico (Table 19). They provide habitat for a large number and variety of fish and invertebrates. Coral reefs protect coastlines from wave action. They are a primary source of carbonate sand. They promote the deposition of sand on beaches as well as the formation of seagrass beds and mangroves. They serve as buffers against coastal erosion.

Puerto Rico is surrounded by approximately 500,000 ha of easily accessed coral reefs (reefs less than 20 meters deep) (CSOR, 2005). Some 228 species of corals have been identified in the territorial waters, including: 117 *scleractinian* corals (rocky), 99 *antipatharia* corals (black or spiny), 13 *corallimorpharia* (fungi type coral), three fire corals and five hydrocorals (DNER, 2000). These coral reefs are formed mainly by three types of structures: fringing or marginal reefs (which are the most common), bank reefs and barrier reefs.

Living coral reefs are present around Puerto Rico, but a large number are degraded, largely because of increased sediment and nutrient discharge resulting from anthropogenic modifications of the densely populated island. These modifications are associated with intensive land clearing, agricultural and industrial development that accompany a steady increase in the standard of living (Goenaga and Cintrón, 1979; Morelock et al. 1980, 1983, 1985; Rogers, 1990; Acevedo and Morelock, 1988; Clark and Wilcock, 2000; Larsen, 2000; Larsen and Santiago-Román, 2001; Torres and Morelock, 2002; Weil, 2004, Warne et al. 2005).

Table 19. Area of coastal wetland types (López 2007).

System	Definition	Hectares
Marine	Area exposed to sea waves and sea currents with a water salinity greater than 30-35 parts per thousand (e.g. coral reefs seagrass beds).	23,642
Estuarine	Area affected by the tide with low energy waves, where the water salinity is greater than 0.5 parts per million (e.g. saltpeter beds, mangroves and coastal rivers).	31,947
Palustrine	Areas in freshwater that may be subject to the ebb and flow of tides. Persistent trees, shrubs, and herbaceous plants. Upright and entrenched, submerged and/or floating plants predominate. (e.g. swamps, marshes, wet meadows, shallow ponds).	31,555
Total		87,144

Initiatives to Identify Areas of Greatest Conservation Need

Natural Heritage Program

Fifty conservation priority areas (covering about 319,631 acres) have been identified by DNER's Natural Heritage Program (NHP) (e.g., the northern karst region; Figure 24). The mechanisms used by the NHP to obtain their objectives include:

- Land acquisition by way of purchase, donation, lease, or public land title or management transfer.
- Agreements and Contracts.
- Funding, both recurring and non-recurring.
- Joint projects between the Puerto Rico Natural Heritage Program and NGOs.

Areas of greatest importance for protection of ecosystems and viable populations of native species are shown in Figure 25.

Figure 24. The Northern karst region, an area of conservation priority identified by the DNER and other partners

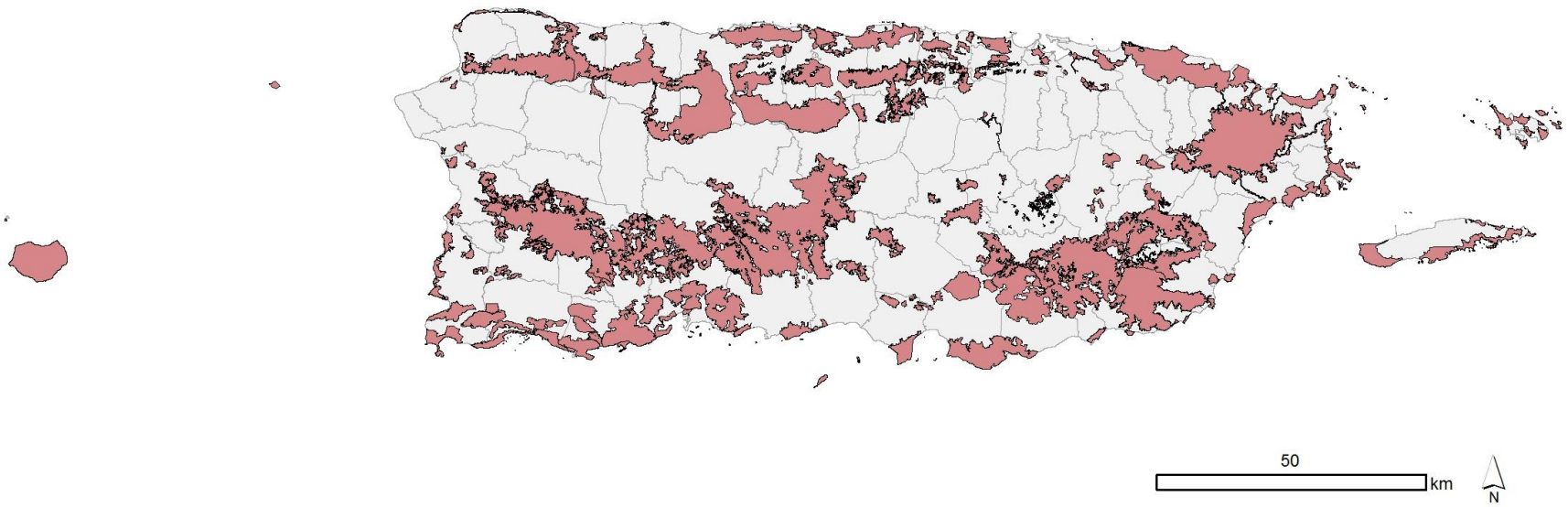


Figure 25. Areas of Conservation Priority identified by the Natural Heritage Program. DRNA 2015.

Critical Wildlife Areas

An important source of information used in lieu of a comprehensive statewide landscape analysis is the target species found in those zones classified as a CWA. The CWA effort identifies areas within Puerto Rico that are necessary to perpetuate the existence of species of special interest for DNER. The CWA identifies public lands as priorities for conservation, lands that DNER considers important wildlife habitat. Table 20 shows target species found in each CWA. Below (Figure 26) is the Plain Coqui (*Eleutherodactylus juanariveroi*), which was discovered in 2005 (Northern Puerto Rico).

Figure 26. Plain Coqui (*Eleutherodactylus juanariveroi*).

Table 20. Data Deficient, Vulnerable, Endangered or Critically Endangered species found in each CWA of P.R.

AREA	ENDANGERED AND VULNERABLE SPECIES
Cucharilla's Marsh, Cataño	White-cheeked Pintail-*Anas bahamensis*
	Ruddy Duck-*Oxyura jamaicensis*
	Caribbean Coot-*Fulica caribaea*
	Yellow shouldered Blackbird-*Agelaius xanthomus*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Masked Duck-*Nomonyx dominicus*
	Brown Pelican-*Pelecanus occidentalis*
	Fishing Bat-*Noctilio leporinus*
	Grasshopper Sparrow-*Ammondramus savannarum*
	Puerto Rican Oriole-*Icterus portoricensis*
	Puerto Rican vireo-*Vireo latimeri*
	Piping Plover-*Charadrius melodus*
Buchanan Haystack Hills and Fort Buchanan Pond, Bayamón ,	Ruddy Duck-*Oxyura jamaicensis*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Puerto RicanOriole-*Icterus portoricensis*
	Adelaide's Warbler-*Setophaga adelaidae*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Puerto Rican Boa-*Chilobotrus inornatus*
	Puerto Rican Slider-*Trachemys stejnegeri*
Torrecillas Swamp System Piñones-Vacía Talega, Carolina-Loíza-Canóvanas - ,	Brown Pelican-*Pelecanus occidentalis*
	Least Tern-*Sterna antillarum*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Masked Duck-*Nomonyx dominicus*
	Caribbean Coot-*Fulica caribaea*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Yellow Warble-*Setophaga petechia*
	Yellow shouldered Blackbird-*Agelaius xanthomus*
	Puerto Rican Oriole-*Icterus portoricensis*
	Puerto Rican Boa-Chilobotrus inornatus
	Leatherback Sea Turtle-*Dermochelys coriacea*
	Hawksbill Turtle-*Eretmochelys imbricata*
	West Indian Manatee-*Trichechus manatus*
	Juey Palancú-*Cardisoma guanhumi*
	Camarón Palaí-*Macrobrachium carcinus*
	Mangrove Crab-*Aratus pisoni*
	Cangrejo de Mangle-*Goniopsis cruentata*
Bo. Borinquen, Trujillo Alto Lake, Bairoa Lake La 25 and Gurabo River Mouth, Trujillo Alto-Caguas-Gurabo	Caribbean Coot-*Fulica caribaea*
	Least Grebe-*Tachybaptus dominicus*
	Puerto Rican Plain Pigeon-*Patagioenas inornata*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieillot*
Baja Swamp and Herrera River Mouth, Río Grande ,	White-cheeked Pintail-*Anas bahamensis*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Ruddy Duck-*Oxyura jamaicensis*
	Masked Duck-*Nomonyx dominicus*
	Juey Palancú-*Cardisoma guanhumi*

AREA	ENDANGERED AND VULNERABLE SPECIES
Ensenada Comezón, Río Grande	Brown Pelican-*Pelecanus occidentalis*
	Caribbean Coot-*Fulica caribaea*
	Piping Plover-*Charadrius melodus*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Nassau Grouper-*Epinephelus striatus*
	Juey Palancú-*Cardisoma guanhumi*
	Mangrove Root Crab-*Goniopsis cruentata*
	Zambuco-*Ucides cordatus*
	Mangrove Crab-*Aratus pisoni*
Street # 968, Río Mar, Rio Grande	Puerto Rican Boa-*Chilobotrus inornatus*
	Virgin Island Tree Boa-*Chilobotrus granti*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
Luquillo Mountains, Luquillo	Sharp shinned Hawk-*Accipiter striatus*
	Broad-winged Hawk-*Buteo platypterus*
	Puerto Rican Parrot-*Amazona vittata*
	Puerto Rican vireo-*Vireo latimeri*
	Puerto Rican Oriole *Icterus portoricensis*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Elfin Woods Warbler *Setophaga angelae*
	Adelaide's Warbler-*Setophaga adelaidae*
	Puerto Rican Boa-*Chilobotrus inornatus*
	Puerto Rican Coqui-*Eleutherodactylus portoricensis*
	Ground Coqui-*Eleutherodactylus richmondi*
	Tree hole Coqui-*Eleutherodactylus hedricki*
	Mottled Coqui-*Eleutherodactylus eneidae*
	Web footed Coqui-*Eleutherodactylus karlschmidti*
	Free tailed Bat-*Tadarida brasiliensis*
	Cave Bat-*Brachyphylla cavernarum*
	Greater Antillean Long-tongued Bat-*Monophyllus redmani*
	Red fruit Bat-*Stenoderma rufum*
San Miguel, La Paulina and El Convento Natural Area, Luquillo-Fajardo	West Indian Whistling Duck-*Dendrocygna arborea*
	Masked Duck-*Nomonyx dominicus*
	Ruddy Duck-*Oxyura jamaicensis*
	Puerto Rican Plain Pigeon-*Patagioenas inornata*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Brown Pelican-*Pelecanus occidentalis*
	Least Grebe-*Tachybaptus dominicus*
	Adelaide's Warbler-*Setophaga adelaidae*
	Yellow Warble-*Setophaga petechia*
	Caribbean Coot-*Fulica caribaea*
	White-cheeked Pintail-*Anas bahamensis*
	Least Tern-*Sternulla antillarum*
	Snowy Plover-*Charadrius alexandrinus*
	Piping Plover-*Charadrius melodus*
	Roseate Tern-*Sterna dougalli*
	Grasshopper Sparrow-*Ammondramus savannarum*
	Puerto Rican Vireo-*Vireo latimeri*
	Puerto Rican Oriole-*Icterus portoricensis*
	Puerto Rican Boa-Chilobotrus inornatus
	Virgin Island Tree Boa-*Chilobotrus granti*
	Leatherback Sea Turtle-*Dermochelys coriacea*
	Hawksbill Turtle-*Eretmochelys imbricata*

AREA	ENDANGERED AND VULNERABLE SPECIES
	Puerto Rican Slider-*Trachemys stejnegeri*
	West Indian Manatee-*Trichechus manatus*
	Schoepfia arenaria
	Cobana Negra *Stahlia-monosperma*
	Beautiful Goetzea-*Goetzea elegans*
	Bloodwoodtree-*Pterocarpus officinalis*
Laguna Grande, Laguna Aguas Prietas and adjacent areas, Fajardo	West Indian Whistling Duck-*Dendrocygna arborea*
	Brown Pelican-*Pelecanus occidentalis*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Caribbean Coot-*Fulica caribaea*
	Adelaide's Warbler-*Setophaga adelaidae*
	Yellow Warble-*Setophaga petechia*
	White-cheeked Pintail-*Anas bahamensis*
	Ruddy Duck-*Oxyura jamaicensis*
Fajardo Coast Line, Fajardo	Green Sea Turtle-*Chelonia mydas*
	Leatherback Sea Turtle-*Dermochelys coriacea*
	Hawksbill Turtle-*Eretmochelys imbricata*
	White-cheeked Pintail-*Anas bahamensis*
	Brown Pelican-*Pelecanus occidentalis*
	Roseate Tern-*Sterna dougalli*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Yellow shouldered Blackbird-*Agelaius xanthomus*
	Yellow Warble-*Setophaga petechia*
	West Indian Manatee-*Trichechus manatus*
La Cordillera Reefs Natural Reserve, Fajardo	Roseate Tern-*Sterna dougalli*
	Brown Pelican-*Pelecanus occidentalis*
	White-cheeked Pintail-*Anas bahamensis*
	Roseate Tern-*Sterna dougalli*
	Virgin Island Tree Boa-*Chilobotrus granti*
	Hawksbill Turtle-*Eretmochelys imbricata*
	Green Sea Turtle-*Chelonia mydas*
	Slippery-backed Mabuya-*Mabuya mabouya*
Flamenco Peninsula, Culebra Island	Slippery-backed Mabuya-*Mabuya mabouya*
	Roseate Tern-*Sterna dougalli*
Flamenco Lagoon, Culebra Island	White-cheeked Pintail-*Anas bahamensis*
	Ruddy Duck-*Oxyura jamaicensis*
	Caribbean Coot-*Fulica caribaea*
	Least Grebe-*Tachybaptus dominicus*
	White-crowned Pigeon-*Patagioenas leucocephala*
Cornelius Lagoon, Culebra Island	White-cheeked Pintail-*Anas bahamensis*
	Ruddy Duck-*Oxyura jamaicensis*
	Masked Duck-*Nomonyx dominicus*
	Brown Pelican-*Pelecanus occidentalis*
Resaca Mountain, Culebra Island	Culebra Iisland GiantAnole-*Anolis roosevelti*
Resaca Beach, Culebra Island	Leatherback Sea Turtle-*Dermochelys coriacea*
	Hawksbill Turtle-*Eretmochelys imbricata*
Brava Beach, Culebra Island	Leatherback Sea Turtle-*Dermochelys coriacea*
	Hawksbill Turtle-*Eretmochelys imbricata*

AREA	ENDANGERED AND VULNERABLE SPECIES
Larga Beach and Zoní Lagoon, Culebra Island	Leatherback Sea Turtle-*Dermochelys coriacea*
	Hawksbill Turtle-*Eretmochelys imbricate*
	Brown Pelican-*Pelecanus occidentalis*
	White-cheeked Pintail-*Anas bahamensis*
	Ruddy Duck-*Oxyura jamaicensis*
	Caribbean Coot-*Fulica caribaea*
Mailux Lagoon, Culebra Island	White-cheeked Pintail-*Anas bahamensis*
Puerto del Manglar, Culebra Island	Brown Pelican-*Pelecanus occidentalis*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Roseate Tern-*Sterna dougalli*
Los Caños, Culebra Island	White-crowned Pigeon-*Patagioenas leucocephala*
	White-cheeked Pintail-*Anas bahamensis*
Cementerio Bay, Culebra Island	White-crowned Pigeon-*Patagioenas leucocephala*
Culebra's Surrounding Cays, Culebra Island	Roseate Tern-*Sterna dougalli*
	Slippery-backed Mabuya-*Mabuya mabouya*
	Hawksbill Turtle-*Eretmochelys imbricata*
	Green Sea Turtle-*Chelonia mydas*
Vieques west coast, Vieques Island	White-crowned Pigeon-*Patagioenas leucocephala*
	White-cheeked Pintail-*Anas bahamensis*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Leatherback Sea Turtle-*Dermochelys coriaceae*
	Hawksbill Turtle-*Eretmochelys imbricata*
	Adelaide's Warbler-*Setophaga adelaidae*
	Yellow Warble-*Setophaga petechia*
	Green Sea Turtle-*Chelonia mydas*
	Loggerhead Turtle-*Caretta caretta*
	West Indian Manatee-*Trichechus manatus*
	Cobana Negra-*Stahlia monosperma*
	Thoma's lidflower-*Calyptranthes thomasiana*
Kiani Lagoon, Vieques Island	White-cheeked Pintail-*Anas bahamensis*
	Ruddy Duck-*Oxyura jamaicensis*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Adelaide's Warbler-Setophaga adelaidae
	Yellow Warble-*Setophaga petechia*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Brown Pelican-*Pelecanus occidentalis*
Playa Grande Lagoon, Vieques Island	White-crowned Pigeon-*Patagioenas leucocephala*
	White-cheeked Pintail-*Anas bahamensis*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	Ruddy Duck-*Oxyura jamaicensis*
	Cobana Negra-*Stahlia monosperma*
	Beautiful Goetzea-*Goetzea elegans*
Ensenada Honda Mangrove, Vieques Island	West Indian Manatee-*Trichechus manatus*
	Cobana Negra-*Stahlia monosperma*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
Yanuel Lagoon, Vieques Island	Yellow Warble-*Setophaga petechia*
	White-crowned Pigeon-*Patagioenas leucocephala*
	White-cheeked Pintail-*Anas bahamensis*
	Cobana Negra-*Stahlia monosperma*

AREA	ENDANGERED AND VULNERABLE SPECIES
Chiva Swamp, Vieques Island	White-cheeked Pintail-*Anas bahamensis*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	Least Tern-*Sternulla antillarum*
Tapón Bay, Vieques Island	White-crowned Pigeon-*Patagioenas leucocephala*
	White-cheeked Pintail-*Anas bahamensis*
Ferro Bay, Mosquito Bay and Sombe Bay, Vieques Island	Key West Quail-Dove-*Geotrygon chrysie*
	Brown Pelican-*Pelecanus occidentalis*
	White-cheeked Pintail-*Anas bahamensis*
	West Indian Manatee-*Trichechus manatus*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
East tip of Vieques and Conejo Cay, Vieques Island	White-cheeked Pintail-*Anas bahamensis*
	Roseate Tern-*Sterna dougalli*
	Brown Pelican-*Pelecanus occidentalis*
	Adelaide's Warbler-*Setophaga adelaidae*
	Hawksbill Turtle-*Eretmochelys imbricata*
	Leatherback Sea Turtle-*Dermochelys coriacea*
	Green Sea Turtle-*Chelonia mydas*
Roosevelt Roads Naval Base, Ceiba	West Indian Whistling Duck-*Dendrocygna arborea*
	Least Grebe-*Tachybaptus dominicus*
	White-cheeked Pintail-*Anas bahamensis*
	Brown Pelican-*Pelecanus occidentalis*
	Yellow shouldered Blackbird-*Agelaius xanthomus*
	Ruddy Duck-*Oxyura jamaicensis*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Key West Quail-Dove-*Geotrygon chrysia*
	West Indian Manatee-*Trichechus manatus*
	Green Sea Turtle-*Chelonia mydas*
	Hawksbill Turtle-*Eretmochelys imbricata*
Ceiba State Forest, Fajardo, Ceiba and Naguabo	Brown Pelican-*Pelecanus occidentalis*
	Key West Quail-Dove-*Geotrygon chrysia*
	Bridled Quail-Dove-*Geotrygon mystacea*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	Yellow shouldered Blackbird-*Agelaius xanthomus*
Humacao Natural Reserve, Humacao	Caribbean Coot-*Fulica caribaea*
	Least Tern-*Sternulla antillarum*
	Least Grebe-*Tachybaptus dominicus*
	Brown Pelican-*Pelecanus occidentalis*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Masked Duck-*Nomonyx dominicus*
	Adelaide's Warbler-*Setophaga adelaidae*
	Ruddy Duck-*Oxyura jamaicensis*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Leatherback Sea Turtle-*Dermochelys coriacea*
	Hawksbill Turtle-*Eretmochelys imbricate*
	Yellow-breasted crake-*Porzana flaviventer*
	Loggerhead Turtle-*Caretta caretta*
	Puerto Rican Slider-T*rachemys stejnegeri*

AREA	ENDANGERED AND VULNERABLE SPECIES
	Juey Palancú-*Cardisoma guanhumi*
	Mangrove root Crab-*Goniopsis cruentata*
	Cangrejo violinista-*Uca thayeri*
Pandura Mountain Range, Yabucoa-Maunabo	Brown Pelican-*Pelecanus occidentalis*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Adelaide's Warbler-Setophaga adelaidae
	Puerto Rican plain Pigeon-*Patagioenas inornata*
	Puerto Rican Vireo-*Vireo latimeri*
	Puerto RicanOriole-*Icterus portoricensis*
	Puerto Rican demon-*Eleutherodactylus cooki*
Palmas Pond, Arroyo	Brown Pelican-*Pelecanus occidentalis*
	Ruddy Duck-*Oxyura jamaicensis*
	Masked Duck-*Nomonyx dominicus*
	Caribbean Coot-*Fulica caribaea*
	Least Tern-*Sternulla antillarum*
Carite State Forest, Cayey	Elfin woods Warbler-*Setophaga angelae*
	Sharp shinned Hawk-*Accipiter striatus*
	Broad-winged Hawk-*Buteo platypterus*
	Key West Quail-Dove-*Geotrygon chrysia*
	Puerto Rican Vireo-*Vireo latimeri*
	Puerto RicanOriole-*Icterus portoricensis*
	Puerto Rican Boa-Chilobotrus inornatus
	Golden Coqui-*Eleutherodactylus jasperi*
	Puerto Rican Coqui-*Eleutherodactylus portoricensis*
	Ground Coqui-*Eleutherodactylus richmondi*
	Eneida's Coqui-*Eleutherodactylus eneidae*
	Warty Coqui-*Eleutherodactylus locustus*
	Tree hole Coqui-*Eleutherodactylus hedricki*
	Web footed Coqui-*Eleutherodactylus karlschmidti*
Cerro El Gato and Associated Areas, Cayey	Golden Coqui-*Eleutherodactylus jasperi*
39- Cidra Lake, Cidra	Puerto Rican plain Pigeon-*Patagioenas inornata*
Aguirre State Forest, Punta Pozuelo, Cayos Caribe & Mar Negro, Guayama-Salinas-Santa	Brown Pelican-*Pelecanus occidentalis*
	White-cheeked Pintail-*Anas bahamensis*
	Least Tern-*Sternulla antillarum*
	Roseate Tern-*Sterna dougalli*
	Least Grebe-*Tachybaptus dominicus*
	Puerto Rican-Oriole-*Icterus portoricensis*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Puerto Rican plain Pigeon-*Patagioenas inornata*
	Puerto Rican Vireo-*Vireo latimeri*
	Grasshopper Sparrow-*Ammondramus savannarum*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-Setophaga adelaidae
	Leatherback Sea Turtle-*Dermochelys coriacea*
	Green Sea Turtle-*Chelonia mydas*
	Hawksbill Turtle-*Eretmochelys imbricata*
	Dryland grass Anole-*Anolis poncensis*
	West Indian Manatee-*Trichechus manatus*
	Fishing Bat-*Noctilio leporinus*
	Nassau grouper-*Epinephelus striatus*
	Jewfish-*Epinephelus itajitara*

AREA	ENDANGERED AND VULNERABLE SPECIES
Punta Arenas, Salinas	Brown Pelican-*Pelecanus occidentalis*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	White-cheeked Pintail-*Anas bahamensis*
Salinas Training Area, Salinas	Dryland Grass Anole-*Anolis poncensis*
	Adelaide's Warbler-Setophaga adelaidae
	Key west Quail-Dove-*Geotrygon chrysia*
	Puerto Rican Oriole-*Icterus portoricensis*
	Erubia-*Solanum ensipholium*
Punta Petrona Mangroves and Caracoles Cay, Santa Isabel	Brown Pelican-*Pelecanus occidentalis*
	White-cheeked Pintail-*Anas bahamensis*
	Ruddy Duck-*Oxyura jamaicensis*
	Yellow Warble-*Setophaga petechia*
	Green Sea Turtle-*Chelonia mydas*
	West Indian Manatee-*Trichechus manatus*
Cabuyón Mangrove and Fríos Cays, Ponce	Brown Pelican-*Pelecanus occidentalis*
	Caribbean Coot-*Fulica caribaea*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	White-cheeked Pintail-*Anas bahamensis*
	Brown Pelican-*Pelecanus occidentalis*
	Snowy Plover-*Charadrius nivosus*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Grasshopper Sparrow-*Ammondramus savannarum*
Caja de Muertos Complex, Ponce-Juana Díaz-Santa Isabel	Brown Pelican-*Pelecanus occidentalis*
	Least Tern-*Sternulla antillarum*
	White-tailed Tropicbird-*Phaeton aethereus* (nesting)
	Roseate Tern *Sterna dougalli*
	Yellow Warble-*Setophaga petechia*
	Green Sea Turtle-*Chelonia mydas*
	Hawksbill Turtle-*Eretmochelys imbricata*
	Grant's Blind Snake-*Typhlops granti*
	Cook's Anole-*Anolis cooki*
	Jueyita de Tierra-*Gecarcinus lateralis*
	Juey Morado-*Gecarcinus ruricola*
	Juey de Mangle-*Aratus pisonii*
Serrallés Lakes, Juana Díaz-Ponce	Ruddy Duck-*Oxyura jamaicensis*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Adelaide's Warbler-*Setophaga adelaidae*
	Caribbean Coot-*Fulica caribaea*
	Least Grebe-*Tachybaptus dominicus*
	Puerto Rican Oriole-*Icterus portoricensis*
	Brown Pelican-*Pelecanus occidentalis*
Toro Negro and Tres Picachos State Forest, Ciales-Jayuya-Orocovis	Sharp-shinned Hawk-*Accipiter striatus*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Puerto Rican Vireo-*Vireo latimeri*
	Puerto Rican Oriole-*Icterus portoricensis*
	Cave Bat-*Brachyphylla cavernarum*
	Long-tongued Bat-*Monophyllus redmani*
	Red Fruit Bat-*Stenoderma rufum*
	Brown Flower Bat-*Erophylla sezekorni*
	Slippery-backed Mabuya-*Mabuya mabouya*

AREA	ENDANGERED AND VULNERABLE SPECIES
	Treehole Coqui-*Eleutherodactylus hedricki*
	Ground Coqui-*Eleutherodactylus richmondi*
	Eneida's Coqui-*Eleutherodactylus eneidae*
	Camarón Palaí-*Macrobrachium carcinus*
	Camarón-*Macrobrachium crenulatum*
	Camarón-*Macrobrachium faustinum*
	Camarón-*Macrobrachium heterochirus*
	Buruquena-*Epilobocera suinuatifrons*
Las Salinas Lagoon, El Tuque, Ponce	White-cheeked Pintail-*Anas bahamensis*
	Brown Pelican-*Pelecanus occidentalis*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	Least Tern *STernulla antillarum*
	Puerto Rican Vireo-*Vireo latimeri*
	Puerto RicanOriole-*Icterus portoricensis*
	Dryland Grass Anole-*Anolis poncensis*
Monte Guilarte State Forest, Adjuntas-Guayanilla, Peñuelas-Yauco -	Sharp-shinned Hawk-*Accipiter striatus*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Puerto Rican Vireo-*Vireo latimeri*
	Key West Quail-Dove-*Geotrygon chrysia*
	Puerto Rican Oriole-*Icterus dominicensis*
	Red fruit Bat-*Stenoderma rufum*
	Cave Bat-*Brachyphylla cavernarum*
	Eneida's Coqui-*Eleutherodactylus eneidae*
	Puerto Rican Coqui-*Eleutherodactylus portoricensis*
	Puerto Rican Boa-*Chilobotrus inornatus*
	West Indian Walnut-*Juglans jamaicensis*
	Puerto Rican manac-*Calyptronoma rivalis*
Punta Verraco, Cerro Toro and Punta Ventana, Guayanilla	Puerto Rican CrestedToad-*Peltophryne lemur*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-Setophaga adelaidae
	Brown Pelican-*Pelecanus occidentalis*
	Puerto Rican Nightjar-*Caprimulgus noctitherus*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Key West Quail-Dove-*Geotrygon chrysia*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
Guayanilla Hills, Guayanilla	Puerto Rican Nightjar-*Caprimulgus noctitherus*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Bariaco-*Trichilia triacantha*
Guánica Lagoon, Guánica	Puerto Rican Nightjar-*Caprimulgus noctitherus*
	Yellow-breasted Crake-*Porzana flaviventer*
	West Indian Whistling Duck-*Dendrocygna arborea*
	White-cheeked Pintail-*Anas bahamensis*
	Ruddy Duck-*Oxyura jamaicensis*
Guánica State Forest, Guánica	Key West Quail-Dove-*Geotrygon chrysia*
	Puerto Rican Nightjar-*Caprimulgus noctitherus*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Puerto Rican Oriole-*Icterus dominicensis*
	Puerto Rican Vireo-*Vireo latimeri*
	Yellow Warble-*Setophaga petechia*

AREA	ENDANGERED AND VULNERABLE SPECIES
	Adelaide's Warbler-*Setophaga adelaidae*
	Bridled Quail-Dove-*Geotrygon mystacea*
	Puerto Rican CrestedToad- *Peltophryne lemur*
	Slippery-backed Mabuya-*Mabuya mabouya*
	Grant's Blind Snake-*Typhlops granti*
	Juey Morado-*Gecarcinus ruricola*
	Camarón Troglobita de *Mona-Typhlatya monae*
	Bariaco-*Trichilia triacantha*
San Jacinto Salt Flats and Tamarindo Lagoon, Guánica	Puerto Rican Nightjar-*Caprimulgus noctitherus*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Brown Pelican-*Pelecanus occidentalis*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	White-cheeked Pintail-*Anas bahamensis*
	Roseate Tern-*Sterna dougallii*
Susúa State Forest and Adjacent Lands,	Yauco-Sabana Grande Key West Quail-Dove-*Geotrygon chrysia*
	Puerto Rican Nightjar-*Caprimulgus noctitherus*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Puerto Rican Vireo-*Vireo latimeri*
	Adelaide's Warbler-*Setophaga adelaidae*
	Puerto Rican Oriole-*Icterus dominicensis*
	Cobana Negra-*Stahlia monosperma*
	Pelos del Diablo-*Aristida portoricensis*
La Parguera Natural Reserve, Lajas	White-cheeked Pintail-*Anas bahamensis*
	Puerto Rican Nightjar-*Caprimulgus noctitherus*
	Yellow Warble-*Setophaga petechia*
	Yellow shouldered Blackbird-*Agelaius xanthomus*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Brown Pelican-*Pelecanus occidentalis*
	Adelaide's Warbler-*Setophaga adelaidae*
	Least Tern-*Sternulla antillarum*
	Puerto Rican Vireo-*Vireo latimeri*
	Hawksbill Turtle-*Eretmochelys imbricata*
	Green Sea Turtle-*Chelonia mydas*
	Leatherback Sea Turtle-*Dermochelys coriacea*
	West Indian Manatee-*Trichechus manatus*
Cartagena Lagoon, Lajas	Yellow shouldered Blackbird-*Agelaius xanthomus*
	Caribbean Coot-*Fulica caribaea*
	Least Grebe-*Tachybaptus dominicus*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	Ruddy Duck-*Oxyura jamaicensis*
	West Indian Whistling Duck-*Dendrocygna arborea*
	White-cheeked Pintail-*Anas bahamensis*
	Masked Duck-*Nomonyx dominicus*
	Broad-winged Hawk-*Buteo platypterus*
	Least Tern-*Sternulla antillarum*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Key West Quail-Dove-*Geotrygon chrysia*
	Puerto Rican Oriole-*Icterus dominicensis*
	Puerto Rican Vireo-*Vireo latimeri*

AREA	ENDANGERED AND VULNERABLE SPECIES
	Yellow-breasted Crake-*Porzana flaviventer*
	Grasshopper Sparrow-*Ammondramus savannarum*
Boquerón State Fores, Cabo Rojo	Yellow shouldered Blackbird-*Agelaius xanthomus*
	Brown Pelican-*Pelecanus occidentalis*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	West Indian Whistling Duck-*Dendrocygna arborea*
	White-cheeked Pintail-*Anas bahamensis*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	Ruddy Duck-*Oxyura jamaicensis*
	Caribbean Coot-*Fulica caribaea*
	Least Tern-*Sternulla antillarum*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Puerto Rican Oriole-*Icterus dominicensis*
	Grasshopper Sparrow-*Ammondramus savannarum*
	Yellow-breasted Crake-*Porzana flaviventer*
	Piping Plover-*Charadrius melodus*
	West Indian Manatee-*Trichechus manatus*
	Cook's Anole-*Anolis cooki*
	Free tailed Bat-*Tadarida brasiliensis*
	Bariaco-*Trichilia triacantha*
Boquerón Wildlife Refuge, Cabo Rojo	Least Grebe-*Tachybaptus dominicus*
	Brown Pelican-*Pelecanus occidentalis*
	West Indian Whistling Duck-*Dendrocygna arborea*
	White-cheeked Pintail-*Anas bahamensis*
	Masked Duck-*Nomonyx dominicus*
	Ruddy Duck-*Oxyura jamaicensis*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-Setophaga adelaidae
	Caribbean Coot-*Fulica caribaea*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Puerto Rican Oriole-*Icterus dominicensis*
	Grasshopper Sparrow-*Ammondramus savannarum*
	Yellow shouldered Blackbird-*Agelaius xanthomus*
	Fishing Bat-*Noctilio leporinus*
	West Indian Manatee-*Trichechus manatus*
	Swamp Ghost Crab-*Ucides cordatus*
	Juey Palancú-*Cardisoma guanhumi*
	Mangrove Root Crab-*Goniopsis cruentata*
Cabo Rojo Salt Flats and Adjacent Areas, Cabo Rojo	Snowy Plover-*Charadrius alexandrinus*
	Piping Plover-*Charadrius melodus*
	Yellow shouldered Blackbird-*Agelaius xanthomus*
	Least Tern-*Sternulla antillarum*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	White-cheeked Pintail-*Anas bahamensis*
	Roseate Tern-*Sterna dougalli*
	Green Sea Turtle-*Chelonia mydas*
	Hawksbill Turtle-*Eretmochelys imbricata*
	Leatherback Sea Turtle-*Dermochelys coriacea*
	Woodbury's stopper-*Eugenia woodburyana*
	Chase's threeawn-*Aristida chaseae*

AREA	ENDANGERED AND VULNERABLE SPECIES
	Cobana Negra-*Stahlia monosperma*
Punta Guaniquilla Natural Reserve, Cabo Rojo	Least Grebe-*Tachybaptus dominicus*
	Brown Pelican-*Pelecanus occidentalis*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	Ruddy Duck-*Oxyura jamaicensis*
	White-cheeked Pintail-*Anas bahamensis*
	Least Tern-*Sternulla antillarum*
	Cobana Negra-*Stahlia monosperma*
	Bariaco-*Trichilia triacantha*
Joyuda Lagoon Natural Reserve, Cabo Rojo	Ruddy Duck-*Oxyura jamaicensis*
	Yellow Warble-*Setophaga petechia*
	Puerto Rican Oriole-*Icterus dominicensis*
	Brown Pelican-*Pelecanus occidentalis*
Cuevas Lagoon, Cabo Rojo	White-cheeked Pintail-*Anas bahamensis*
	Ruddy Duck-*Oxyura jamaicensis*
	Masked Duck-*Nomonyx dominicus*
Sabanetas Swamp-Boquilla Channel, Mayagüez	Leatherback Sea Turtle-*Dermochelys coriacea*
	Hawksbill Turtle-*Eretmochelys imbricata*
	West Indian Manatee-*Trichechus manatus*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Caribbean Coot-*Fulica caribaea*
	Brown Pelican-*Pelecanus occidentalis*
	Least Tern-*Sternulla antillarum*
	Roseate Tern-*Sterna dougalli*
	Puerto Rican Oriole-*Icterus portoricensis*
	Swamp Ghost Crab-*Ucides cordatus*
	Mangrove root Crab-*Goniopsis cruentata*
	Juey de mangle-*Aratus pisonii*
Maricao State Forest, Maricao	Sharp-shinned Hawk-*Accipiter striatus*
	Broad-winged Hawk-*Buteo platypterus*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Puerto Rican Oriole-*Icterus portoricensis*
	Puerto Rican Vireo-*Vireo latimeri*
	Adelaide's Warbler-*Setophaga adelaidae*
	Elfin Woods Warbler *Aetophaga angelae*
	Puerto Rican Manac-*Calyptronoma rivalis*
	Higüero de Sierra-*Crescentia portoricensis*
	Orquid-*Cranichis ricartii*
	Gesneria pauciflora
	Palo de Rosa-*Ottoschulzia rhodoxylon*
Mona Island	White tailed Tropicbird-*Phaeton aethereus* (nesting)
	Yellow shouldered Blackbird-*Agelaius xanthomus*
	White-crowned Pigeon-*Patagioenas leucocephala*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Sharp shinned Hawk-*Accipiter striatus*
	Key west Quail-Dove-*Geotrygon chrysia*
	Higo Chumbo-*Harrisia portoricensis*
	Slippery-backed Mabuya-*Mabuya mabouya*
	Mona Island Ground Iguana-*Cyclura cornuta stejnegeri*

AREA	ENDANGERED AND VULNERABLE SPECIES
	Mona Blind Snake-*Typhlops monensis*
	Mona Boa-Chilobotrus monensis monensis
	Hawksbill Turtle-*Eretmochelys imbricata*
	Green Sea Turtle-*Chelonia mydas*
	Fishing Bat-*Noctilio leporinus*
	Humpback Whale-*Megaptera novaeangliae*
	Camarón Troglobita de Mona-*Typhlatya monae*
	Juey Morado-*Gecarcinus ruricola*
	Jueyita de Tierra-*Gecarcinus lateralis*
Monito Island	Yellow-shouldered Blackbird-*Agelaius xanthomus*
	Brown Pelican-*Pelecanus occidentalis*
	Slippery-backed Mabuya-*Mabuya mabouya*
	Monito's Gecko-*Sphaerodactylus micropithecus*
	Higo Chumbo-Harrisia portoricensis
Pozo Hondo Swamp, Añasco,	West Indian Whistling Duck-*Dendrocygna arborea*
Cayures Swamp, Aguada	Masked Duck-*Nomonyx dominicus*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Brown Pelican-*Pelecanus occidentalis*
	Caribbean Coot-*Fulica caribaea*
Desecheo Island	Brown Pelican-*Pelecanus occidentalis*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Slippery-backed Mabuya-*Mabuya mabouya*
	Desecheo's Gecko-*Sphaerodactylus levinsi*
	Higo Chumbo-*Harrisia portoricensis*
Barrio Coto, Isabela	Puerto Rican Boa-*Chilobotrus inornatus*
	Beautiful Goetzea-*Goetzea elegans*
	Adelaide's Warbler-*Setophaga adelaidae*
	Puerto Rican CrestedToad-*Peltophryne lemur*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Auerodendron pauciflorum
Guajataca Cliffs, Isabela-Quebradillas-Camuy	White-tailed Tropicbird-*Phaeton aethereus* (nesting)
	Bridled Tern-*Onychoprion anaethetus* (nesting)
Guajataca State Forest, Isabela	Key West Quail-Dove-*Geotrygon chrysia*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Bridled Quail-Dove-*Geotrygon mystacea*
	Sharp shinned Hawk-*Accipiter striatus*
	Adelaide's Warbler-*Setophaga adelaidae*
	Puerto Rican Oriole-*Icterus portoricensis*
	Puerto Rican Vireo-*Vireo latimeri*
	Puerto Rican Boa-*Chilobotrus inornatus*
	Slippery-backed Mabuya *Mabuya mabouya*
	Grant's Blind snake-*Typhlops granti*
	Puerto Rican Crested Toad-*Peltophryne lemur*
	Long-tongued Bat-*Monophyllus redmani*
	Vahl's Boxwood-*Buxus vahlii*
	Palo de Rosa-*Ottoschulzia rhodoxylon*
	Ausú-*Myrcia paganii*
	Uvillo-*Eugenia haematocarpa*
	Spider-*Schoepfia arenaria*

AREA	ENDANGERED AND VULNERABLE SPECIES
	St. Thomas prickly-ash-*Zanthoxylum thomasianum*
	Beautiful Goetzea-*Goetzea elegans*
	Erubia-*Solanum drymophilum*
	Daphnopsis helleriana
	Palo de Nigua-*Cornutia obovata*
Guajataca Reservoir, Quebradillas	Key West Quail-Dove-*Geotrygon chrysia*
	Brown Pelican-*Pelecanus occidentalis*
	Broad-winged Hawk-*Buteo platypterus*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Ruddy Duck-*Oxyura jamaicensis*
	Adelaide's Warbler-Setophaga adelaidae
	Caribbean Coot-*Fulica caribaea*
	Puerto Rican Vireo-*Vireo latimeri*
	Puerto Rican Oriole-*Icterus portoricensis*
	Puerto Rican Boa-Chilobotrus inornatus
	Puerto Rican Slider-*Trachemys stejnegeri*
	Fishing Bat-*Noctilio leporinus*
Barrio Cocos and Bellaca Creek, Quebradillas	Puerto Rican CrestedToad-*Peltophryne lemur*
	Adelaide's Warbler-Setophaga adelaidae
	Beautiful Goetzea-*Goetzea elegans*
	Puerto Rican Boa-*Chilobotrus inornatus*
Carrizales Mangroves, Hatillo	Least Grebe-*Tachybaptus dominicus*
	Brown Pelican-*Pelecanus occidentalis*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Grasshopper Sparrow-*Ammondramus savannarum*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Puerto Rican Slider-*Trachemys stejnegeri*
Tiburones Swamp and La Tembladera Pond, Arecibo	Least Grebe-*Tachybaptus dominicus*
	Yellow-breasted Crake *Porzana flaviventer*
	Brown Pelican-*Pelecanus occidentalis*
	West Indian Whistling Duck-*Dendrocygna arborea*
	White-cheeked Pintail-*Anas bahamensis*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	Masked Duck-*Nomonyx dominicus*
	Ruddy Duck-*Oxyura jamaicensis*
	Caribbean Coot-*Fulica caribaea*
	Roseate Tern-*Sterna dougalli*
	Least Tern-*Sterna antillarum*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Key West Quail-Dove-*Geotrygon chrysia*
	Puerto Rican Oriole-*Icterus portoricensis*
	Grasshopper Sparrow-*Ammondramus savannarum*
	Yellow shouldered Blackbird-*Agelaius xanthomus*
Cambalache Forest, Arecibo	Puerto Rican Boa-*Chilobotrus inornatus*
	Red fruit Bat-*Stenoderma rufum*
	Cave Bat-*Brachyphylla cavernarum*
	Beautiful Goetzea-*Goetzea elegans*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Adelaide's Warbler-*Setophaga adelaidae*

AREA	ENDANGERED AND VULNERABLE SPECIES
	Palo de Ramón-*Banara vanderbiltii*
	Palo de Rosa-*Ottoschulzia rhodoxylon*
	Puerto Rican Oriole-*Icterus portoricensis*
	Puerto Rican Vireo-*Vireo latimeri*
Río Abajo State Forest, Arecibo	Broad-winged Hawk-*Buteo platypterus*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Adelaide's Warbler-*Setophaga adelaidae*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Puerto Rican Parrot *Amazona vitatta*
	Puerto Rican Vireo-*Vireo latimeri*
	Puerto Rican Oriole-*Icterus portoricensis*
	Puerto Rican Boa-*Chilobotrus inornatus*
La Esperanza Natural Reserve, Manatí	Ruddy Duck-*Oxyura jamaicensis*
	White-cheeked Pintail-*Anas bahamensis*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Brown Pelican-*Pelecanus occidentalis*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	Roseate Tern-*Sterna dougalli*
	Bridled Tern-*Sterna anaethetus* (nesting)
	Grasshopper Sparrow-*Ammondramus savannarum*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Masked Duck-*Nomonyx dominicus*
	Caribbean Coot-*Fulica caribaea*
	Puerto Rican Oriole-*Icterus portoricensis*
	Puerto Rican vireo-*Vireo latimeri*
	Puerto Rican Slider-*Trachemys stejnegeri*
	Puerto Rican Boa-*Chilobotrus inornatus*
Tortuguero Lagoon, Cabo Caribe Swamp and Rica Lagoon, Vega Baja	Least Grebe-*Tachybaptus dominicus*
	Caribbean Coot-*Fulica caribaea*
	Brown Pelican-*Pelecanus occidentalis*
	Ruddy Duck-*Oxyura jamaicensis*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Yellow Warble-*Setophaga petechia*
	Adelaide's Warbler-*Setophaga adelaidae*
	Key West Quail-Dove-*Geotrygon chrysia*
	White-crowned Pigeon-*Patagioenas leucocephala*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Bridled Quail-Dove-*Geotrygon mystacea*
	Yellow-breasted Crake-*Porzana flaviventer*
	Grasshopper Sparrow-*Ammondramus savannarum*
	Puerto Rican Boa-*Chilobotrus inornatus*
	Puerto Rican Senna-*Chamaecrista glandulosa var. mirabilis*
Cibuco Swamp, Vega Baja	Brown Pelican-*Pelecanus occidentalis*
	Least Grebe-*Tachybaptus dominicus*
	White-crowned Pigeon-*Patagioenas leucocephala*
	West Indian Whistling Duck-*Dendrocygna arborea*
	Ruddy Duck-*Oxyura jamaicensis*
	White-cheeked Pintail-*Anas bahamensis*
	Roseate Tern-*Sterna dougalli*
	Yellow Warble-*Setophaga petechia*

AREA	ENDANGERED AND VULNERABLE SPECIES
	Puerto Rican Vireo-*Vireo latimeri*
	Grasshopper Sparrow-*Ammondramus savannarum*
	Long-tongued Bat-*Monophyllus redmani*
	Juey Palancú-*Cardisoma guanhumi*
	Mangrove Root Crab-*Goniopsis cruentata*
	Juey de Mangle-*Aratus pisonii*
	Swamp Ghost Crab-*Ucides cordatus*
	Juey Morado-*Gecarcinus ruricola*
Vega State Forest, Vega Alta	Key West Quail-Dove-*Geotrygon chrysia*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Adelaide's Warbler-*Setophaga adelaidae*
	Puerto Rican Vireo-*Vireo latimeri*
	Cobana Negra-*Stahlia monosperma*
Lakes and Forests of Dorado	White-crowned Pigeon-*Patagioenas leucocephala*
	Brown Pelican-*Pelecanus occidentalis*
	Caribbean Coot-*Fulica caribaea*
	Hawksbill Turtle-*Eretmochelys imbricata*
	Juey Palancú-*Cardisoma guanhumi*
	Bloodwood tree-*Pterocarpus officinalis*
Mogotes Río Lajas y Nevárez, Toa Baja	Key West Quail-Dove-*Geotrygon chrysia*
	Puerto Rican Lizard-Cuckoo-*Cocccyzus vieilloti*
	Puerto Rican Boa-*Chilobotrus inornatus*
	Slippery-backed Mabuya-*Mabuya mabouya*
	Palo de Ramón-*Banara vanderbiltii*
	Daphnopsis helleriana
El Mameyal, Toa Baja	West Indian Whistling Duck-*Dendrocygna arborea*
San Pedro Swamp, Toa Baja	West Indian Whistling Duck-*Dendrocygna arborea*
	White-crowned Pigeon-*Patagioenas leucocephala*
	Yellow Warble-*Setophaga petechia*
	Grasshopper Sparrow-*Ammondramus savannarum*
	Puerto Rican Boa-*Chilobotrus inornatus*
	Juey Palancú-*Cardisoma guanhumi*
	Green Sea Turtle-*Chelonia mydas*
	Loggerhead Turtle-*Caretta caretta*

Caribbean Landscape Conservation Cooperative

The Caribbean Landscape Conservation Cooperative (CLCC)'s mission is to develop and provide the best available conservation science and strategies to agencies, decision-makers, organizations, researchers, and the public in order to conserve, restore and sustain natural and cultural resources in the US Caribbean. The CLCC is part of a national network of 22 Landscape Conservation Cooperatives (LCCs). An LCC is an applied conservation science partnership among state and federal agencies, regional organizations, tribes,

NGOs, universities and other entities within a geographic area. LCCs are designed to inform resource management decisions in an integrated fashion across landscapes – at a broader scale than any individual spouse's responsibility (http://caribbeanlcc.org/).

The Caribbean Landscape Conservation Cooperative (CLCC) serves as a catalyst for interagency collaborations and a primary source for science-based information and implementation to sustain natural and cultural resources in Caribbean landscapes and seascapes. DNER is a critical partner of the CLCC and therefore, the cooperative actions need to align with the state and local government conservation plans. The CLCC provides a regional context for conservation planning and management at several scales, from making decisions on site management, understanding the implications of management actions at the regional, national and global levels. It offers a platform for partners working to integrate information, perform regional assessments of conservation status, assess future scenarios, and collaborate in applied conservation science. The CLCC supports site level conservation initiatives and complements other landscape conservation strategies to restore, manage, and conserve natural resources in the region in the face of climate change and development pressure.

An important component of the CLCC are the conservation action teams (CAT's). These units are autonomus bodies that tackle specific conservation initiatives. Currently exist three CAT's, namely the Protected Area (PA), Dune and the Cays CAT. A major contribution has been the updated map of protected areas for Puerto Rico, developed by the PA CAT (Figure 27) which using IUCN's definition of protected area and the addition of new ones, increased the total area of protecte lands from 8% to 16%.

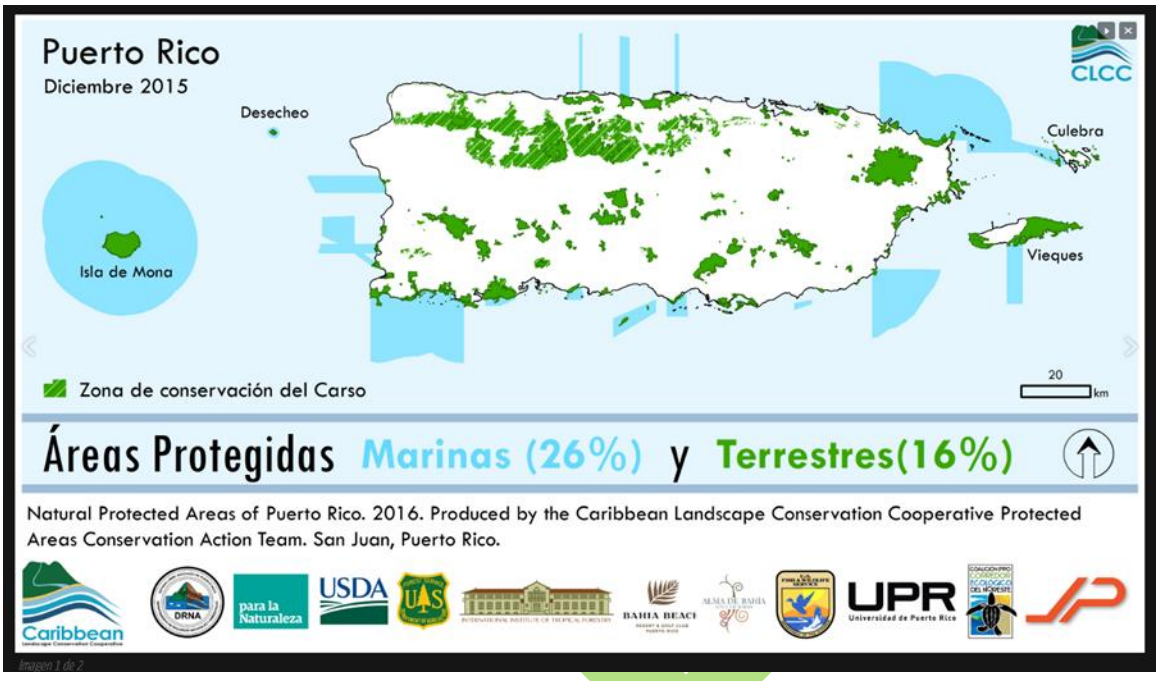


Figure 27. Natural Protected Area of Puerto Rico in 2016.

Marine Protected Areas

Wetlands are natural areas defined by their hydrology, soil and vegetation (Cowardin et al., 1979). Wetlands have essential functions and economic, social and scientific value. They help control floods, provide water and recharge areas for aquifers, feed springs, modify climate, improve water quality, maintain the salt balance needed for estuarine life, and stabilize and protect coasts. Economically, wetlands are a highly productive resource by being a source of food, wood, energy, and recreational opportunities. They influence the quality and ecological status of associated water bodies and moderate peak stream flows during storm events. They are important nurseries for aquatic life.

Inventories of wetlands in Puerto Rico mainly cover the coastal zone (Figure 28). Through an NOAA initiative, in 2004 approximately 160,000 ha of benthic niches in the territorial waters of Puerto Rico were mapped. Approximately 87,578 ha of wetlands were inventoried (Table 17). It is

estimated that 25% of them are found within marine protected areas (Lopez, 2007). Marine protected areas can be natural reserves, marine reserves, coastal state forests, national estuarine research reserves or seasonal fishing closures.

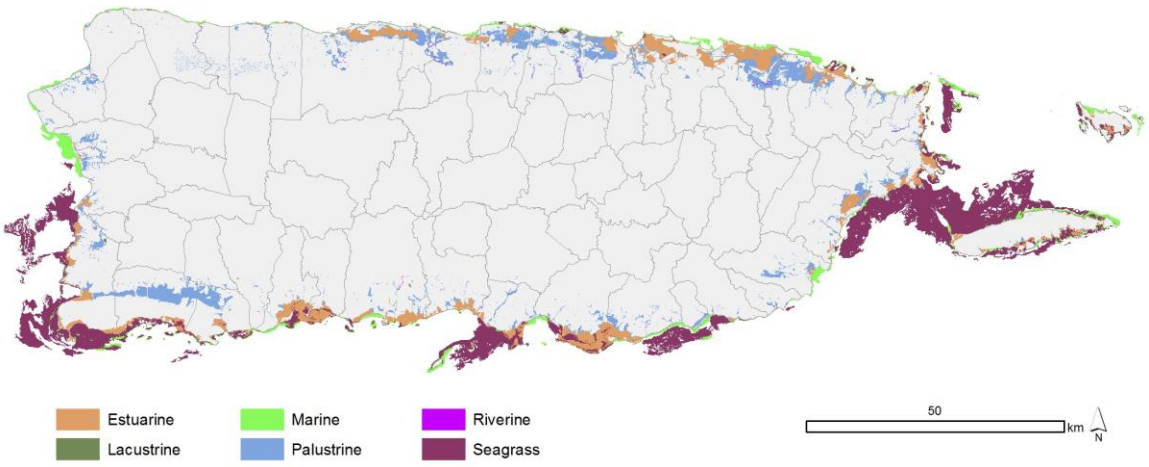


Figure 28. Inventory of Puerto Rico's Wetlands. From DNER 2015

Puerto Rico Model Forest ("Bosque Modelo")

On November 3rd, 2014, Governor Alejandro García Padilla approved the Puerto Rico Model Forest Law. With this law, Puerto Rico becomes the first country in the world to appoint a Model Forest through legislation. The Puerto Rico Model Forest, or "bosque modelo" in Spanish, is comprised of approximately 390,000 acres of land in 31 municipalities (over 17% of the island). The Model Forest connects 26 natural areas (state forests, nature reserves and refuges), which make up approximately 66,000 acres (17%) of the total area of the Model Forest (Figure 29). The Model Forest area is an ecological corridor in west-central Puerto Rico. The most comprehensive, collaborative management initiative in the history of Puerto Rico is in the process of implementation in the remaining 83% of land within the Model Forest boundaries. Activities include integrated management, land uses of high ecological value, agriculture and tourism initiatives.

Given the fiscal and economic situation in Puerto Rico, the Model Forest initiative aims to identify the most cost-effective and efficient ways of using public resources for promoting conservation, sustainable development and collaborative management. The future of Puerto Rico's natural resources lies in these types of efforts and collaborations. DNER expects that the Model Forest will encourage the participation and commitment of volunteers and other entities in order to promote sustainable practices with landowners, farmers, retailers and municipalities within the agro-forestry zone in west-central Puerto Rico.

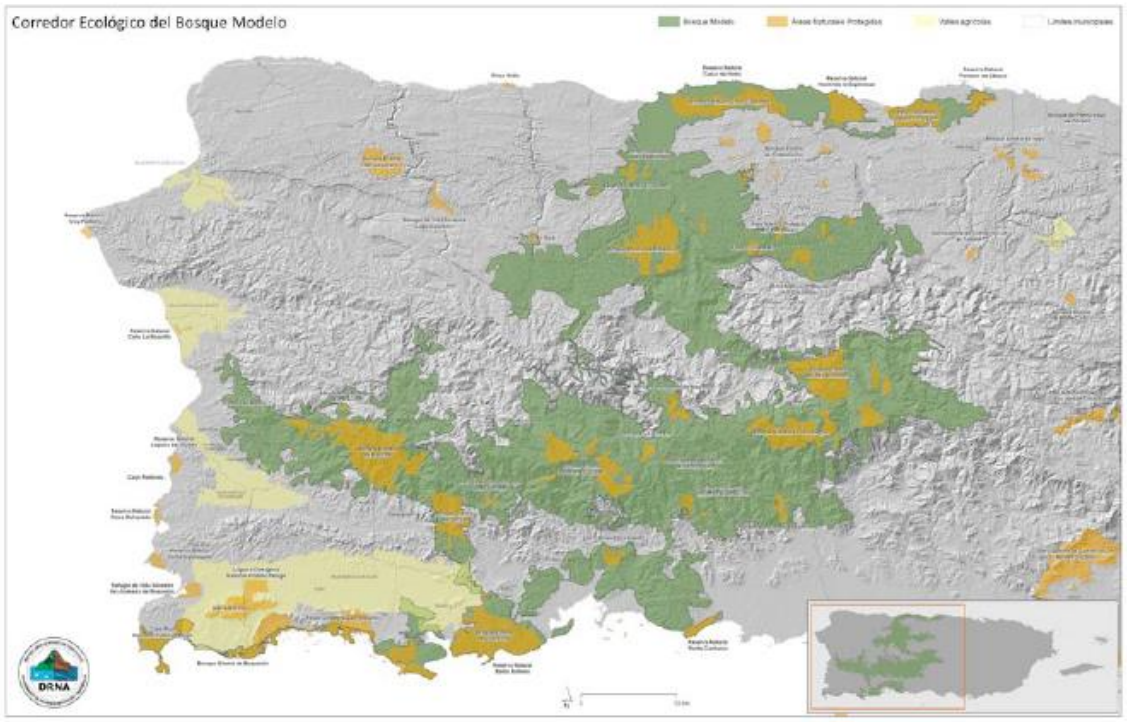


Figure 29. The Model Forest in west-central P.R.

Avian Conservation Planning Priorities Report (2015)

In this report (Nytch et al., 2015) 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 they 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. They also subsequently analyzed Gap Analysis Project (GAP) predicted species distribution and stewardship management data for 125 bird species associated with 11 distinct habitat types. Then, they synthesized their findings with recommendations from several relevant conservation reports in order to identify priority habitat areas and establish conservation objectives.

The 11 habitat types include forested and non-forested categories present in Puerto Rico 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 were grouped assemblages. For example, forested coastal wetlands include saline mangrove and freshwater Pterocarpus forests, and open water are a generalized habitat group that in reality includes reservoirs, fresh and salt water lagoons and mud flats, and other aquatic features. The following table (from Nytch et al., 2015), shows the general habitat cover types and their associated bird species in their prioritization analysis for Puerto Rico and US Virgin Islands.

Table 21 (From Nytch et al 2015): 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
Accipiter striatus venator++	Sharp-shinned Hawk	x	x						x			
Agelaius xanthomus++	Yellow-shouldered Blackbird		x		x	x	x	x				
Amazona vitatta vittata++	Puerto Rican Parrot	x	x	x					x			
Ammodramus savannanum++	Grasshopper Sparrow									x		
Anas bahamiensis+++++	White-cheeked Pintail					x				x	x	
Anas discors+++++	Blue-winged Teal										x	
Anous stolidus+++++	Brown Noddy											x
Anthracothorax dominicus+++	Antillean Mango		x						x	x		
Anthracothorax viridis++	Green Mango	x	x		x				x			
*Aramus guarauna**	Limpkin			x								
Aratinga chloroptera++	Hispaniolan Parakeet°		x	x					x			
Ardea herodias+++++	Great Blue Heron										x	
Arenaria interpres+++++	Ruddy Turnstone										x	x
Asio flammeus++	Short-eared Owl									x		
*Botaurus lentiginosus**	American Bittern										x	
Bubulcus ibis+++	Cattle Egret							x	x		x	
Buteo jamaicensis++	Red-tailed Hawk	x	x	x	x	x	x		x	x		
Buteo platypterus brunnescens++	Broad-winged Hawk	x	x	x								
Calidris alba+++++	Sanderling										x	x
Calidris canutus+++	Red Knot										x	

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Calidris fuscicollis+++*	Yellow-rumped Warbler				x		x	x			x	
Calidris himantopus+++**	Stilt Sandpiper										x	
Calidris mauri+++**	Western Sandpiper										x	x
Calidris melanotos+++**	Pectoral Sandpiper										x	
Calidris minutilla+++**	Least Sandpiper										x	x
Calidris pusilla+++**	Semipalmated Sandpiper										x	
*Caprimulgus carolinensis**+	Chuck-will's-widow	x	x	x								
Caprimulgus noctitherus++*	Puerto Rican Nightjar					x						
*Catharus bicknelli**	Bicknell's Thrush	x										
*Charadrius alexandrinus**+	Snowy Plover										x	x
*Charadrius melodus**+	Piping Plover										x	x
Charadrius semipalmatus+++**	Semipalmated Plover										x	x
Charadrius wilsonia+++**	Wilson's Plover											x
Chlorostilbon maugaeus++*	Puerto Rican Emerald	x	x	x	x	x	x		x			
Chordeiles gundlachii+++**	Antillean Nighthawk						x			x		
*Circus cyaneus**+	Northern Harrier										x	
Coccyzus americanus+++**	Yellow-billed Cuckoo					x	x	x				
Coccyzus minor+++**	Mangrove Cuckoo		x			x	x	x	x			
Coccyzus vieilloti++*	Puerto Rican Lizard-Cuckoo	x	x	x	x	x	x		x			
Coereba flaveola+++**	Bananaquit	x	x	x	x	x	x	x	x	x	x	
Contopus latirostris++*	Lesser Antillean Pewee			x		x						
*Corvus leucognaphalus**+	White-necked Crow°	x	x		x				x			
Cypseloides niger++*	Black Swift		x	x				x				

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Dendrocygna arborea+++*	West Indian Whistling-Duck										x	
Dendrocygna bicolor++*	Fulvous Whistling-Duck										x	
Egretta caerulea+++*	Little Blue Heron										x	
Egretta thula+++*	Snowy Egret										x	
Egretta tricolor+++*	Tricolored Heron										x	
Elaenia martinica+++++*	Caribbean Elaenia					x	x					
Eulampis holosericeus+++++*	Green-throated Carib				x		x					
Euphonia musica++*	Antillean Euphonia	x	x	x	x	x	x		x			
Falco peregrinus tundrius++++*	Peregrine Falcon										x	x
Falco sparverius+++++*	American Kestrel		x	x	x	x	x		x			
Fregata magnificens++++*	Magnificent Frigatebird											x
Fulica americana++++*	American Coot										x	
Fulica caribaea+++++*	Caribbean Coot										x	
Gallinago delicata++++*	Wilson's Snipe										x	
*Gelochelidon nilotica**+	Gull-billed Tern											x
*Geothlypis formosus**+	Kentucky Warbler		x		x				x			
Geothlypis trichas++++*	Common Yellowthroat										x	
Geotrygon chrysia++*	Key West Quail-Dove					x	x					x
Geotrygon mystacea+++++*	Bridled Quail-Dove			x	x		x					x
Haematopous palliatus++++*	American Oystercatcher											x
Helmitheros vermivorus++++*	Worm-eating Warbler	x	x	x					x			
Icterus portoricensis++*	Puerto Rican Oriole	x	x	x					x			
Ixobrychus exilis+++*	Least Bittern										x	
*Laterallus jamaicensis**	Black Rail°										x	

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*Leucophaeus atricilla******+*	Laughing Gull											x
*Limnodromus griseus*******+*	Short-billed Dowitcher										x	
*Lonchura malacca*****	Chestnut-sided Warbler	x	x		x							
*Loxigilla noctis****+*	Lesser Antillean Bullfinch					x	x					
*Loxigilla portoricensis***+*	Puerto Rican Bullfinch	x	x	x	x	x	x		x			
*Margarops fuscatus*******+*	Pearly-eyed Thrasher	x	x	x	x	x	x	x	x	x		
*Megascops nudipes*****+*	Puerto Rican Screech-Owl	x	x	x	x	x	x		x			
*Melanerpes portoricensis***+*	Puerto Rican Woodpecker	x	x	x	x	x	x	x	x			
*Mniotilta varia*******+*	Black-and-white Warbler	x	x	x								
*Molothrus bonariensis***+*	Shiny Cowbird	x	x	x	x	x	x	x	x	x		
*Myiarchus antillarum*******+*	Puerto Rican Flycatcher		x	x		x		x				
*Nesospingus speculiferus***+*	Puerto Rican Tanager	x	x						x			
*Nomonix dominicus**	Masked Duck										x	
*Numenius phaeopus******+*	Whimbrel										x	
*Nyctanassa violacea*******+*	Yellow-crowned Night-Heron							x			x	
*Nycticorax nycticorax*****+*	Black-crowned Night-Heron										x	
*Onychoprion anaethetus******+*	Bridled Tern											x
*Orthorhyncus cristatus*******+*	Antillean Crested Hummingbird				x	x	x					
*Oxyura jamaicensis*******+*	Ruddy Duck										x	
*Parkesia motacilla******+*	Louisiana Waterthrush		x	x					x			
*Parkesia novaboracensis******+*	Northern Waterthrush							x				
*Parula americana*******+*	Northern Parula	x	x	x	x	x	x		x			
*Patagioenas inornata wetmorei***+*	Plain Pigeon		x	x					x			

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*Patagioenas leucocephala****+++*	White-crowned Pigeon				x	x	x	x				x
*Patagioenas squamosa****+++*	Scaly-naped Pigeon	x	x	x					x			x
*Pelecanus occidentalis****+++*	Brown Pelican											x
Petrochelidon fulva++*	Cave Swallow								x	x	x	
*Phaethon aethereus****++*	Red-billed Tropicbird											x
*Phaethon lepturus****++*	White-tailed Tropicbird											x
*Phoenicopterus ruber****	American Flamingo°										x	x
*Pluvialis dominica****+*	American Golden-Plover										x	
*Pluvialis squatarola****+++*	Black-bellied Plover										x	x
*Podilymbus podiceps****+++*	Pied-billed Grebe										x	
Porphyrio martinica++*	Purple Gallinule										x	
Porzana flaviventer++*	Yellow-breasted Crake										x	
*Progne dominicensis****+++*	Caribbean Martin								x	x		
*Protonotaria citrea****+*	Prothonotary Warbler							x				
*Puffinus iherminieri****+*	Audubon's Shearwater											x
*Rallus longirostris****+++*	Clapper Rail							x			x	
*Seiurus aurocapillus****+*	Ovenbird	x	x	x	x	x	x	x	x			
Setophaga adelaidae+*	Adelaide's Warbler			x		x	x					
Setophaga angelae+*	Elfin-woods Warbler	x	x									
*Setophaga caerulescens****+++*	Black-throated Blue Warbler		x	x					x			
*Setophaga discolor****+++*	Prairie Warbler					x						
*Setophaga dominica****	Yellow-throated Warbler				x		x	x				
*Setophaga palmarum****	Palm Warbler							x			x	
*Setophaga petechia****+++*	Yellow (Golden) Warbler					x		x				

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*Setophaga ruticilla****++	American Redstart	x	x	x	x	x	x	x	x			
*Setophaga tigrina****+++	Cape May Warbler		x		x				x			
*Sphyrapicus varius***	Yellow-bellied Sapsucker					x	x					
*Spindalis portoricensis**+	Puerto Rican Spindalis	x	x	x	x	x	x		x			
*Sterna dougalli****++	Roseate Tern											x
*Sterna fuscata****++	Sooty Tern											x
*Sterna hirundo***+	Common Tern											x
*Sternula antillarum****++	Least Tern											x
*Sula dactylatra****++	Masked Booby											x
*Sula leucogaster****++	Brown Booby											x
*Sula sula****++	Red-footed Booby											x
*Tachybaptus dominicus*****++	Least Grebe										x	
*Thalasseus maximus****++	Royal Tern											x
*Thalasseus sandvicensis****++	Sandwich Tern											x
*Todus mexicanus**+	Puerto Rican Tody	x	x	x	x	x	x		x			
*Tringa flavipes****++	Lesser Yellowlegs										x	x
*Tringa melanoleuca****++	Greater Yellowlegs										x	x
*Tringa semipalmata*****++	Willet										x	x
*Tringa solitaria****++	Solitary Sandpiper										x	x
*Turdus plumbeus**+	Red-legged Thrush	x	x	x	x	x	x		x			
*Tyrannus caudifasciatus**+	Loggerhead Kingbird		x	x				x	x			
*Tyrannus dominicensis*****++	Gray Kingbird		x	x	x	x	x		x	x		
*Vermivora chrysoptera**	Golden-winged Warbler	x										
*Vermivora pinus***	Blue-winged Warbler					x	x					
*Vireo altiloquus*****++	Black-whiskered Vireo	x	x	x	x	x	x		x			

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*Vireo latimeri***	Puerto Rican Vireo	x	x	x		x	x		x			
*Wilsonia citrina**+++	Hooded Warbler		x	x	x			x	x			
*Zenaida asiatica**+++	White-winged Dove				x		x	x	x			x
*Zenaida aurita**+++	Zenaida Dove		x	x	x	x	x		x			x
*Zenaida macroura***+	Mourning Dove		x	x	x	x	x		x			x

Table 22: From Nitch et. al., (2015) is a summary of conservation level rankings relative to each habitat cover type for the bird species included in the prioritization analysis for Puerto Rico. Individual species can occur in more than one habitat type. Conservation action levels are as follows: 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.

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

Additional sources of information

Wildlife Conservation Areas, forest types, land cover, geographic shape, locations and descriptions

Several studies were conducted in order to select and describe wildlife conservation areas and their habitats. These studies provide geographic information about priority conservation areas (Figure 30), critical wildlife areas (Figure 31), wildlife-protected areas (Figure 32), forest type and land cover. Some priority conservation areas and critical wildlife areas are within the wildlife-protected areas managed and protected by DNER.

A map layer with wildlife conservation areas (Figure 33) was obtained by merging the geographic location of the priority conservation areas, critical wildlife areas and wildlife protected areas (Figure 34). Then, the Puerto Rico mainland forest types and land cover layers were clipped from this map (Helmer et al. 2002). Figures 35 to 40 present the geographic shape and locations of each of the different forest types and land cover as described by Helmer et al. (2002) within the wildlife conservation areas. With the information and analysis of our natural protected areas, DNER can then focus conservation actions and efforts according to the habitat types of interest.

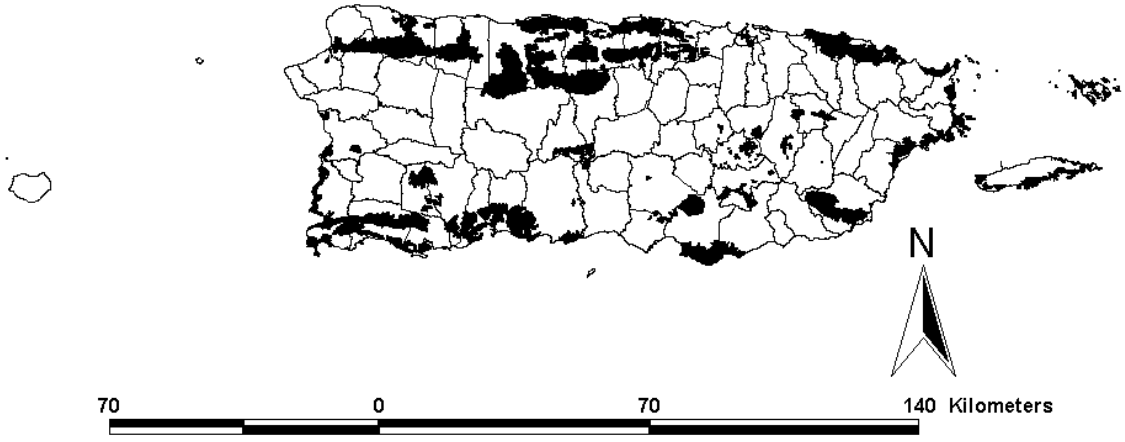

Figure 30. Marine and Terrestrial priority conservation areas

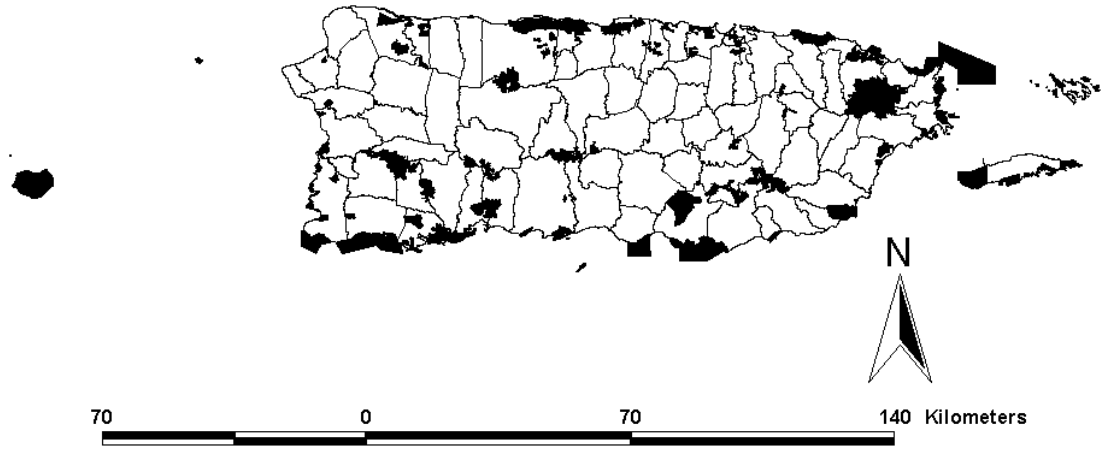

Figure 31. Critical Wildlife Areas and Waterfowl Focus Areas (marine and terrestrial)

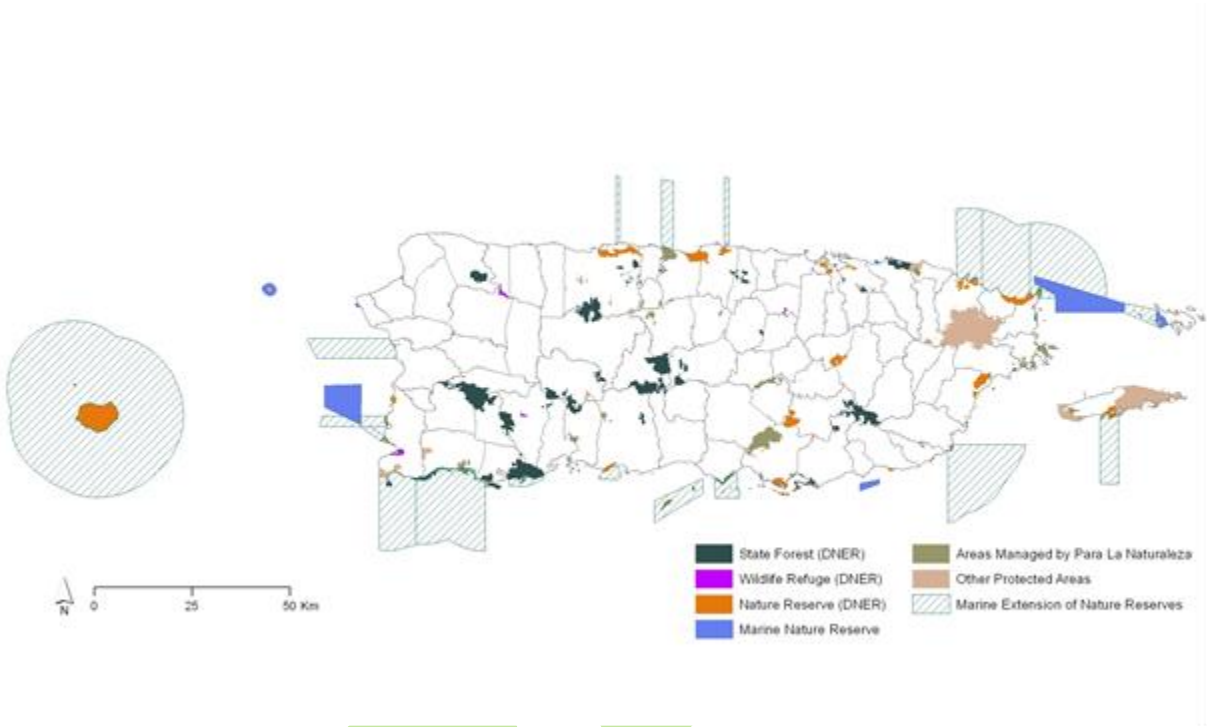

Figure 32. Marine and terrestrial wildlife protected areas

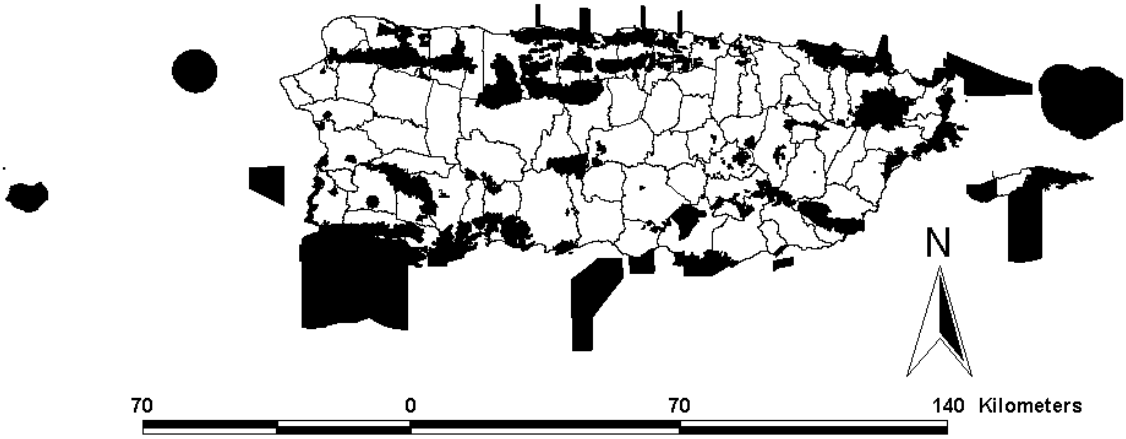

Figure 33. Marine and terrestrial wildlife conservation areas

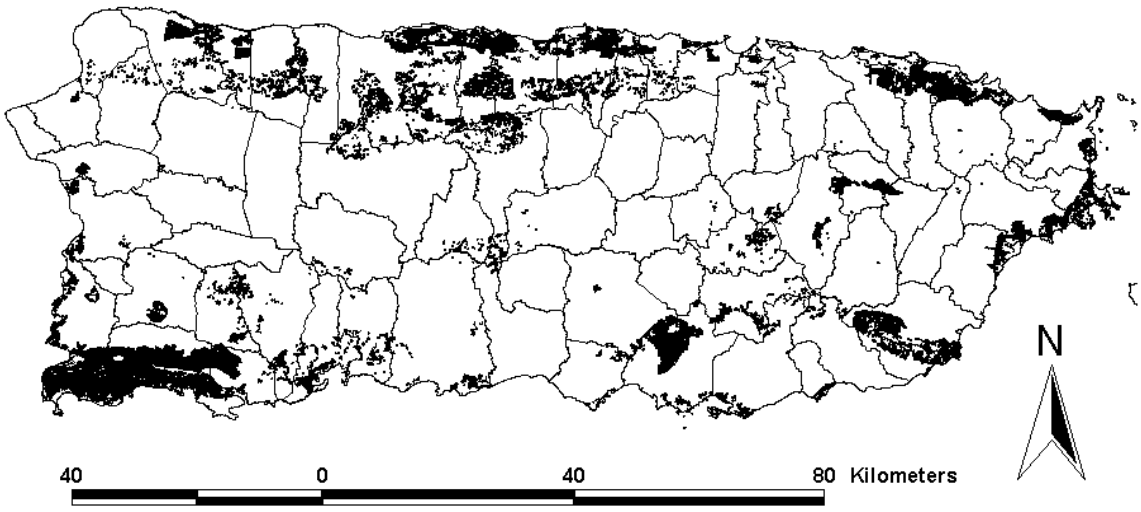

Figure 34. Agricultural land for conservation

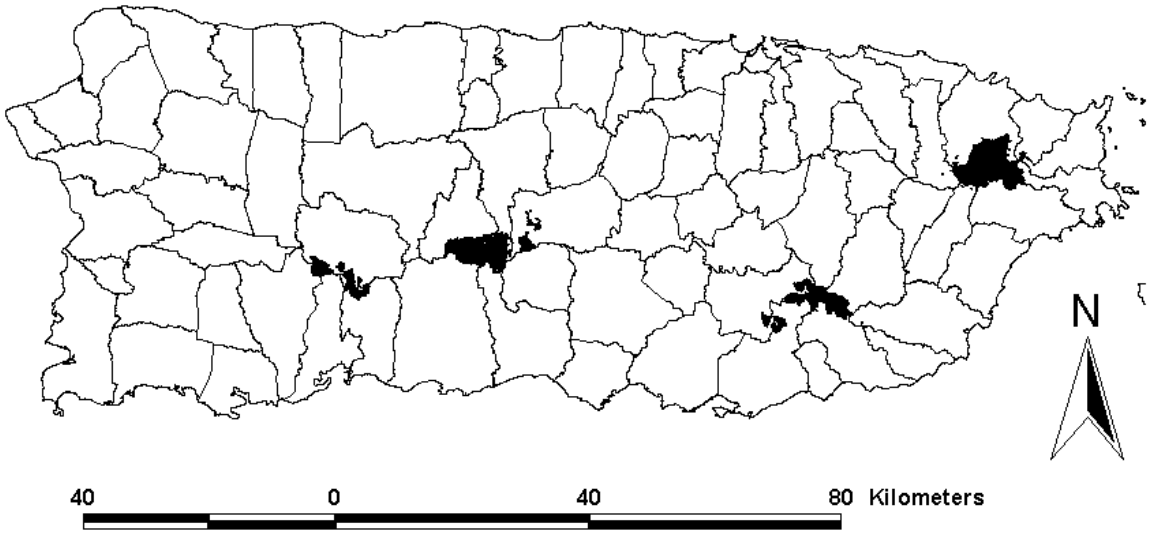

Figure 35. Lower montane wet evergreens forest for conservation

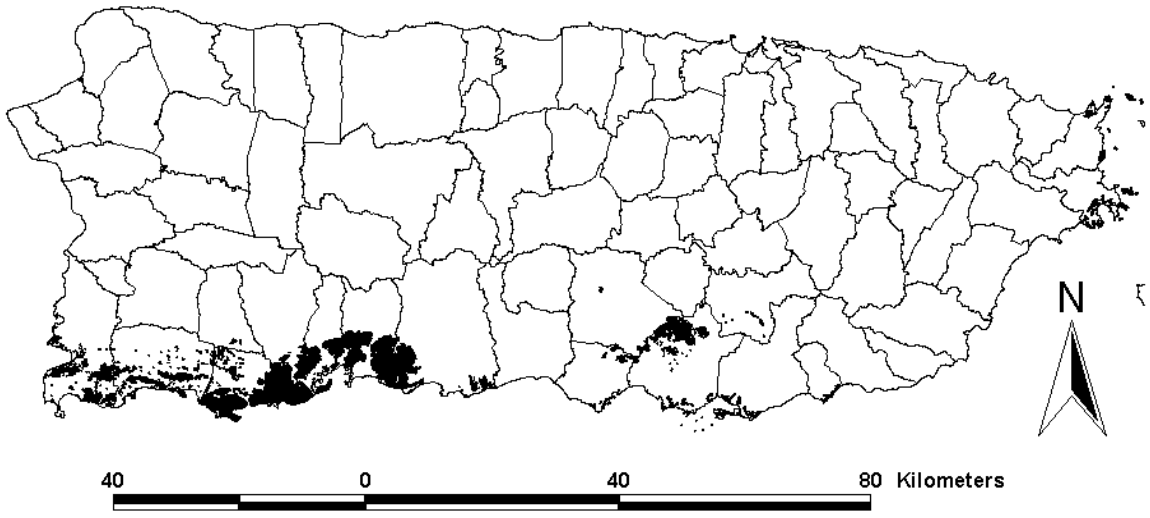

Figure 36. Lowland dry areas for conservation

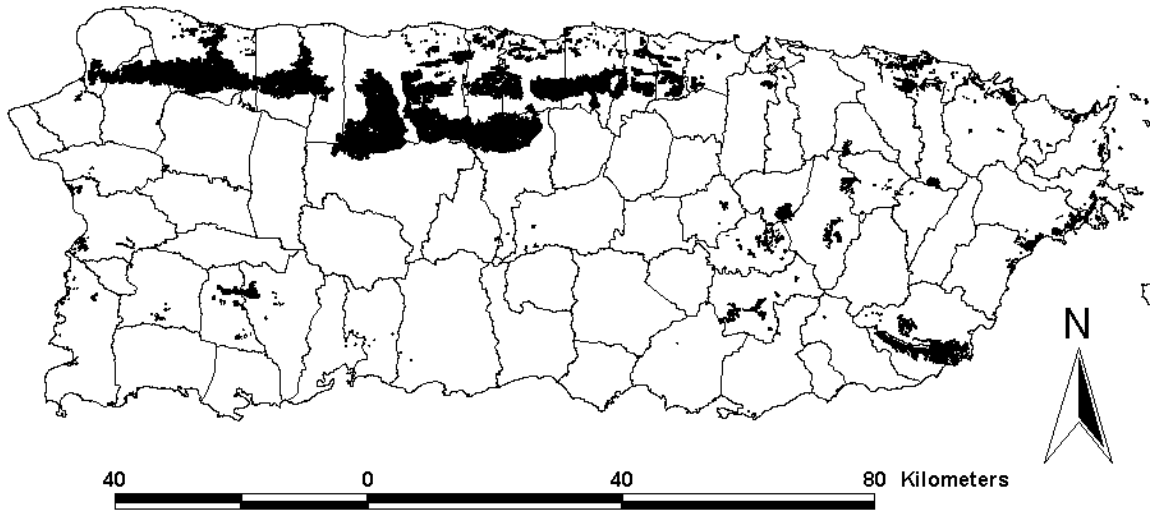

Figure 37. Lowland moist areas for conservation

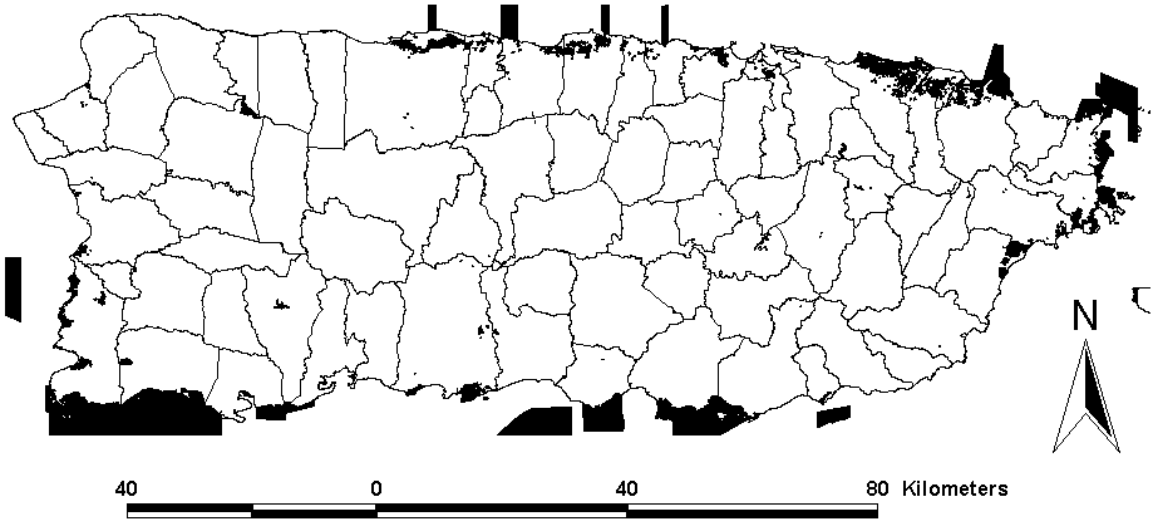

Figure 38. Wetlands, marine and terrestrial areas for conservation

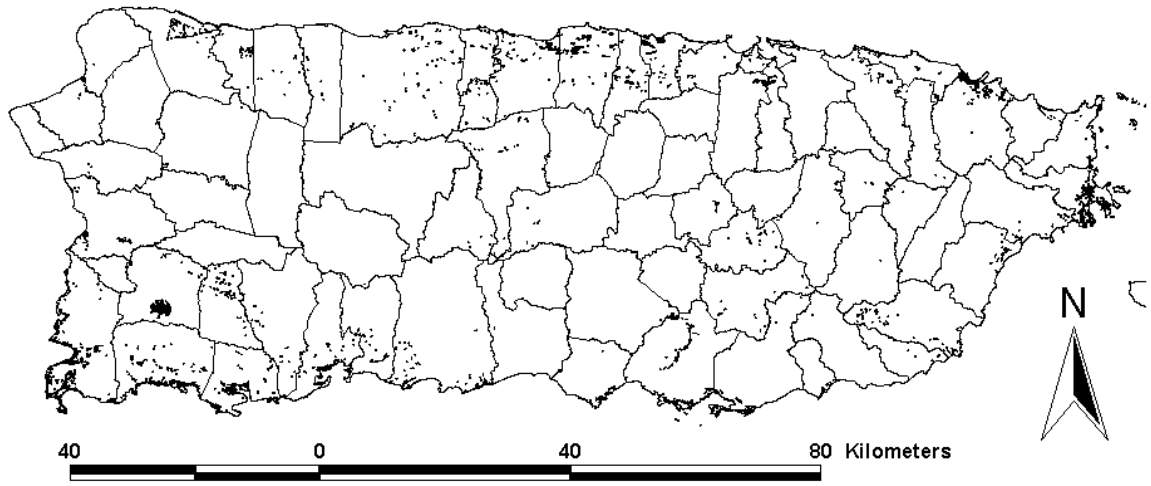

Figure 39. Deforested areas for conservation

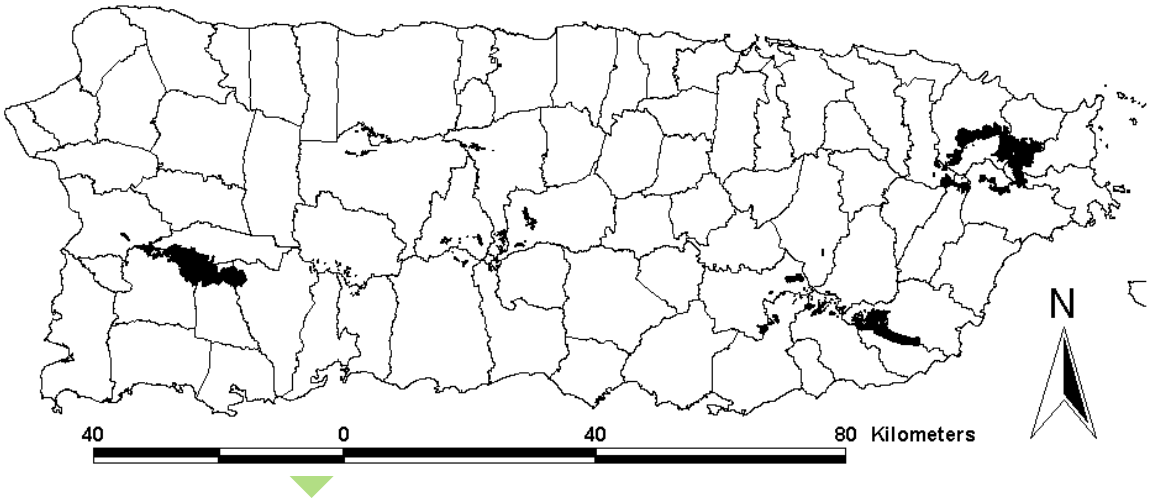

Figure 40. Submontane areas for conservation

CHAPTER 7. MONITORING AND ADAPTATION OF CONSERVATION ACTIONS

Monitoring is an essential element for the success of the Puerto Rico State Wildlife Action Plan. Understanding ongoing activities, their effectiveness will allow DNER and its conservation partners to adapt to changing conditions and new knowledge. This plan's monitoring strategy is built upon existing efforts conducted by DNER and other entities to monitor individual wildlife populations, as well as to identify, protect, and manage important habitats on the Island.

Monitoring the success of conservation actions, changes in land use and habitat conditions will provide up to date information for managers to design conservation actions and implement cost effective methods. Results from monitoring and evaluation efforts may also be used to effectively communicate conservation achievements to obtain support for programs with decision-makers such as legislators, funding organizations, non-profit organizations, and the general public.

Wildlife Permits

The New Puerto Rico Wildlife Law establishes that all related wildlife activities will be regulated by DNER. The Terrestrial Resources Division (TRD) of DNER is the office in charge of granting permits for scientific investigations, collections, importation, and exportation of wildlife, and education. One of the conditions of each permit is a report of authorized activities. These reports provide updated information on the status of studied species, and inform DNER about programs being conducted by non-governmental organizations or individuals to educate the public about the conservation of wildlife resources.

Regulation No. 6766 specifically mandates a five-year revision of the priority species list. It also dictates the preparation of recovery plans within a year for species listed as critically endangered, two years for endangered species, and three years for threatened species.

Game Species

The TRD has monitored game species populations for over 25 years through ground and aerial counts, and harvest data. Game species in Puerto Rico include migratory waterfowl, columbids, feral goats and pigs. However, non-game species such as native and resident waterfowl (e.g., White-cheeked pintail, West Indian whistling duck), and columbids (i.e., Puerto Rican Plain Pigeon) are also surveyed. These surveys are an important tool for continued monitoring of these priority species.

Threatened and Endangered Species

Commonwealth and federal legislations mandate the monitoring of Threatened and Endangered species. The DNER allocates monitoring priorities according to the level of endangerment of the species. There is a Cooperative Agreement between USFWS and the DNER under Section 6 of the Endangered Species Act for the recovery of the threatened and endangered species. DNER works closely with the USFWS establishing priorities for the recovery of listed species and the implementation of recovery actions with Section 6 funds. Nevertheless, limited funding and resources restrict the number of species that may be effectively monitored. To manage the lack of adequate resources, DNER has established cooperative agreements with universities, cooperative units, federal agencies,

non-governmental agencies, and more recently, private landowners in order to maintain the agency's primary mission.

Habitat Conservation and Protection

Wildlife habitat is evaluated and characterized according to the categories established in Regulations No. 6765 and 6766. The DNER Secretary designates habitat for endangered and threatened species as Critical Habitat (CH) or Critical Essential Habitat (CEH). The CEH cannot be modified unless a change in designation is supported by scientific data. For instance, a CH may be modified only if the proposed action has a vital public interest and there is no other option. Any alteration to a CH will require a mitigation of at least a 3:1 proportion with a habitat of the same ecological value or higher.

The DNER-Terrestrial Resources Division evaluates the potential impact that development will have on our wildlife species and their habitats. Personnel from this Division provide technical guidance about proposed actions in accordance with regulations. The action to be implemented will depend upon the habitat designation (Table 23).

Table 23. Wildlife habitat categories and actions proposed to deter habitat loss

Habitat Category	Protection	Action
Critical Essential	Endangered/Threatened Species (only known locality)	No Modification
Critical	Endangered/Threatened Species (Natural or Historical distribution) (Reintroduction Potential)	Restricted Modification Requires a 3:1 or higher habitats compensation (mitigation)

Irreplaceable	All Wildlife	No Net Loss
Essential	All Wildlife	No Net Loss or *in situ* or adjacent 1:1 compensation
High Ecological Value	All Wildlife	No Net Loss or *in situ* or adjacent 1:1 compensation
Ecological Value	All Wildlife	No Impact or *in situ*, adjacent or off-site 1:1 compensation
High Potential	All Wildlife	Mitigation through habitat enhancement or land acquisition
Low Potential	All Wildlife	Mitigation through habitat enhancement and other actions that improve habitat conditions

The preferred strategy coincides with the one championed by Nitch et. al., (2015) to conserve locations of habitat synergy that expands upon protected areas and create convergent habitat linkages among jurisdictions and across public and private lands. Similarly, habitat and wildlife protection measures described by Nitch et. al., (2015) are considered as valuable elements on this plan. Their proposed habitat conservation strategies for birds could be adopted, whith minor modifications, as strategies to protect all wildlife.

Several Conservation Strategies to consider include:

- Expanding private lands and public engagement programs (e.g., Safe Harbor Program, shade grown coffee incentives through Partners for Fish and Wildlife) to conserve, restore, and enhance the ecological functions and services 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 wildlife 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 wildlife 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 habitats, 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;

Technical Assistance for Wildlife Conservation in Puerto Rico

The Terrestrial Resources Division maintains a technical assistance program that provides landowners with up-to-date management information and techniques to sustain and enhance wildlife habitats on their properties. This project is also responsible for reviewing projects proposed by government and private entities that could impact wildlife resources and provide guidance on how to minimize any potential negative affect of such projects. The TRD and staff from other agency units created a matrix to categorize habitats proposed for modification to facilitate the decision-making process. Habitat categories range from irreplaceable to habitats with low potential of being transformed into a higher category (see Table 8). Management and restoration of target habitats such as wetlands, shade coffee plantations, tropical hardwood forests and riparian habitats are the primary focus of the program. The program monitors the number of private landowners consulted, the number of actual restoration and/or management projects developed, and the number of acres and/or kilometers enhanced, restored or protected.

Safe Harbor Agreements

The Safe Harbor Program is a conservation strategy that will be implemented by the DNER in order to monitor and manage species of concern on private lands. The program will support recovery efforts of many federal and commonwealth trust species. With the development of multiple recovery projects for endangered species in Puerto Rico (e.g., the establishment of a second wild population of the Puerto Rican parrot in northern Puerto Rico), a strong private lands program is critical for the success of these initiatives. Monitoring will be completed through regular visits to enrolled properties to ensure compliance with established agreements. DNER, possibly with the assistance of the USFWS, will monitor protected species to estimate the number of individuals occurring on enrolled lands.

Para la Naturaleza ("For Nature"; a unit of the Puerto Rico Conservation Trust)

The Puerto Rico Conservation Trust is a private non-profit organization that currently manages 14 reserves (~13,000 acres) throughout the island. This entity monitors habitat as it relates to native habitat preservation and restoration. This organization also works to educate the public regarding conservation of natural resources.

Ciudadanos del Carso ("Citizens of the Karst")

Ciudadanos del Carso is a private non-profit organization whose mission is the acquisition of land, particularly in the karst region of Puerto Rico, for protection and conservation. This organization monitors habitat as it relates to native habitat preservation and restoration. Ciudadanos del Carso also educates the public on the conservation of natural resources, and collaborates with other environmental organizations and government agencies in projects and studies related to the conservation of the karst region.

Joint Priority Landscapes

Joint Priority Landscapes are created when Federal and State agencies and non-governmental organizations independently establish complimentary conservation priorities. It often makes sense to leverage these resources against each other. Joint Priority Landscapes have the potential to take many forms, due to the variety of approaches (e.g. watersheds, ecological units, issue centered) that are available. These efforts explicitly seek public engagement in a unified manner respects the time and talent of community members.

Work on two (2) joint priority priority landscapes will be in progress during this action plan's implementation period:

1) The Guánica/Maricao joint priority landscape (Figure 41): This project is located in the southwestern corner of Puerto Rico. The Guanica/Maricao joint priority landscape will leverage most federal, state and independent conservation and management efforts. The NOAA Coastal Zone Management Program is working to protect the coral reef system, The Natural Resource Conservation

Service is working with local famers to improve water quality in the Rio Loco watershed and reduce soil erosion that affects streams and the reefs. Multiple wildlife and forestry agencies are collaborating with coffee growers to convert their plantations from sun coffee to shade coffee in order to benefit migratory birds and native wildlife. The EPA is considering a major estuary restoration effort. The US Forest Service and the DNER Forestry Bureau are working to promote the establishment of riparian buffer zones and agroforestry pilot programs in the area. The P.R. Fire Department, Guánica State Forest and the Cabo Rojo National Wildlife Refuge (USFWS) are working on strategies for managing wildlife fires. This landscape includes several important regional offices, including the Guánica State Forest (DNER), the Cabo Rojo Wildlife Refuge (USFWS) and the Maricao State Forest.

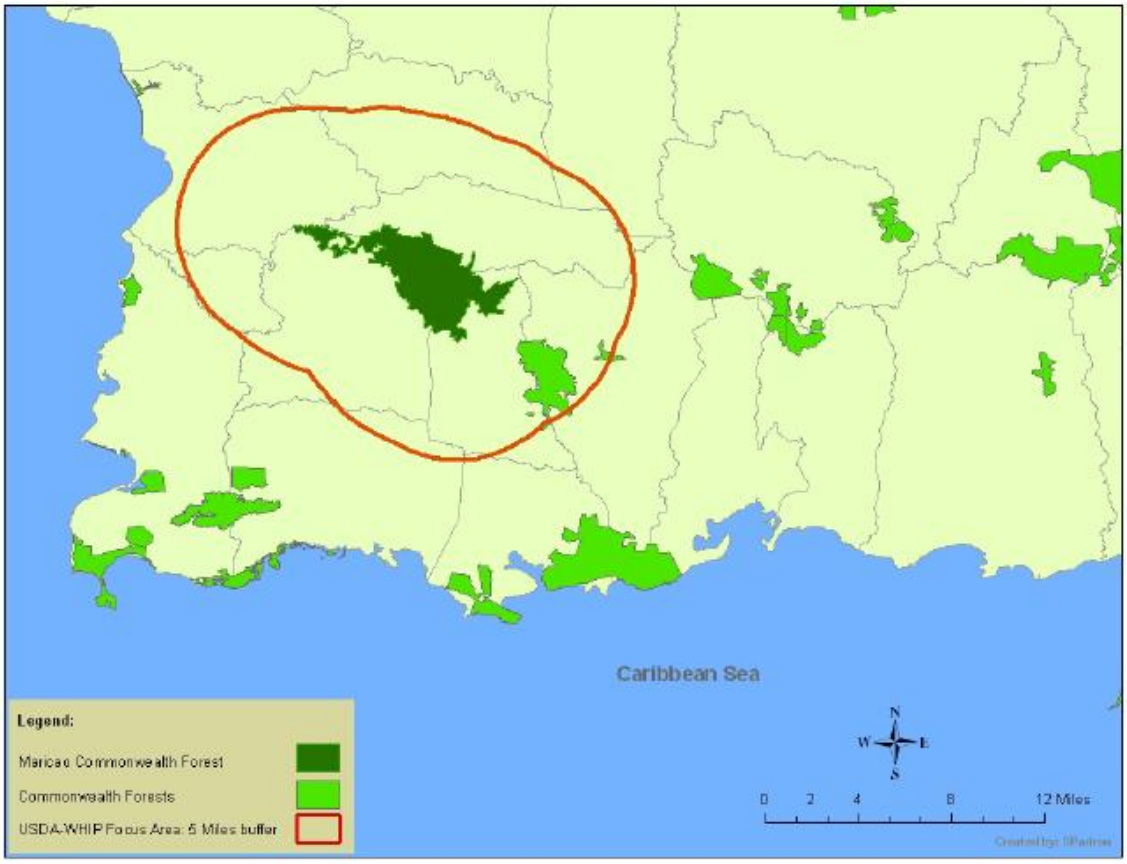

Figure 41. Overview of USDA-WHIP Focus Area, 5 miles around Maricao State Forest (From DNER 2011).

2) The Humacao joint priority landscape: This area is located in the southeastern corner of Puerto Rico, in an area of urban sprawl. All the federal and state partners in the NRCS State Technical committee have endorsed a collaborative effort in this area. The project would encourage the collaboration of several local communities in theconservation efforts. Efforts in the Humacao landscape will involve financial and technical assistance from federal agencies, as well as cost incentive programs. The DNER and the US Forest Service will be engaged through urban and community outreach programs, a forest stewardship program, a forest legacy program, and eventually a program creating new public spaces

for Humacao communities. Federal and state fish and wildlife agencies will continue their conservation efforts focused species and habitats that are considered endangered and threatened.

Adaptive Management

The Puerto Rico State Wildlife Action Plan does not pretend to be a fixed set of conservation strategies and goals. The main objective of the plan is to establish DNER's priorities for the conservation of wildlife species and their habitat in Puerto Rico. Once conservation actions are implemented, it is important to evaluate their progress and measure their effectiveness. Maintaining a loop between monitoring and management actions will help correct for the uncertainty resulting from management and adapt to new conditions and developments. Continued feedback among collaborators (e.g., DNER staff, stakeholders, academia, and the public) is essential in order to fill information gaps related to particular conservation actions, as well aspropose alternatives for improving project organization and fiscal responsibility. Conservation priorities and actions should be flexible in order to adapt to all possible situations.

Monitoring and conservation measures have been identified for many wildlife species in recovery or management plans. As mentioned previously, regular systematic surveys are conducted by DNER for some avian taxa. The Puerto Rican Ornithological Society conducts annual Audubon Christmas Bird Counts in southwestern and eastern Puerto Rico. However, most species require additional surveys, analysis, and conservation measures. For example, terrestrial invertebrates have not been adequately monitored, except for studies on specific species.

It is recognized that the monitoring phase will be time consuming and resource intensive. Thus, there will be a need to set limits on the number of species and habitats monitored. However, through this program, the DNER will encourage the participation of other parties (e.g., Universities, Conservation Organizations) by funding research projects that will provide information on the status of SGCN, particularly on data deficient species and habitats.

The specific long-term success of the PRSWAP conservation actions will be evaluated through different approaches: new scientific knowledge about SGCN and their habitats, number of funded and completed projects of conservation priority, net increase in the acreage of key habitats conserved through acquisition, restoration, or mitigation as mandated by Law No. 241, an increase of partnerships and public involvement resulting in the protection of wildlife resources, a reduction or elimination of threats to SGCN and priority habitats, and a long-term reduction in the number of SGCN and threats.

Portals of Information on the DNER Web Page

The development of a web site within the official DNER web page is recommended to facilitate the sharing up-to-date information related to current research findings, and monitoring data on species and habitats of concern.
http://www.drna.pr.gov

CHAPTER 8. REVISIONS TO THE PRSWAP – 10 YEARS

The DNER will conduct internal evaluations and revisions of the PRSWAP every 2.5 years in order to adaptively address conservation priorities within the 10-year timeframe (Table 20). Changes in priorities will be based on changes in landscape and environmental conditions, and on wildlife and habitat responses to such changes and to implemented conservation actions. Performance reports for federally assisted projects and State Wildlife Grant projects, reports from wildlife permits granted by the agency, and in-house updates to the species priority list (mandated under Regulation No. 6766) will be used to document progress on activities related to the PRSWAP.

A detailed evaluation of the PRSWAP will be completed every 5 years in order to assess the status of conservation strategies and initiatives, SGCNs, and the stressors that significantly affect the island's wildlife and habitats. Input from partners and the general public will be requested during these evaluations. Previously identified partners and stakeholders will be asked to collaborate in the 5-year review with DNER staff. This mid-term evaluation will allow corrections to the strategy within the anticipated 10-year timeframe.

Table 24. Planned Wildlife Action Plan 2015-2025 timeline.

FY 01	FY 02	FY 03-04	FY 05	FY 06-09	FY 10
July 1st, 2014 – June 30, 2015	July 1st, 2015 – June 30, 2016	July 1st, 2016 – June 30, 2018	July 1st, 2018 – June 30, 2019	July 1st, 2019 – June 30, 2024	July 1st, 2024 – June 30, 2025
↓	↓	↓	↓	↓	↓
PRSWAP Preparation	PRSWAP Completion and Implementation	PRSWAP Implementation	PRSWAP Mid-Term Evaluation	PRSWAP Implementation	PRSWAP Revision

CHAPTER 9. COORDINATION OF DEVELOPMENT, IMPLEMENTATION, REVIEW OF THE PLAN-STRATEGY WITH FEDERAL, STATE, AND LOCAL AGENCIES AND INVOLVEMENT OF GENERAL PUBLIC IN THE PRSWAP

History

The DNER officially began the PRSWAP revision in September 2014, assembling an expert committee comprised of DNER staff within the Fisheries and Wildlife Bureau and collaborating with external resources to revise and develop the new action plan. External resources included technical assistance from Effective Environmental Restoration Inc., meetings with USFWS staff in Puerto Rico and information and feedback provided by researchers and members of the academia.

The original version of the document was submitted to USFWS in June 2016. After a review period, the plan was conditionally approved in May 2017 by the Regional Review Team from FWS. This started a process of additional revisions to ensure that all required elements were met and information deficiencies corrected. This effort was led primarily by Mrs. Damaris Delgado (DNER), Mr. Eduardo Ventosa (Effective Environmental Restoration) and Dr. Ricardo López (DNER). The 2017 reviewing committee also included partners from the FWS Ecological Services Office, the Caribbean Landscape Conservation Cooperative (CLCC), and the National Wildlife Refuge Association.

The PRSWAP was made public on January 19th, 2018, on DNER's official website and social media channels. Physical copies will be distributed through DNER's regional offices, in order to facilitate access to the more remote areas of the island.

Coordination

The Puerto Rico State Wildlife Action Plan, was supported by a number of initiatives conducted before and after the development of the strategy that provided valuable information through data collection, final reports, and other scientific publications. Regulation No. 6766 was of particular importance to this endeavor. This regulation includes the original SGCN list, along with each species' status and threats. For the current revision, an expert committee assembled in 2011 worked to develop recommendations for the updated list of SGCN presented in this document.

Other key initiatives included in this revision include publications such as the Puerto Rico Critical Wildlife Areas (2005), the Puerto Rico Waterfowl Focus Areas (2005), and the Strategic Plan for Fisheries and Wildlife (PRDNER 1996). These documents have been subject to peer reviews by both private and public (State and Federal) agencies and organizations, providing and exchanging valuable information and input. Thus, these entities provided indirect input in the development and revision of the PRSWAP.

In 2010, the DNER created the "Puerto Rico Statewide Assessment and Strategies for Forest Resources". This publication describes forest conditions on all ownerships in Puerto Rico; identifies forests related benefits and services; identifies threats to forest resources; highlights issues and trends of concern related to Puerto Rico's forests and delineates high priority forest landscapes. It serves its three main goals: 1) Conserve forest landscapes; 2) Protect forest from harm; 3) Enhance benefits from trees and forests. This publication was an important resource in the revision of the PRSWAP.

Agencies and Organizations that Provided Input:

State Agencies:

P.R. Department of Natural and Environmental Resources (several units)

Federal Agencies:

U.S. Fish and Wildlife Service, Caribbean Field Office and Caribbean Landscape Conservation Cooperative (www.caribbeanlcc.org).

Non-profit Organizations:

Effective Environmental Restoration, Inc.

National Wildlife Refuge Association

Private Conservation Organizations:

Puerto Rican Ornithological Society

Academia:

University of Puerto Rico

Neftalí Rios, UPR Humacao

Interamerican University of Puerto Rico

Armando Rodriguez Durán

North Carolina State University

Jaime Collazo and Sara Prado

The draft of the Puerto Rico PRSWAP is currently posted on the DNER web page for revision. State and federal agencies, as well as other partners were

asked to review the document and submit their comments in order to incorporate these inputs into the final document. Partners are encouraged to integrate SGCN, habitat, and conservation actions identified in the PRSWAP into their future plans and programs, and are invited to collaborate with DNER on the implementation of these actions.

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APPENDIX I - CATEGORIES AND DEFINITIONS

Critically Endangered (CR): A taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. An observed, estimated, inferred or suspected population size reduction of ≥80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.
3. A population size reduction of ≥80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.
4. An observed, estimated, inferred, projected or suspected population size reduction of ≥80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km², and estimates indicating at least two of a-c:
    a. Severely fragmented or known to exist at only a single location.
    b. Continuing decline, observed, inferred or projected, in any of the following:
        (i) extent of occurrence
        (ii) area of occupancy
        (iii) area, extent and/or quality of habitat
        (iv) number of locations or subpopulations
        (v) number of mature individuals.
    c. Extreme fluctuations in any of the following:
        (i) extent of occurrence
        (ii) area of occupancy
        (iii) number of locations or subpopulations
        (iv) number of mature individuals.
2. Area of occupancy estimated to be less than 10 km², and estimates indicating at least two of a-c:
    a. Severely fragmented or known to exist at only a single location.
    b. Continuing decline, observed, inferred or projected, in any of the following:
        (i) extent of occurrence
        (ii) area of occupancy
        (iii) area, extent and/or quality of habitat
        (iv) number of locations or subpopulations
        (v) number of mature individuals.
    c. Extreme fluctuations in any of the following:
        (i) extent of occurrence
        (ii) area of occupancy
        (iii) number of locations or subpopulations
        (iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

(a) Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 50 mature individuals, OR

(ii) at least 90% of mature individuals in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

ENDANGERED (EN): A taxon is Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a very high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not

have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.
3. A population size reduction of ≥50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.
4. An observed, estimated, inferred, projected or suspected population size reduction of ≥50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 5,000 km², and estimates indicating at least two of a-c:
    a. Severely fragmented or known to exist at no more than five locations.
    b. Continuing decline, observed, inferred or projected, in any of the following:
        (i) extent of occurrence
        (ii) area of occupancy
        (iii) area, extent and/or quality of habitat
        (iv) number of locations or subpopulations
        (v) number of mature individuals.
    c. Extreme fluctuations in any of the following:
        (i) extent of occurrence
        (ii) area of occupancy
        (iii) number of locations or subpopulations
        (iv) number of mature individuals.
2. Area of occupancy estimated to be less than 500 km², and estimates indicating at least two of a-c:
    a. Severely fragmented or known to exist at no more than five locations.
    b. Continuing decline, observed, inferred or projected, in any of the following:
        (i) extent of occurrence
        (ii) area of occupancy

(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

C. Population size estimated to number fewer than 2,500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future) OR
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

(a) Population structure in the form of one of the following:
(i) no subpopulation estimated to contain more than 250 mature individuals, OR
(ii) at least 95% of mature individuals in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

VULNERABLE (VU): A taxon is Vulnerable when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are

clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 20,000 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than 10 locations.
b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.
c. Extreme fluctuations in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 2,000 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than 10 locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

(a) Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 1000 mature individuals, OR

(ii) all mature individuals are in one subpopulation.

b) Extreme fluctuations in number of mature individuals.

D. Population very small or restricted in the form of either of the following:

1. Population size estimated to number fewer than 1,000 mature individuals.

2. Population with a very restricted area of occupancy (typically less than 20 km²) or number of locations typically five or fewer such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years

Lower Risk (LR) - A species is at lower risk when, after an evaluation, it did not satisfy any of the categories of Critically Endangered, Endangered or Vulnerable, and it is not Data Deficient. Species included in the category of lower risk can be divided in three sub-categories:

1. Conservation Dependant (dc) - Species that are the center of a continuous conservation program of taxonomic or habitat specificity, focused on a particular species, which would be classified into one of the previous categories if the program ends within a period of five year.
2. Almost Threatened (ca) - Species that can not be classified as Conservation Depended, but are close to be classified as Vulnerable.
3. Lower Concern (lc) - Species that can not be classified as Conservation Depended or Almost Threatened.

Data Deficient (DD) - A species belongs to the category of Data Deficient when the information is not adequate for a direct or indirect evaluation of risk of extinction, over the base of distribution and/or condition of the population. A species in this category could 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 or risk category. Including a species in this category indicates that more information is required, and it is recognized that future investigations could determine that a threatened classification can be appropriate. It is important to make a conscious use of all data available. In many cases caution is advised when selecting between Data Deficient and a threatened condition. If it is suspected that the distribution of a species is relatively restricted, and a considerable period of time has passed since the last time the species was registered, then the threatened condition could be well justified.

APPENDIX II - LIST OF ACRONYMS

ACJV – Atlantic Coast Joint Venture

CH – Critical Habitat

CR – Critically Endangered

CWA – Critical Wildlife Areas

PRSWAP – Comprehensive Wildlife Conservation Strategy

DD – Data Deficient

DNER – Department of Natural and Environmental Resources

DNR – Department of Natural Resources

E – Endemic

CEH – Critical Essential Habitat

EN - Endangered

FY – Fiscal Year

I - Introduced

IITF – International Institute of Tropical Forestry

ITIS - Integrated Taxonomic Information System

LR – Low Risk

M - Migratory

N - Native

NCSU – North Carolina State University

NGO – Non-governmental Organization

NHP – Natural Heritage Program

PFW – Partners for Fish and Wildlife

PRCT – Puerto Rico Conservation Trust

PR-GAP – Puerto Rico Gap Analysis Project

PRLUP – Puerto Rico Land Use Plan

PRPP – Puerto Rican Plain Pigeon

PRSWAP – Puerto Rico State Wildlife Action Plan

PRWFA – Puerto Rico Waterfowl Focus Area

SGCN – Species of Greatest Conservation Need

SWG – State Wildlife Grants

T/E – Threatened and Endangered Species

TRD – Terrestrial Resources Division

USFWS – United States of America Fish and Wildlife Service

VU – Vulnerable

WCRP – Wildlife Conservation and Restoration Program

APPENDIX III - ROAD MAP

This roadmap is provided for those who are evaluating the Action Plan for the purpose of determining how well it meets the eight elements required by congress.

Element 1:

Information on the distribution and abundance of species of wildlife, including low and declining populations as the state deems appropriate, that are indicative of the diversity and health of the state's wildlife.

Sub-elements:

A. The Action Plan indicates sources of information (e.g., literature, data bases, agencies, individuals) on wildlife abundance and distribution consulted during the planning process.
B. The Action Plan includes information about both abundance and distribution for species in all major groups to the extent that data are available. There are plans for acquiring information about species for which adequate abundance and/or distribution information is unavailable.
C. The Action Plan identifies low and declining populations to the extent data are available.
D. All major groups of wildlife have been considered or an explanation is provided as to why they were not. The State may indicate whether these groups are to be included in a future Action Plan revision.
E. The Action Plan describes the process used to select the species in greatest need of conservation. The quantity of information in the Action Plan is determined by the State with input from its partners, based on what is available to the State.

Chapter	Sub-element addressed	Page(s)
Executive Summary	D	9-11
Introduction - Background	A, E	14-16
Introduction - Approach	B, D	17
Species of Greatest Conservation Need	A, B, C, D, E	23-45
Habitats of Greatest Conservation Need	B	139-189

Acknowledgments	A	8
Literature Cited	A	206-224

Element 2:

Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in Element 1.

Sub-elements:

A. The Action Plan provides a reasonable explanation for the level of detail provided; if insufficient, the Action Plan identifies the types of future actions that will be taken to obtain the information.
B. Key habitats and their relative conditions are described in enough detail such that the State can determine where (i.e., in which regions, watersheds, or landscapes within the State) and what conservation actions need to take place.

Chapter	Sub-element addressed	Page(s)
Executive Summary	A	9-11
Introduction	A, B	14-22
Habitat Requirements and Information Needs for Priority Species	A, B	46-74
Habitats of Greatest Conservation Need	A, B	139-189

Element 3:

Descriptions of problems which may adversely affect species identified in Element1 or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats:

Sub-elements:

A. The Action Plan indicates sources of information (e.g., literature, databases, agencies, or individuals) used to determine the problems or threats.

B. The threats/problems are described in sufficient detail to develop focused conservation actions.

C. The Action Plan considers threats/problems, regardless of their origins (local, State, regional, national and international), where relevant to the State's species and habitats.

D. If available information is insufficient to describe threats/problems, research and survey efforts are identified to obtain needed information.

E. The priority research and survey needs, and resulting products, are described sufficiently to allow for the development of research and survey projects after the Action Plan is approved.

Chapter	Sub-element addressed	Page(s)
Introduction	A, C	14-22
Habitat Requirements and Information Needs for Priority Species	C, D	46-74
Identifying Stressor/Threats to Puerto Rico Wildlife	A, B, C, D, E	75-100
Acknowledgments	A	8
Literature Cited	A	206-224

Element 4:

Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions:

Sub-elements:

A. The Action Plan identifies how conservation actions address identified threats to species of greatest conservation need and their habitats.

B. The Action Plan describes conservation actions sufficiently to guide implementation of those actions through the development and execution of specific projects and programs.

C. The Action Plan links conservation actions to objectives and indicators that will facilitate monitoring and performance measurement of those conservation actions.

D. The Action Plan describes conservation actions (where relevant to the State's species and habitats) that could be addressed by Federal agencies or regional, national or international partners and shared with other States.

E. If available information is insufficient to describe needed conservation actions, the Action Plan identifies research or survey needs for obtaining information to develop specific conservation actions.

F. The Action Plan identifies the relative priority of conservation actions.

Chapter	Sub-element addressed	Page(s)
Executive Summary	C, D	9-11
Introduction	C, D	14-22
Habitat Requirements and Information Needs for Priority Species	A, B, C, D, E, F	46-74
Identifying Stressor/Threats to Puerto Rico Wildlife	A, B, C, D, E, F	75-100
Conservation Strategies for Puerto Rico Wildlife Action Plan	A, B, C, D, E, F	101-138

Element 5:

Proposed plans for monitoring species identified in Element 1 and their habitats, for monitoring the effectiveness of the conservation actions proposed in Element 4, and for adapting these conservation actions to respond appropriately to new information or changing conditions:

Sub-elements:

A. The Action Plan describes plans for monitoring species identified in Element 1, and their habitats.

B. The Action Plan describes how the outcomes of the conservation actions will be monitored.
C. If monitoring is not identified for a species or species group, the Action Plan explains why it is not appropriate, necessary or possible.
D. Monitoring is to be accomplished at one of several levels including individual species, guilds, or natural communities.
E. The monitoring utilizes or builds on existing monitoring and survey systems or explains how information will be obtained to determine the effectiveness of conservation actions.
F. The monitoring considers the appropriate geographic scale to evaluate the status of species or species groups and the effectiveness of conservation actions.
G. The Action Plan is adaptive in that it allows for evaluating conservation actions and implementing new actions accordingly.

Chapter	Sub-element addressed	Page(s)
Introduction	A, B, C, D, E, F, G	14-22
Executive Summary	A, B, C, D, E, F, G	9-11
Habitat Requirements and Information Needs for Priority Species	A, B	46-74
Monitoring and Adaptation of Conservation Actions	A, B, C, D, E, F, G	190-201

Element 6:

Descriptions of procedures to review the Action Plan at intervals not to exceed 10 years:

Sub-elements:

A. The State describes the process that will be used to review the Action Plan within the next ten years.

Chapter	Sub-element addressed	Page(s)
Executive Summary	A	9-11
Introduction	A	14-22
Revisions to the PRSWAP	A	202

Element 7:

Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Action Plan with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats:

Sub-elements:

A. The State describes the extent of its coordination with and efforts to involve Federal, State and local agencies, and Indian Tribes in the development of its Action Plan.
B. The State describes its continued coordination with these agencies and tribes in the implementation, review and revision of its Action Plan.

Chapter	Sub-element addressed	Page(s)
Introduction	A, B	14-22
Revision to the PRSWAP	A, B	202
Coordination of Development, Implementation, Review, and Revision	A, B	203-205

Element 8:

Provisions to ensure public participation in the development, revision, and implementation of projects and programs. Congress has affirmed that broad public participation is an essential element of this process:

Sub-elements:

A. The State describes the extent of its efforts to involve the public in the development of its Action Plan.

B. The State describes its continued public involvement in the implementation and revision of its Action Plan.

Chapter	Sub-element addressed	Page(s)
Introduction	A, B	14-22
Coordination of Development, Implementation, Review, and Revision	A, B	203-205

APPENDIX V – SGCN REMOVED FOR THIS REVISION

Common Name	Scientific Name	Category 2005
Marine Mammals		
Minke Whale	*Balaenoptera acutorostrata*	DD
Sei Whale	*Balaenoptera borealis*	EN
Fin Whale	*Balaenoptera physalus*	EN
Short-Finned Pilot Whale	*Globicephala macrorhynchus*	DD
Risso's Dolphin	*Grampus griseus*	DD
Killer Whale	*Orcinus orca*	DD
False Killer Whale	*Pseudorca crassidens*	DD
Striped Dolphin	*Stenella coeruleoalba*	DD
Spinner Dolphin	*Stenella longirostris*	DD
Birds		
Peregrine Falcon	*Falco peregrinus tundrius*	CR
Reddish Egret	*Egretta rufescens*	DD
Mangrove Cuckoo	*Coccyzus minor*	DD
Bobolink	*Dolichonyx oryzivorus*	DD
Common Yellowthroat	*Geothlypis trichas*	DD
Red Siskin	*Carduelis cucullata*	DD
Black Rail	*Laterallus jamaicensis*	DD
Stilt Sandpiper	*Calidris himantopus*	DD
Whimbrel	*Numenius phaeopus*	LR
Freshwater Fishes		
Hognose mullet	Joturus pichardi	CR
Puerto Rican Galliwasp	Diploglossus pleei	-
	Eleotris amblyopsis	DD

Common Name	Scientific Name	Category 2005
Large Scaled Spinnycheeck Sleeper		
Flautín de Agua Dulce	Pseudophalus mindii	DD
	Malanorhinus boeki	DD
Spinycheek Sleeper	Eleotris pisonis	DD
Saltwater Fishes		
Sword-spine Snook	Centropomus ensiferus	DD
Fat Snook	Centropomus parallelus	DD
Fairy Basslet	Gramma loreto	DD
Jackknife	Equetus lanceolatus	DD