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FINAL BIOLOGICAL ASSESSMENT SELECT PORTIONS OF THE SURFACE IMPACT AREA
AND EASTERN MANEUVER AREA FORMER VIEQUES NAVAL TRAINING RANGE VIEQUES
ISLAND PUERTO RICO
12/01/2010
GEO-MARINE INC

Biological Assessment

Select Portions of the Surface Impact Area and Eastern Maneuver Area Former Vieques Naval Training Range

Vieques, Puerto Rico



prepared for



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Virginia Beach, Virginia 23462

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December 2010

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**Under contract Number:
N62470-08-D-1000
P.O. Number 936323**

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LIST OF ACRONYMS AND ABBREVIATIONS

ac	Acre(s)
BA	Biological Assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species
cm	Centimeter(s)
CPC	Center for Plant Conservation
CWA	Clean Water Act
DGM	Digital Geophysical Mapping
DOI	Department of Interior
DON	Department of Navy
EMA	Eastern Maneuver Area
EO	Executive Order
ESA	Endangered Species Act
ft	Foot(Feet)
GIS	Geographic Information Systems
GMI	Geo-Marine, Inc.
GPS	Global Positioning System
in.	Inch(es)
IUCN	International Union for Conservation of Nature
LIA	Live Impact Area
LUMP	Land Use Management Plan
m	Meter(s)
MBTA	Migratory Bird Treaty Act
MEC	Munitions and Explosive of Concern
mi	Mile(s)
mi ²	Square Mile(s)
mm	Millimeter(s)
MRP	Munitions Response Program
MSL	Mean Sea Level
NAVFAC	Naval Facilities Engineering Command
NLV	Navy Lands of Vieques
NWI	National Wetlands Inventory
OP1	Observation Point One
PRDNER	Puerto Rico Department of Natural and Environmental Resources
SDF	Subtropical Dry Forest
SIA	Surface Impact Area
T&E	Threatened and Endangered
U.S.	United States
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife
UXO	Unexploded Ordnance
VNTR	Vieques Naval Training
WWF	World Wildlife Fund

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1.0 INTRODUCTION

This biological assessment (BA) has been prepared in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 United States Code [U.S.C.] 1531 et seq.), other regulations contained in 50 Code of Federal Regulations (CFR) Part 402.12, and other relevant guidelines. Geo-Marine, Inc. (GMI) prepared this BA to evaluate the potential effects of the Naval Facilities Engineering Command (NAVFAC) Atlantic proposed munitions cleanup response actions, within portions of the former Surface Impact Area (SIA) and Eastern Maneuver Area (EMA) of the former Vieques Naval Training Range (VNTR) located on Vieques Island, Puerto Rico, on threatened and endangered species, rare species, and/or designated critical habitats and communities. The results of this evaluation are presented as potential effects on protected species and unique habitats, indicating if any such species and/or habitat are likely to be adversely affected by the action.

The primary objectives of this BA are:

1. Provide an overview of the project;
2. Describe the proposed actions;
3. Provide detailed natural history information for all known or potentially occurring federally-listed endangered or threatened species, other sensitive species, and critical habitats and communities occurring in the project area;
4. Evaluate the potential effects of the proposed actions on these listed species and/or habitats;
5. Provide a description of recommended conservation measures or action alternatives to avoid or minimize potential effects to listed species and/or habitats.

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2.0 PROPOSED ACTION

2.1 PURPOSE AND NEED

The purpose of this project is to remove unexploded ordnance (UXO) within portions of the SIA and EMA areas of the VNTR. This BA examines whether UXO response actions in both areas will adversely affect listed species or the vegetation communities they are dependent on and/or result in the modification of existing rare or endangered plant communities.

2.2 BACKGROUND

In 2003, the United States (U.S.) Navy turned over the former VNTR to the Department of Interior (DOI) U.S. Fish and Wildlife Service (USFWS). Environmental cleanup actions are to be conducted in a phased approach under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The CERCLA response action addresses areas that pose an imminent threat to human health, safety, and the environment. The CERCLA approach may include the following response actions: site inspections, site investigations, time-critical removal actions, and permanent remedial actions. A portion of the cleanup involves removal of surface UXO to mitigate the hazard posed by UXO to authorized and unauthorized land users.

This assessment is intended to aid NAVFAC Atlantic efforts to determine best the approaches and management tools to minimize the impact of cleanup activities on endangered, threatened, and rare plant communities and wildlife species that are dependent on these communities for survival.

2.3 DESCRIPTION OF THE PROPOSED ACTION FOR MUNITIONS RESPONSE

The Munitions Response Program (MRP) for the VNTR is anticipated to be a multi-phased approach that will extend over several years. The munitions response actions include site inspections, site investigations, interim removal actions, time-critical removal actions, and permanent remedial actions (Department of Navy [DON] 2005). The following munitions response actions may be implemented within the areas assessed:

- Site preparation, including vegetation removal from the areas to be cleared of munitions items and performance of UXO safety support required for this operation;
- Locating surface munitions using a visual and a detector-aided approach;
- Locating subsurface anomalies that could represent munitions and explosives of concern (MECs) through digital geophysical mapping (DGM); and,
- Identification, removal, and disposal (detonation) of surface and subsurface munitions equal to and greater in size to a 20-milimeter (mm) projectile.

All removal actions will be conducted in accordance with methods described in the *Non-time-critical Removal Action Work Plan, Surface Munitions and Explosives of Concern at Munitions Response Area-Surface Impact Area Munitions Response Sites 1 through 7* (CH2M HILL, January 2009) and *Work Plan for Munitions and Explosives of Concern Subsurface Interim Removal Action Beaches and Roadways, Former Vieques Naval Training Range (VNTR) and Former NASD Solid Waste Management Unit 4, Vieques Puerto Rico* (DON 2008) and subsequent amendments.

3.0 PROJECT AREA DESCRIPTION

3.1 PROJECT AREA

The project area is located on the island of Vieques in the Caribbean Sea, approximately 6 miles (mi) southeast from the main island of Puerto Rico and 22 mi southwest of St. Thomas, U.S. Virgin Islands. Vieques covers approximately 33,000 acres (ac; 51.5 square miles [mi^2]). Over 68% of the island was maintained by the U.S. Navy as the VNTR. The SIA is located immediately west of the former Live Impact Area (LIA) and occupies approximately 2,500 ac. The EMA is located immediately west of the SIA and occupies approximately 11,552 ac.

3.1.1 Action Area

The action area is the area of potential impacts to listed, threatened, or rare species and critical habitat associated with actual project activities throughout the VNTR. Pursuant to 50 CFR 402.02, the action area for the proposed project is comprised of “all areas to be directly or indirectly affected by the proposed action”. The action area encompasses portions of the SIA and EMA near the eastern end of Vieques Island, Puerto Rico. **Figure 3-1** provides an outline of the survey areas with actual surveyed transect lines denoted by lines within the yellow-orange-red highlighted areas. Mangrove and other limited access areas are also depicted in this figure. Additional survey areas are also included as light yellow-white highlight.

3.2 DESCRIPTION OF BASELINE CONDITIONS

3.2.1 Topography

A series of rolling hills and peaks, and narrow, low-lying coastal zones characterize the topography of the project area. The highest elevations on Vieques are found on the western portion of the island, declining along an axis that runs through the center of the island to the east. The highest peak in the project area is Observation Point One (OP1), which lies near the eastern end of the SIA and western end of the LIA at an elevation of 446 feet (ft) above mean sea level (MSL).

3.2.2 Soils

Soils in the project area are described in the *Soil Survey of Humacao Area of Eastern Puerto Rico* (Boccheciamp 1977). Contained within the project area are portions of three different soil associations. These soil associations, listed in order of abundance, consist of the Descalabrado-Guayama association, Coamo-Guamani-Vives association, and Swamps-Marshes association. These three soil associations are described by Boccheciamp (1977) as follows:

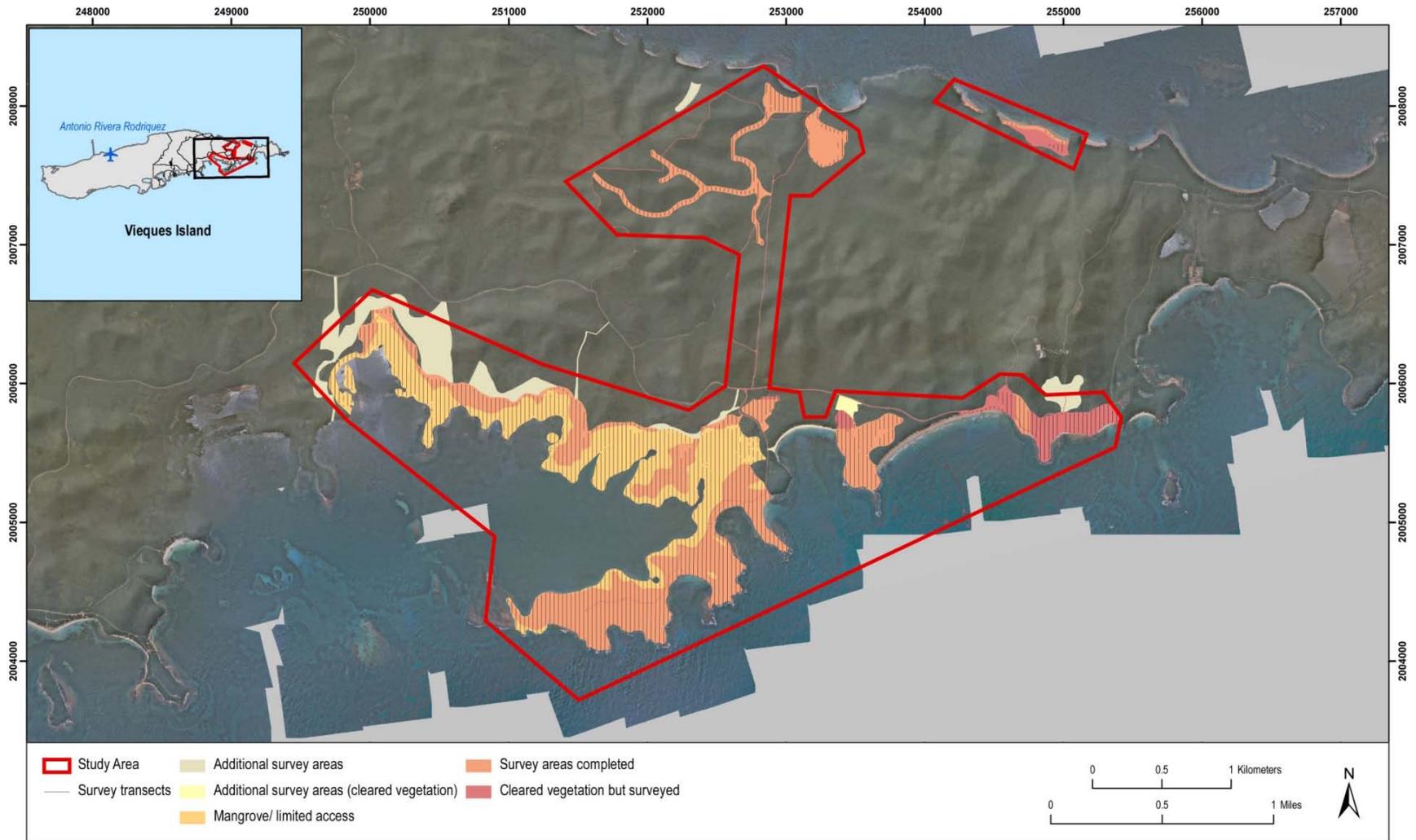


Figure 3-1. SIA and EMA survey area with transects.

- The Descalabrado-Guayama association consists of soils that formed in moderately fine-textured to fine residual material derived from basic volcanic rocks. These soils are shallow, well drained, and strongly sloping to very steep. The soils of this association are used for pasture or are in brush. They have severe limitations for farming, recreation, and urban uses because they are shallow to bedrock, lack sufficient moisture, are steep, and are susceptible to erosion.
- The Coamo-Guamani-Vives association consists of soils that formed in sediment derived from limestone and volcanic rocks. The Coamo soils are deep, well drained, and nearly level to strongly sloping, and they occur on terraces. The Guamani soils are shallow to sand and gravel, well drained, and nearly level, and they occur on floodplains. The Vives soils are deep, well drained, and nearly level to strongly sloping, and they are found on floodplains, alluvial fans, and terraces.
- The Swamps-Marshes association is in level or nearly level, narrow strips adjacent to the ocean. The areas are slightly above sea level but are wet and, when the tide is high, are covered or affected by salt water or brackish water. The high concentration of salt inhibits the growth of all vegetation except mangrove trees and, in small, scattered patches, other salt-tolerant plants. The soils are sandy or clayey and contain organic material from decaying mangrove trees. They are underlain by coral, shells, and marl at varying depths. This association is not extensive and has no value for farming, but it serves as a feeding and breeding place for birds and crabs.

Twenty different soil series are contained within the three soil associations found in the project area.

3.2.3 Hydrology

Vieques Island has very limited freshwater resources due to the climatic and physiographic conditions. There are 24 watersheds or parts of watersheds found within the project area. Watershed size, geology, topography, and plant cover factor into the water regimes present in the project area. Although there are some large watersheds, the geology (which allows for increased infiltration and percolation to aquifers) and topography (which allows for rapid runoff) prevent the development of any permanent freshwater streams in the project area. The National Wetlands Inventory (NWI) map identifies and classifies potential wetlands including streams and other water resource habitats. All project area streams are classified as temporarily flooded water regime based on the NWI map of Vieques Island. Temporarily flooded streams, also considered ephemeral streams, only contain water during and shortly after rainfall events.

There are 14 lagoons within mangrove-forested areas identified by Lewis (1985). All of these lagoons are classified as estuaries with various water regimes (i.e., subtidal, irregularly exposed, regularly flooded, or irregularly flooded). All lagoons with a subtidal water regime have a permanent water regime, whereas all others are flooded or saturated depending upon the rainfall patterns.

3.2.4 Plant Communities

The project area supports a variety of habitat types and plant communities (DON 1986). They include bare ground, beach, salt/sand flat, lagoon, mangrove, evergreen scrub, mixed woodland, forest scrub, forested, sparse thorn scrub, thick thorn scrub, and grassland.

The primary plant community in the project area occupies the life zone classified by the Holdridge System as the subtropical dry forest (SDF; Ewel and Whitmore 1973). The subtropical dry forest is the driest zone found in the region that has a nearly complete cover of deciduous vegetation (e.g. – *Plumeria alba*, *Pisonia alba*, *Bursera simaruba*). The World Wildlife Fund (WWF) applies a critical conservation status to SDF communities (Ricketts et al. 1999, 2010). The moist coastal forest is found in patches within the project area usually at the higher elevations as you move into the interior of the island.

The SDF evergreen scrub consists mainly of drought-resistant shrubs with sclerophyllous (leathery) leaves and occurs on rocky coasts and limestone formations. This community type generally covers rocky soils exposed to the sea breeze and extends inland for variable distances. Evergreen scrub is most extensive on limestone uplift formations. This scrub community is composed of a variety of shrubs that grow on rocky coasts and limestone formations that are exposed to sea breezes. Dominant species in this community vary by location but include spoon tree (*Cassine xylocarpa*), uverillo (*Coccoloba microstachya*), Alelí palmetto (*Thrinax morrissi*), crabwood (*C. krugii*), and black torch (*Erithalis fruticosa*). Many clumps of the regionally unique orchid *Psychilis maconnellae* are present in these communities. The density of evergreen scrub woodland varies considerably, from an almost impenetrable low forest in the center of these limestone areas to a sparsely populated transitional zone where the evergreen shrubs grade into the acacia-mesquite thorn scrub associations further inland.

The mixed woodland/upland forest community (moist deciduous formations) is found mostly on inland hills and slopes. Typical species are almacigo (*Bursera simaruba*), ironwood (*Krugiodendron ferreum*), caper trees (*Capparis* spp.), “fish poison” (*Piscidia carthaginensis*), fustic (*Pictetia aculeata*), cat’s claw (*Macfadyena unguis-cati*), and myrtle trees (*Eugenia* spp.). Other important associates are candle-berry (*Byrsonium lucida*), goatbush (*Pithecellobium unguis-cati*), and the large pipe organ cactus (*Cephalocereus royenni*). Patches of forest vegetation are broken up by microphyllous scrub of up to 16 ft in height and mixed low scrub, 6 to 10 ft in height, consisting mainly of sage (*Lantana involucrata*).

Quebrada drainage systems commonly have a forest scrub community association. This forest community is typically limited in distribution to quebradas with perched water tables. It can occur along the inland borders of mangrove forests, and the dominant tree is usually oxhorn bucida (*Bucida buceras*). The trees occur in pure stands forming a partially closed canopy; however, genogeno (*Lonchocarpus domingensis*) and dense stands of *Acacia* spp. and mesquite trees (*Prosopis* spp.) may also be present.

Other trees or shrubs, if present, are usually widely scattered and are less than 10 ft in height. The common associates are box-briar, tachuelo, goatbush, and Jamaican caper (*Capparis cynophallophora*). The ground cover is characteristically limited to leaf litter. Oxhorn bucida represents a timber resource, and where it has been cut, the forest has grown from stump sprouts.

Thorn scrub species include *Acacia* spp., mesquite, *Leucaena glauca*, box-briar, goatbush, sage, and *Croton* spp. (Buell and Dansereau 1966). With the exception of leadtree (*Leucaena leucocephala*), all these shrub species have thorns. The above species generally grow on a wide variety of site conditions, and while thorn scrub vegetation type can occur almost anywhere, there are situations where certain species are more prevalent. The thorn scrub is generally characterized as a low-growing community; all thorn scrub plants in the project area are generally less than 10 ft tall.

The grassland plant community is not a dominant community type within the moist or dry subtropical life zones. Historically, these communities were maintained for grazing pastures. Guinea grass (*Panicum maximum*) has become the dominant species of large interior areas that have accidentally burned twice in the recent past; however, this large interior grassland is slowly changing back to thorn scrub, based on the number of acacia and mesquite saplings. Other grasslands found on Vieques include the maintained areas around Camp Garcia, gun ranges, and OP areas. These maintained grassland areas are dominated by short bunch grasses and sod grasses, including pitted bluestem (*Bothriochloa pertusa*), southern crabgrass (*Digitaria ciliaris*), bermudagrass (*Cynodon dactylon*), Dutch grass (*Eleusine indica*), smutgrass (*Sporobolus indicus*), and sandbur (*Cenchrus brownii*).

Mangrove forests in the project area are located on both the southern and northern coasts (Sorrie et al. 1981). Mangrove communities and their associated open-water lagoons, shallow salt/sand flats or tidal mudflats occupy approximately 1,327 ac on Vieques. Of 36 mangrove forest areas on Vieques (Lewis 1985), 11 are within the project area. Mangrove forests in the project area are characterized as open (fringe) and closed lagoon forests. Mangrove species include red mangrove (*Rhizophora mangle*), white mangrove (*Laguncularia racemosa*), black mangrove (*Avicennia germinans*), and button mangrove (*Conocarpus erectus*; Callahan et al. 1981; Cintrón et al. 1978; D'Aluisio-Guerrieri et al. 1981; Lewis et al. 1981; Proctor 1994). The largest project area mangrove forest is found fringing Ensenada Honda of the south-central coastline.

3.2.5 Terrestrial Animal Species

In general, Puerto Rico supports 25 orders of insects, which are represented by 5,066 species (Colon 1996). Approximately 90% of these insect species can be classified into one of six orders. These six orders include Hymenoptera or “membrane-winged” insects (bees, ants, and wasps), Lepidoptera (butterflies and moths), Diptera or “true flies” (flies, midges, and mosquitoes), Coleoptera (beetles and

fireflies), Heteroptera or “true bugs” (plant bugs and stink bugs), and Homoptera (cicadas and leafhoppers). Representatives of these families are expected in all types of interior habitats.

The terrestrial snail *Physa cubensis* is the only native species of mollusk that has been identified as occurring on Navy Lands of Vieques (NLV), although other species are expected to occur (Colin 1978). Additionally, the gray land crab (*Cardisoma guanhum*) is the only native species of terrestrial crustacean that has been identified as occurring on NLV (Raffaele et al. 1973).

At least 17 species of reptiles and amphibians have been reported on Vieques (DON 1986). These species include three frogs, the marine toad (*Bufo marinus*), 11 lizards and geckos, the worm snake (*Typhlops richardii*), and the ground snake (*Alsophis* spp.).

Common terrestrial birds that may occur in all types of habitats in the project area include common ground dove (*Columba passerina*), zenaida dove (*Zenaida aurita*), Caribbean elaenia (*Elaenia martinica*), gray kingbird (*Tyrannus dominicensis*), mangrove cuckoo (*Coccyzus minor*), bananaquit (*Coerba flaveola*), black-faced grassquit (*Tiaris bicolor*), yellow warbler (*Dendroica petechia*), Greater Antillean grackle (*Quiscalis niger*), green-throated carib (*Sericotes holosericeus*), northern mockingbird (*Mimus polyglottos*), pearly-eyed thrasher (*Maragarops fuscatus*), Antillean crested hummingbird (*Orthorhynchus cristatus*), and smooth-billed ani (*Crotophaga ani*; DON 1986; Sorrie 1978). Shorebirds found in non-vegetated habitats (e.g., mudflats, beaches, rocky shores) include American oystercatcher (*Haematopus palliatus*) and spotted sandpiper (*Actitis macularia*; DON 1986; Sorrie 1978).

Bats make up the largest group of mammals on Vieques. Red fruit bats (*Stenoderma* spp.) and free-tailed bats (*Tadarida* spp.) are the most commonly observed bat species. All other mammals were introduced by man to the island and include the house mouse (*Mus musculus*), rat (*Rattus* spp.), small Indian mongoose (*Herpestes auropunctatus*), and domestic animals such as cattle (*Bos taurus* and *Bos indicus*), horses (*Equus caballus*), dogs (*Canis familiaris*), and cats (*Felis catus*; DON 1986).

4.0 BIOLOGICAL ASSESSMENT ANALYSIS METHODS AND RESULTS

The findings and analysis in this BA are based on relevant existing information (e.g., environmental assessments, conservation plans, scientific literature, etc.) as well as field surveys conducted specifically designed to aid this assessment. GMI closely followed the guidance set forth in the Section 7 of the ESA. Field surveys began 02 November 2009 by GMI biologists and concluded on 13 January 2010.

This report is intended to aid the NAVFAC Atlantic in determining whether munitions response actions (hereafter referred to as proposed action) within portions of the SIA and EMA are likely to 1) adversely affect listed species; 2) jeopardize the continued existence of species that are proposed for listing; or 3) adversely modify proposed critical habitat.

4.1 SURVEY METHODOLOGY

GMI biologists were tasked to conduct listed biological species (flora and fauna) and critical or rare habitats surveys within portions of the SIA and the EMA on Vieques, Puerto Rico. Data obtained from these surveys was used to produce this BA which identifies areas of concern and mitigation measures for anticipated future impacts.

The species addressed in this BA were identified on the basis of the following:

- Review of the Vieques National Wildlife Refuge Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2007);
- Review of the Integrated Natural Resource Management Plan (GMI 2003);
- Review of the Land Use Management Plan (LUMP; GMI 1996);
- Review of the Biological Assessment for Continuing Training Activities on the Inner Range, Vieques, Puerto Rico (GMI 2001);
- Geographic Information Systems (GIS) Analysis of vegetation communities and topography and natural history requirements for potentially occurring endangered, threatened or rare species and plant communities;
- Review of the scientific literature regarding the Natural History of Vieques, Puerto Rico;
- Field Investigations conducted November 2009 thru January 2010.

4.1.1 *Protected species Potentially Occurring in the Project Area*

The USFWS lists 10 threatened and endangered (T&E) bird and 49 plant species as occurring or possibly occurring in Puerto Rico (**Appendix A**). Vieques also has habitat that may support five species listed as endangered, vulnerable, or of concern by the additional stakeholder Puerto Rico Department of Natural and Environmental Resources (PRDNER). Of these species, four bird and six plant species were

identified as potentially occurring within the project area based on their specific habitat requirements and availability of these habitats within the SIA and EMA (**Table 4-1**), as described in the following section.

4.1.2 Survey Areas

To determine locations for surveys, extensive review of the ecological requirements for each T&E plant species was completed. This information, in conjunction with findings from previous surveys and existing vegetation, soil, and elevation data was mapped using ArcGIS to determine where the specific required parameters for each species overlap. Polygons or shapefiles were then created for areas of overlap to indicate locations of high probability for the existence of each T&E species. Of those listed in **Table 4-1**, four species show a high probability of occurring in the project area, including *Stahlia monosperma*, *Psychilis macconnelliae*, *Goetzea elegans*, and *Chaemacrista glandulosa var. mirabilis*.

Table 4-1. Federally threatened or endangered bird or plant species potentially occurring on Vieques, Puerto Rico.

Scientific Name	Common Name	Conservation Status
Birds		
<i>Agelaius xanthomus</i>	Yellow-shouldered blackbird	Endangered
<i>Charadrius melodus</i>	Piping plover	Threatened
<i>Sterna dougallii dougallii</i>	Roseate tern	Threatened
<i>Pelecanus occidentalis</i>	Brown pelican	Recently delisted (formerly Endangered)
Plants		
<i>Aristida chaseae</i>	Chases's threeawn	Endangered
<i>Buxus vahlii</i>	Vahl's boxwood	Endangered
<i>Calypttranthes thomasiana</i>	none	Endangered
<i>Calyptronoma rivalis</i>	Palma de manaca	Threatened
<i>Chamaecrista glandulosa var. mirabilis</i>	none	Endangered
<i>Cornutia obovata</i>	Palo de nigua	Endangered
<i>Daphnopsis hellerana</i>	none	Endangered
<i>Eugenia woodburyana</i>	none	Endangered
<i>Gesneria pauciflora</i>	Yerba maricao de cueva	Threatened
<i>Goetzea elegans</i>	Beautiful goetzea	Endangered
<i>Leptocereus grantianus</i>	none	Endangered
<i>Myrcia paganii</i>	Ausu	Endangered
<i>Ottoschulzia rhodoxylon</i>	Palo de rosa	Endangered
<i>Psychilis macconnelliae</i>	none	Threatened
<i>Schoepfia arenaria</i>	Arana	Threatened
<i>Stahlia monosperma</i>	Cobana negra	Threatened
<i>Zanthoxylum thomasianum</i>	St. Thomas prickly-ash	Endangered

Two additional plant species that were thought to potentially occur on Vieques, *Eugenia woodburyana* and *Calyptanthes thomasiana*, could not be “matched” to any areas within the SIA or EMA based on previous surveys or their elevation, soil, and associated vegetation requirements.

The survey areas within the SIA and EMA that have been selected due to the high probability of occurrence of *S. monosperma*, *C. thomasiana*, and *G. elegans*, and *C. glandulosa* include the majority of the mangroves, wetlands, salt flats, brackish lagoons, quebradas, and forested areas that exist in the study area. These habitats were also target locations for T&E bird species. Additionally, all roads and trails within the SIA and EMA project area were initially surveyed either by vehicle or on foot to determine if suitable habitat, elevation, and soil requirements exist for any of the T&E species. Areas that were suitable were marked with global positioning system (GPS) points and maps were created displaying the survey areas. Although the survey areas targeted specific plant species as listed in preliminary survey plans, GMI biologists surveyed for all threatened, endangered, or rare species possibly occurring in the SIA and a small portion of the EMA.

4.1.3 Areas Not Surveyed

Portions of land where site conditions indicated a low probability of finding T&E species within the SIA and EMA were not included in the T&E surveys. The majority of the area not surveyed was covered in either thick thorn scrub or grassland vegetation. Of the T&E plant and bird species listed as potentially occurring on Vieques, none are known to occur in dense thorn scrub or grassland habitat, therefore, the focus for these surveys was limited to areas that have a high probability of containing T&E species.

4.1.4 Field Methodology

The roads and trails within the SIA and EMA were surveyed, including 25 ft on either side, for T&E plants and birds or their habitat. In areas where roads and trails are within 100 ft of any beach, surveys were conducted throughout the 100-ft area. The high probability areas for plant T&E species were also surveyed. **Figure 1-1** depicts the areas surveyed in portions of the SIA and EMA. Additional surveys were conducted within specialized habitats, such as quebradas, that may not have been adequately surveyed during the prescribed plan surveys.

Field surveys within the SIA and EMA were conducted by both teams simultaneously to expedite sampling. Linear transects spaced 50 to 100 ft apart, depending on terrain and vegetation, were used to conduct surveys and ensure comprehensive coverage. Teams of two biologists walked each transect surveying 25 to 50 ft on either side of the centerline depending on visibility and terrain. Field maps were prepared for all surveyors and provided information on areas to be investigated, transect locations, and GPS coordinates at the end and mid points of each transect to assist with on the ground location and navigation. If threatened, endangered, or rare species plant species (includes all species listed by

USFWS) were encountered in any area during surveys, the location point was recorded with a hand held GPS unit and individual plants or area of the populations marked with flagging tape. Time, date, habitat and vegetation descriptions and photographs were recorded. GIS maps generated using ArcGIS show the location of all T&E species encountered and incorporated into the BA. All listed avian species encountered were identified, counted, and their location recorded with a GPS unit. Maps were generated using ArcGIS showing location(s) by species. Behavior (i.e., transitioning, feeding, loafing, nesting, roosting) for each species were documented.

Survey Results

GMI personnel surveyed approximately 236 ac and over 44 linear miles of transects during field assessments within the project area. Focused surveys were conducted for threatened, rare, and endangered species identified through literature review, discussions with ecologist, discussions with the USFWS and discussions with biologists experienced in the plants found in Puerto Rico and especially on Vieques.

See **Table 4-2** for a listing of threatened, rare, endangered or protected species and plant communities identified in one or more locations within or adjacent to the project area:

Table 4-2. Observed threatened, rare, endangered, or protected species and plant communities.

Name	Scientific Name	Status	Reference	Habitat
Subtropical Dry Forest Community	NA	Critical	IUCN	Dry forest community found in southern peninsula of project area.
Mangrove Communities	NA	Protected	USACE	Mangroves are found across the project area, especially dense around lagoons and the southern coast of the project area.
Cobana negra	<i>Stahlia monosperma</i>	Endangered	USFWS, IUCN	Coastal forests, mangroves
Peacock Orchid	<i>Psychilis macconnelliae</i>	Threatened	USFWS	Dry forest communities
Sessileleaf Stopper	<i>Eugenia sessiliflora</i>	Rare	USFWS	Dry forests, Coastal forests
Lathberry	<i>Eugenia cordata</i>	Rare	USFWS	Nonspecific coastal forests
Graytwig	<i>Schoepfia schreberi</i>	Rare	USFWS	Coastal forests, Subtropical dry forests
Ridgetop Guavaberry	<i>Myrciaria myrtifolia</i>	Rare	USFWS	Moist coastal forests
Rumberry	<i>Myrciaria floribunda</i>	Rare	USFWS	Moist coastal forests
Hog Plum	<i>Ximenia americana</i>	Rare	USWFS	Coastal thickets
Lignum vitae	<i>Guaicum officinale</i>	Endangered	IUCN, CITES	Subtropical dry forests
Brown Pelican	<i>Pelecanus occidentalis</i>	Recently delisted	USFWS	Coastal areas
Sharp-shinned Hawk	<i>Accipiter striatus (venator – see discussion)</i>	The venator subspecies is endangered.	USFWS	Forest edges, ecotones
Lesser Bahama White-cheeked Pintail	<i>Anas bahamensis</i>	Threatened	PRDNER	Coastal lagoons and ponds
White-crowned Pigeon	<i>Patagioenas leucocephala</i>	Threatened	CITES, PRDNER	Coastal forests, Dry forests

Detailed species accounts are provided in **Section 5**. Other plant and animal species observed during the survey were recorded. A total 225 plant species were identified across the survey areas, and are listed in **Appendix B**. A total of 39 bird species were observed during the surveys. Observations include: red-necked phalarope, American kestrel, merlin, brown boobys, black-necked stilts, greater yellowlegs, warblers, hummingbirds, ground doves, cuckoos, smooth-billed anis, white egrets, green herons, tri-colored heron, red-tailed hawks, magnificent frigatebirds, woodpeckers, American golden plover, gray kingbirds, various flycatchers, grackles, and belted kingfisher. See **Appendix C** for a list of all bird species observed during surveys. Maps of the locations of all listed and rare plant and bird species occurring within the project area are provided in **Appendix D: Maps D1 – D12**.

The maps found in **Appendix D** depict the project area and areas surveyed. All observations of species of interest and areas of special note are denoted by representative separate icons (**Figure 4-1**). Map key icons are color coded by species or observation. Color shading is also provided that depicts areas that were surveyed or that were limited in access by water or other factors. Additional survey areas, areas that were not included in the original survey plan, are also depicted by multiple levels of color shading.

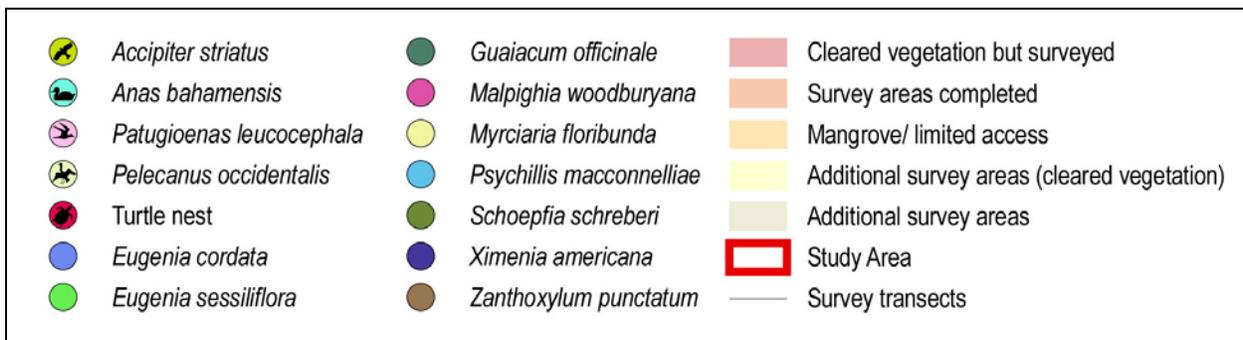


Figure 4-1. Example Map Key.

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5.0 STATUS OF TARGET LISTED SPECIES AND CRITICAL HABITAT

5.1 PLANT SPECIES ACCOUNTS

As previously described, six targeted endangered plants possibly occur in the project area. These include Thomas' lidflower (*Calyptanthes thomasi*), *Chamaecrista glandulosa* var. *mirabilis*, *Eugenia woodburyana*, beautiful goetzea (*Goetzea elegans*), cobana negra (*Stahlia monosperma*), and the butterfly orchid (*Psychilis macconnelliae*).

Detailed descriptions of these plants, their habitat requirements, and presence on Vieques and within the project area are presented in the following sections. **Section 6.0** discusses observations and impacts for all target species.

5.1.1 Thomas' Lidflower (*Calyptanthes thomasi*)

5.1.1.1 Species Description

Thomas' lidflower is a small evergreen tree/shrub in the Myrtaceae (myrtle) family. Thomas' lidflower may reach 9 meters (m) in height and 13 centimeters (cm) in diameter. Leaves have a shiny upper surface, have glandular dots on the lower surface, and are opposite, obovate to oblong, blunt at the apex, and short-pointed at the base. Flower buds are obovoid, apiculate, and 3 mm long with flowers having four small, spatulate petals. It is unlikely that Thomas' lidflower occurs in the project area due to lack of appropriate habitat.

5.1.1.2 Status

Thomas' lidflower was listed as an endangered species in 1994 (USFWS 1994). Habitat loss, coupled with inherent rarity, is the primary threat to *Calyptanthes thomasi*. Hurricanes pose a further threat (USFWS 1997).

5.1.1.3 Ecology and Distribution in the Project Vicinity

Thomas' lidflower occurs in moist forests where it is found in only three localities, one of which is Monte Pirata on Vieques (Center for Plant Conservation [CPC] 1992, Federal Register 1993). Monte Pirata is a steep hill comprised of cretaceous plutonic rocks and is covered with large boulders. The soils are Pandura-very stony land complex with 40 to 60% slope and are shallow, well drained, moderately permeable, and acidic.

Thomas' lidflower is normally found in the moist deciduous formation of the inner hills and slopes that include semi-evergreen forests. This forest type is characterized by trees that are 10 to 15 m in height, of which one-third to one-half are deciduous. Typically, a lower layer with epiphytic orchids and vines is

present. The most common species in this forest type is the palm tree (*Coccothrinax argentea*; USFWS 1997).

Thomas' lidflower was not found within the SIA and EMA project area.

5.1.2 *Cobana Negra (Stahlia monosperma)*

5.1.2.1 Species Description

This medium-sized evergreen tree is a member of the Leguminosae family. This tree ranges in height from 25 to 50 ft with up to a 1.5-ft diameter. Leaves are pinnately compound 6 to 12 opposite, lance-shaped to ovate leaflets on red stalks with scattered raised dots on the lower surface. Flowers are yellow and open between March and May, depending on yellow. Flower clusters are terminal, up to 6 inches (in.) long and unbranched. A thin, red fleshy fruit is produced in late June through July.

5.1.2.2 Status

Cobana negra was listed as a threatened species in 1990 (USFWS). Critical habitat was not designated for various reasons including the small number of known trees and fear of vandalism to avoid protection regulations and efforts.

5.1.2.3 Ecology and Distribution in the Project Vicinity

Cobana negra occurs in coastal woodlands of eastern and southern areas of Puerto Rico, on Vieques, and on Hispaniola (Liogier 1999). This species is known to exist at multiple sites in close proximity (due west of the **Map D5** survey area) to the project area, in adjacent lands found in the EMA outside of the survey area and on the western end of Vieques near Monte Pirata.

The largest known population is in southwestern Puerto Rico near Boqueron and contains 23 mature trees and many seedlings. *Cobana negra* usually grows in brackish, periodically flooded wetlands in association with mangroves. Associated tree species include *Ucar (Bucida buceras)*, black mangrove, white mangrove, and buttonwood mangrove. Although associated with mangrove forests, *Cobana negra* is limited to the drier, slightly elevated soils not occupied by mangrove species (USFWS 1990).

Cobana negra was not found within the SIA and EMA project area.

5.1.3 *Beautiful Goetzea (Goetzea elegans)*

5.1.3.1 Species Description

Beautiful goetzea is a small tree in the Solanaceae family. *Beautiful goetzea* may reach 9 m in height with a stem diameter of 13 cm. It has simple, alternate, elliptic leaves with entire margins and a shiny dark green upper surface. *Beautiful goetzea* flowers and fruits between April and August. The perfect and

bisexual funnel-shaped flowers are orange-yellow in color. The fruit is an orange drupe approximately 2.5 cm in diameter.

5.1.3.2 Status

Beautiful goetzea was listed as endangered in 1985 (Federal Register 50: 15564).

5.1.3.3 Ecology and Distribution in the Project Vicinity

Typically found growing in moist limestone and moist coastal forests at 60 to 180 m altitude on the north coast of Puerto Rico, beautiful goetzea has been collected or observed near Aguadilla, Guajataca Gorge near Quebradillas, Guajataca Forest, and in 1983, in Jimenez near Rio Grande north of the Luquillo Mountains (Little and Woodbury 1980). This plant is restricted to semi-evergreen forests, with an open understory, of the subtropical moist forest zone and, until a recent Vieques discovery (Wilkinson and Cubana 2000), had only been documented in the hills of northern Puerto Rico. The limestone karst region is characterized by undulating topography with some steep, rounded hills, sinkholes, caves, and subterranean streams. Soils are limestone-derived, poorly developed, and excessively drained. Beautiful goetzea populations are considered relics found in ravines and along fence lines. The present distribution of the species appears to be restricted to mesic sites within topographic moisture gradients of limestone hills.

Beautiful Goetzea was not found within the SIA and EMA project area.

5.1.4 *Eugenia woodburyana*

5.1.4.1 Species Description

Eugenia woodburyana is a small evergreen tree in the Myrtaceae family. *Eugenia woodburyana* may reach a height of 6 m. Leaves are opposite, obovate, pilose on both sides, with glandular dots below. The calyx is 4-lobed and the petals are white. The fruit at maturity is red, 8-winged, and 2 cm in diameter (USFWS 1998).

5.1.4.2 Status

Eugenia woodburyana was listed as endangered in 1994 (USFWS 1994).

5.1.4.3 Ecology and Distribution in the Project Vicinity

Eugenia woodburyana is endemic to southwestern Puerto Rico. There are approximately 150 individuals known from Sierra Bermeja in the municipalities of Cabo Rojo and Lajas and from the Guanica Commonwealth Forest. *Eugenia woodburyana* is listed as an endangered species and has been included in the CPC report on rare plants in Puerto Rico which may become extinct within the next 10 years. *Eugenia woodburyana* is found in subtropical dry forest zones (Puerto Rico Conservation Foundation

1999; USFWS 1998). In 1996, five individuals were observed on the steep, southwest slope of Monte Pirata on the western side of Vieques. The Monte Pirata population was also documented again during a survey conducted during September 2000 (Wilkinson and Cubana 2000). Two additional plants were located on the north side of Monte Pirata during a survey conducted 20 December 2000.

Eugenia woodburyana was not found within the SIA and EMA project area.

5.1.5 *Chamaecrista glandulosa* var. *mirabilis*

5.1.5.1 Species Description

Chamaecrista glandulosa var. *mirabilis* is a small, erect shrub in the Fabaceae family. *Chamaecrista glandulosa* var. *mirabilis* may reach a height of 1 m. Branches are slender and straight. Leaves are alternate, even and pinnate, and 1 to 3 cm long with scattered whitish hairs. The leaflets are typically 18 pairs and membranaceous. Flowers are solitary with a yellow corolla. One petal of the flower is much larger than the others.

5.1.5.2 Status

Chamaecrista glandulosa var. *mirabilis* was listed as endangered in 1990 (USFWS 1990). Critical habitat was not designated because of the risk of collection.

5.1.5.3 Ecology and Distribution in the Project Vicinity

Chamaecrista glandulosa var. *mirabilis* is, prior to this study, known to only exist in the area (between Vega Baja and Manati) of silica sands of the north coast of Puerto Rico. These sandy habitat areas are found at sea level elevations. These sandy soils have been identified as belonging to the Algarrobo-Coroza-Arecibo soil association. These soils are excessively drained, fine sands characterized by rapid percolation due to the high permeability of the upper soils. A hardpan is present between 30 and 40 cm deep in some areas. These soils are extremely acidic and low in nutrients.

Chamaecrista glandulosa var. *mirabilis* was not found within the SIA and EMA project area.

5.1.6 *Psychilis macconnelliae*

5.1.6.1 Species Description

Psychilis macconnelliae is a small epiphytic and terrestrial orchid in the Orchidaceae family. *Psychilis macconnelliae* and its flower stalks may reach a height of 1.8 m. Leaves are stiff, linear-oblong and coriaceous. Flowers range in color from pale pink to purple-red. Flower is typically orchid in structure and physical appearance.

5.1.6.2 Status

Psychilis macconnelliae is listed as threatened or rare (USFWS 2007). Critical habitat is not designated.

5.1.6.3 Ecology and Distribution in the Project Vicinity

Psychilis macconnelliae is somewhat common in subtropical dry forest communities. These communities are rare and considered threatened or endangered (see **Section 1.4.4**).

Psychilis macconnelliae var. *mirabilis* was found within the SIA and EMA project area (**Maps D5, D6, D7, D10, D11, and D12**). Typically, *Psychilis macconnelliae* was observed in SDF communities on up- and down-slope areas near the top of land crests near the coastline. Most observations were in small trees and cacti.

5.1.7 Other Department of Natural and Environmental Resources Species

5.1.7.1 Species Description and Status

PRDNER maintains a list of T&E species separate from the USFWS.

Eugenia sessiliflora is an evergreen shrub or small tree to 15 ft in height and is typically found in the moist coastal forest community. *Eugenia cordata* is a small tree that may be found in moist and dry coastal and lower Cordillera forests at sea level and towards the interior of the project area. *Schoepfia schreberi* is a small, evergreen shrub or tree growing to 25 ft that is absent from the main island of Puerto Rico but is found more commonly in eastern islands of the Caribbean. *Myrciaria myrtifolia* is a shrub to small tree endemic to Puerto Rico and Vieques and is found at higher elevations as you move into the interior of the island. *Myrciaria floribunda* is rare in dry and moist coastal forests of Puerto Rico but is widespread and perhaps common in dry forests on Vieques. *Ximenia americana* is a rare shrub found in dry coastal forest communities in Puerto Rico and Vieques. *Guaicum officinalis* is a small shrub and Convention on International Trade in Endangered Species (CITES) endangered species found in the Caribbean Islands. *Malphigia woodburyana* is a small shrub endemic to the Caribbean island and found on Vieques. *Zanthoxylum punctatum* is an uncommon shrub found in coastal Chordillera forests.

5.1.7.2 Ecology and Distribution in the Project Vicinity

PRDNER listed plant observations include the following species: *Eugenia sessiliflora* (PRDNER watch list or elemento crítico) and *Eugenia cordata* (**Maps D7, D11, and D12**), *Schoepfia schreberi* (**Map D12**; PRDNER watch list or elemento crítico), *Myrciaria myrtifolia* (**Map D5**; PRDNER watch list or elemento crítico) and *M. floribunda* (**Map D5**), *Ximenia americana* (**Maps D6, D10, and D12**), and *Guaicum officinalis* (**Maps D3, D5, D6, D7, and D10**; PRDNER watch list or elemento crítico). *Malphigia woodburyana* (**Maps D3, D4, and D5**) is also listed as rare in the conservation plan, although this species was observed in previously disturbed areas. Additionally, another observed species, *Zanthoxylum*

punctatum (**Map D7**) it is not listed in Proctor's plant list for Vieques, so is possibly a new record. *Guaiacum officinalis* is a shrub - small tree which is very slow growing, reaching about 33 ft in height with a trunk diameter of 24 in. The tree is essentially evergreen throughout most of its native range and has become endangered (International Union for Conservation of Nature [IUCN] Red List) due to habitat destruction.

5.2 ANIMAL SPECIES ACCOUNTS

Endangered or threatened birds are thought to occur on Vieques and possibly in the project area. Possible species include yellow-shouldered blackbird (*Agelaius xanthomus*), piping plover (*Charadrius melodus*), roseate tern (*Sterna dougallii dougallii*), and the brown pelican (*Pelecanus occidentalis*). There were no observations of the piping plover, the yellow-shouldered blackbird, or the roseate tern. Species observed include: the endangered Puerto Rican sharp-shinned hawk (*Accipiter striatus venator*), the recently delisted brown pelican, the threatened lesser white-cheek pintail (*Anas bahamensis bahamensis*), and the white-crowned pigeon (*Patagioenas leucocephala*). Multiple inactive sea turtle nests (species unknown) were located while surveying beach fringe areas. Nests were generally found under or near large shading vegetation and many of the depressions had broken egg shells in a pattern typical of small mammal depredation. Detailed descriptions of observed species and their habitat are presented in the following sections.

5.2.1 Brown Pelican (*Pelecanus occidentalis*)

5.2.1.1 Species Description

The brown pelican is a large bird with an overall length of 41 in. and wing span of 90 in. Typically, brown pelicans have a yellow crown, a white head, a white to chestnut neck, and a grey-brown body with slightly darker primary feathers. Pelicans are colonial in nesting and feeding and require mammal free areas for successful nesting. Nests are typically in mangrove thicket edges or scrapes on the ground.

5.2.1.2 Status

The brown pelican, once considered endangered, has been delisted. Refer to 74 Fed. Reg. 59443-59472 (November 17, 2009) / Volume 74, Number 220 / Rules and Regulations Department of the Interior Fish and Wildlife Service 50 CFR Part 17 for more information.

5.2.1.3 Ecology and Distribution in the Project Vicinity

The brown pelican is found throughout the coastal and beach areas of the SIA project area. All pelican observations were made from observers on land while pelicans flew over both land and water adjacent to and near beach and peninsula areas (**Maps D2, D8, D10, D11, and D12**). There were no observations of perched or roosting birds within the project area.

5.2.2 *Sharp-shinned Hawk (Accipiter striatus; Possibly the venator subspecies)*

5.2.2.1 Species Description

The sharp-shinned hawk is a small raptor with an overall length of 12 in. and wing span of 25 in. Typically, mature sharp-shinned hawks have short broad wings and a long square-ended tail with black to grey bands ending with a white tip. The body is slate gray with barred rufous underparts. Adept at close quarters maneuvering, sharp-shinned hawks hunt on the edges of thickets and into the interior of open forests. Prey consists of small birds and mammals. Nests are typically located in mature conifer or deciduous forest stands.

5.2.2.2 Status

The Puerto Rican sharp-shinned hawk was listed as endangered in 1994 (USFWS 1994). Puerto Rican sharp-shinned hawks have not been previously reported to occur on Vieques Island, Puerto Rico. The observed sharp-shinned hawk could possibly be a vagrant or “lost” North American sharp-shinned hawk but there is a possibility that it was a Puerto Rican sharp-shinned hawk because sharp-shinned hawks do not normally cross large areas of water during their migrations.

5.2.2.3 Ecology and Distribution in the Project Vicinity

There is no data on the ecology or distribution of the sharp-shinned hawk in Vieques. Known populations are limited to the Puerto Rico mainland. Overall Puerto Rican population estimates are approximately 130 to 200 individuals. Cruz and Delannoy (1986) indicate that Puerto Rican sharp-shinned hawks prefer karst areas for foraging and nearby nesting.

An observation of a sharp-shinned hawk was made in the SIA and EMA project area.

5.2.3 *Lesser Bahama White-cheeked Pintail (Anas bahamensis bahamensis)*

5.2.3.1 Species Description

The lesser Bahama white-cheeked pintail is a medium-sized duck with white cheeks and throats. The body is light brown with black markings, feet and legs are gray and the bill is blue with a red spot. These ducks are approximately 19 in. long with a 35-in. wing span. White-cheeked pintails are found in small ponds, salt or tidal lagoons and estuaries, and other coastal waters.

5.2.3.2 Status

The lesser Bahama white-cheeked pintail subspecies is considered threatened due to habitat destruction.

5.2.3.3 Ecology and Distribution in the Project Vicinity

There is no data on the ecology or distribution of the Bahama white-cheeked pintail in the project area. This species occurs in brackish and estuarine waters throughout its range in the Caribbean. Breeding is seasonally determined by water levels.

A group of Lesser Bahama white-cheeked pintails was observed in a mangrove pond (**Map D8**) adjacent to main peninsula road in the southern project area.

5.2.4 White-crowned Pigeon (*Patagioenas leucocephala*)

5.2.4.1 Species Description

The white-crowned pigeon is resident of coastal areas in the Caribbean. It feeds almost exclusively on fruits of various hardwood trees. This species is 12 in. long and has a wingspan of 19 in. Adults are dark grey, with green and white bars on the nape and a brilliant white crown to the head.

5.2.4.2 Status

This species is classified as Near Threatened (IUCN 2010.1) because it is restricted to low-lying areas where deforestation and habitat degradation have been very intense across its range.

5.2.4.3 Ecology and Distribution in the Project Vicinity

There is no data on the ecology or distribution of the white-crowned pigeon in the project area.

The white-crowned pigeon was observed in the SIA and EMA project area (**Map D7**) flying from branch to branch in small trees and shrub on an island surrounded by a mangrove.

5.3 RARE PLANT COMMUNITIES

SDFs (see **Section 1.4.4**) are the primary plant community found across the southern peninsula bounded by Bahia Honda to the northwest and Bahia Fanducula and Bahia Yoye to the southeast within the SIA project area. SDFs are characterized by vegetation that either forms a complete ground cover or dense ground cover with small overstory shrubs and trees. Many of the plants are succulent or coriaceous with many species with thorns and spines and water storage structures. Common tree and large shrub species include *Guaiacum officinale*, *Coccoloba venosa*, *Ceiba pentandra*, *Capparis cynophallophora*, *Plumeria alba*, *Guaiacum sanctum*, *Bursera simaruba*, *Prosopis juliflora*, *Pictetia aculeate*, *Leucana glauca*, various *Acacia* spp. and *Pisonia albida*. This plant community is typically richer in bird diversity than other subtropical community types (31 species per 1000 individuals; Kepler and Kepler, 1970; Ewel and Whitmore, 1973). Fire is common in these dry communities and may be essential to maintaining plant diversity and controlling invasive plant species. The WWF applies a critical conservation status to SDF communities (Ricketts et al. 1999, 2010).

Lower alluvial areas along the immediate coastline and down slope from the SDF communities are dominated by mangrove forests, another threatened plant community. Mangrove forests and SDFs are the only sea-level communities' native to Vieques and the Puerto Rico mainland. The WWF applies a critical and endangered status to mangrove communities across the Greater Antilles (Ricketts et al. 2010).

Mangrove communities are comprised of salt-tolerant species that form coastal forests adjacent to estuaries, lagoons, and ponds. There are four dominant species of mangroves found in the project area. The distribution of these species is dependent on salinity and small differences in topography. *Rhizophora mangle* is a pioneer species of estuaries and shorelines, *Avicennia germinans* is tolerant of large ranges of salinity and is found commonly associated with other mangrove species, *Laguncularia racemosa* prefers muddy, brackish tidal areas, and *Conocarpus erectus* is usually found on the upslope, more landward side of mangrove forests which is least affected by tidal influences. Mangrove forests provide a large amount of carbon through leaf litter and as such, are important for supporting the base of a food web that many species; both plant and animal depend on. These forests are also important nursery and shelter areas for many fish and invertebrate species.

5.3.1 Status

SDFs and mangrove forests are imperiled and highly threatened globally, particularly within the Greater and Lesser Antilles, making these plant communities a high conservation priority (IUCN 2010.1, WWF 1999, 2010). Mangrove plant communities are protected by the Clean Water Act (CWA) and by Executive Order (EO) 11990 as wetlands and are considered jurisdictional waters by the U.S. Army Corps of Engineers (USACE). The PRDNER Ley de Bosques (Ley 133) and Ley Organica (Ley 68) also protect mangroves from cutting and/or alteration.

5.3.1.1 Ecology and Distribution in the Project Vicinity

Mangrove forests are found across the SIA project area (**Maps D1, D3, D4, D7 - D14**). Surveyed SDF communities are found primarily in the southern peninsulas associated with Bahia Fanduca and Bahia Yoye and southeast of Ensenada Honda located in the southern area of the SIA project area (**Maps D9 through D14**).

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6.0 DETERMINATION OF EFFECTS

6.1 DEFINITION OF TERMS

The ESA requires that federal agencies consider effects as defined below.

- **Direct effects** are effects from actions that would immediately remove or destroy habitat or harm (injure or kill) species or adversely modify designated critical or supporting habitat. Direct effects include actions that would potentially influence, positively or negatively, the species or critical habitat.
- **Indirect effects** are those that are caused by the proposed action(s) and that may manifest later in time, but still are reasonably certain to occur. Indirect effects may include impacts to food resources, water availability, and impacts from increased short- or long-term human access.
- **Interdependent and/or interrelated effects** are effects from actions that have no independent utility apart from the primary action, are part of a larger action and depend on the larger action for their justification, and/or are required as part of the action. This includes maintenance and/or use of the project, as well as other actions that would be carried out to implement, maintain, and/or operate the project.
- **Conservation and Mitigation** of sensitive, threatened, and endangered species and communities can be accomplished by careful plans designed to avoid or mitigate damage and destruction resulting from proposed actions. The proposed actions of ordnance removal and ordnance detonation may require vegetation removal and disturbance in sensitive habitats found within the survey area. This section describes possible options to offset or mitigate for any possible damage caused by project actions.

6.2 PLANTS

6.2.1 *Thomas' Lidflower (Calyptanthes thomasiana)*

6.2.1.1 Analysis of Effects

Thomas' lidflower was not found during pre-action ground surveys and is not known to exist in the project area but is found 8 mi west of the SIA project area on Monte Pirata. There is little potential habitat in the SIA and EMA project area. This is primarily due to the lack of altitude and appropriate soil strata required by Thomas' lidflower natural history.

Direct Effects

No direct effects for Thomas' lidflower were identified.

Indirect Effects

No indirect effects for Thomas' lidflower were identified.

Interdependent and Interrelated Effects

No interdependent or interrelated effects for Thomas' lidflower were identified.

Conservation and Mitigation

No project area conservation measures are necessary for Thomas' lidflower.

6.2.2 Cobana Negra (*Stahlia monosperma*)

6.2.2.1 Analysis of Effects

Cobana negra was found in the EMA adjacent to the delineated survey areas project area during pre-action ground surveys.

This species is known to exist at multiple sites in close proximity (due west of the **Map D5** survey area) to the project area, in adjacent lands found in the EMA outside of the survey area and on the western end of Vieques near Monte Pirata.

Direct Effects

Project actions may result in direct effects through the destruction of critical habitat and through the inadvertent taking of individuals or populations in areas that were not part of the approved survey plan and subsequently not surveyed by biologists during the ground survey effort.

Indirect Effects

Project actions may result in alterations to drainage patterns and surface hydrology which could potentially impact critical habitat or unknown populations. In areas where *Cobana negra* was observed, project actions may increase the probability of invasive species expanding their range which may result in loss of critical habitat and competitive exclusion of viable populations of Cobana negra and other native endangered, threatened, and rare plants.

Interdependent and Interrelated Effects

In areas where *Cobana negra* was observed, project actions may, by changing land use patterns or usage, result in interdependent and interrelated effects that may negatively impact Cobana negra or other endangered, threatened or rare species and critical habitat.

Conservation and Mitigation

Require on the ground active oversight by trained project personnel. Project personnel will be provided with training and materials to recognize potential threatened/endangered species. If threatened/endangered species are observed, project personnel will cease work in the area and advise the Title II Site Manager of the sighting so that appropriate action can be taken to minimize impacts to the observed species. to identify and flag individual *Cobana negra* plants. Create a small protective buffer around each Cobana negra plant and prohibit these individuals being removed by project actions.

6.2.3 *Beautiful Goetzea (Goetzea elegans)*

6.2.3.1 Analysis of Effects

Beautiful goetzea was not found in the SIA and EMA project area during pre-action ground surveys.

Direct Effects

No direct effects for beautiful goetzea were identified.

Indirect Effects

No indirect effects for beautiful goetzea were identified.

Interdependent and Interrelated Effects

No interdependent effects for beautiful goetzea were identified.

Conservation and Mitigation

No project area conservation measures are necessary for beautiful goetzea.

6.2.4 *Eugenia woodburyana*

6.2.4.1 Analysis of Effects

Eugenia woodburyana was not found in the SIA and EMA project area during pre-action ground surveys. It is highly unlikely that *Eugenia woodburyana* occurs in the SIA and EMA project area.

Direct Effects

No direct effects for *Eugenia woodburyana* were identified.

Indirect Effects

No indirect effects for *Eugenia woodburyana* were identified.

Interdependent and Interrelated Effects

No interdependent effects for *Eugenia woodburyana* were identified.

Conservation and Mitigation

No project area conservation measures are necessary for *Eugenia woodburyana*.

6.2.5 *Chamaecrista glandulosa* var. *mirabilis*

6.2.5.1 Analysis of Effects

Chamaecrista glandulosa var. *mirabilis* was not found in the SIA and EMA project area during pre-action ground surveys. It is highly unlikely that *Chamaecrista glandulosa* var. *mirabilis* occurs in the SIA and EMA project area.

Direct Effects

No direct effects for *Chamaecrista glandulosa* var. *mirabilis* were identified.

Indirect Effects

No indirect effects for *Chamaecrista glandulosa* var. *mirabilis* were identified.

Interdependent and Interrelated Effects

No interdependent effects for *Chamaecrista glandulosa* var. *mirabilis* were identified.

Conservation and Mitigation

No project area conservation measures are necessary for *Chamaecrista glandulosa* var. *mirabilis*.

6.2.6 *Psychilis macconnelliae*

6.2.6.1 Analysis of Effects

Psychilis macconnelliae was found in many areas (**Maps D5, D6, D7, D10, D11, and D12**) within the SIA and EMA project area during pre-action ground surveys.

Direct Effects

Project actions will result in direct effects through the destruction of critical habitat and through the taking of individuals or populations in areas surveyed.

Indirect Effects

Project actions may result in alterations to drainage patterns and surface hydrology which could potentially impact critical habitat. Project actions will likely increase the probability of invasive species expanding their range which may result in loss of critical habitat and competitive exclusion of viable populations of *Psychilis macconnelliae* and other native endangered, threatened, and rare plants.

Interdependent and Interrelated Effects

Project actions may impact observed individuals of *Psychilis macconnelliae*, by changing land use patterns or usage, result in interdependent and interrelated effects that may negatively impact *Psychilis macconnelliae* or other endangered, threatened or rare species and critical habitat.

Conservation and Mitigation

Require on the ground active oversight by trained project personnel to identify and flag individual *Psychilis macconnelliae* plants and where practical, leave host plants in place or relocate the individual plants to areas that have been cleared by project actions.

6.3 BIRDS

6.3.1 *Brown Pelican (Pelacanus occidentalis)*

6.3.1.1 Analysis of Effects

The brown pelican was observed (**Maps D2, D8, D10, D11, and D12**) flying either over open water or flying overland on most survey days throughout the coastal and beach areas within the SIA and EMA project area during pre-action ground surveys.

Direct Effects

Project actions may result in direct effects through the taking of brown pelicans flying in the vicinity of active UXO detonation activity.

Indirect Effects

No indirect effects for the brown pelican were identified.

Interdependent and Interrelated Effects

No interdependent effects for the brown pelican were identified.

Conservation and Mitigation

Require on the ground active oversight by trained project personnel to monitor for Pelicans during project actions. Stop or delay action, such as UXO detonation, that may result in direct impacts until Pelicans have moved out of the area.

6.3.2 Sharp-shinned Hawk (*Accipiter striatus venator**)

6.3.2.1 Analysis of Effects

The sharp-shinned hawk was observed foraging along the edge of a cleared field and forest in the southern SIA project area (**Map D8**).

Direct Effects

Project actions may result in direct effects through the taking of nestlings or eggs in areas surveyed and not surveyed by biologists during the ground survey effort.

Indirect Effects

Project actions may result in indirect effects through the destruction of foraging and nesting habitat in areas surveyed and not surveyed by biologists during the ground survey effort.

Interdependent and Interrelated Effects

Project actions may, by changing land use and vegetation patterns and/or usage, result in interdependent and interrelated effects that may negatively impact the sharp-shinned hawk or other endangered, threatened or rare species and critical habitat.

Conservation and Mitigation

Require on the ground active oversight by trained project personnel to monitor for sharp-shinned hawks or other migrating birds during project actions. Stop or delay action, such as UXO detonation, until sharp-shinned hawks have moved out of the area. Limit removal of large, mature trees that may serve as foraging and nesting bird habitat and serve as edge or ecotone habitat typically used by sharp-shinned hawks.

* See discussion in section 5.2.2

6.3.3 *Lesser Bahama White-cheeked Pintail (Anas bahamensis bahamensis)*

6.3.3.1 Analysis of Effects

Multiple lesser Bahama white-cheeked pintails were observed in a mangrove pond (**Map D8**) adjacent to main peninsula road in the southern project area.

Direct Effects

Vegetation removal as part of project actions may disturb any lesser Bahama white-cheeked pintails and result in individuals being displaced.

Indirect Effects

Project actions such as vegetation clearing and field detonation of UXO may result in indirect effects through the destruction of foraging and nesting habitat in areas surveyed and not surveyed by biologists during the ground survey effort.

Interdependent and Interrelated Effects

No interdependent effects for the lesser Bahama white-cheeked pintail were identified.

Conservation and Mitigation

Require on the ground active oversight by trained project personnel to monitor for lesser Bahama white-cheeked pintails during project actions. Stop or delay action, such as UXO detonation, until birds have vacated the area. Limit removal of mangrove community plants bordering small ponds or lagoons that may serve as nesting or foraging areas for lesser Bahama white-cheeked pintails.

6.3.4 *White-crowned Pigeon (Patagioenas leucocephala)*

6.3.4.1 Analysis of Effects

A single specimen of the white-crowned pigeon was observed on a small island (**Map D7**) in a mangrove located in the southern project area.

Direct Effects

Project actions, such as vegetation clearing and field detonation of UXO may result in direct effects through the through the taking of nestlings or eggs in areas surveyed and not surveyed by biologists during the ground survey effort.

Indirect Effects

Project actions such as vegetation clearing and field detonation of UXO may result in indirect effects through the destruction of foraging and nesting habitat in areas surveyed and not surveyed by biologists during the ground survey effort.

Interdependent and Interrelated Effects

Project actions may, by changing land use and vegetation patterns and/or usage, result in interdependent and interrelated effects that may negatively impact the white-crowned pigeon or other endangered, threatened or rare species and critical habitat.

Conservation and Mitigation

Require on the ground active oversight by trained project personnel to monitor for white-crowned pigeons or other Migratory Bird Treaty Act (MBTA) species during project actions. Stop or delay action, such as UXO detonation, until individual bird have vacated the area. Limit removal of large, mature trees and shrubs that may serve as refugia, foraging area, and nesting habitat.

6.4 RARE PLANT COMMUNITIES

6.4.1 *Subtropical Dry Forest Community*

6.4.1.1 Analysis of Effects

Direct Effects

Project actions will result in direct effects through the through the destruction of SDF communities.

Indirect Effects

Project actions may result in alterations to drainage patterns and surface hydrology which could potentially impact the physical habitat necessary for the health of SDF communities. Most of the observed SDF communities are found on very shallow soils overlaying limestone and ancient coral reefs. These soils may be susceptible to increased erosion in areas where plants are removed by project actions. Actions that result in opening the canopy will likely lead to erosion and reductions of root biomass, which together may reduce SDF resilience. Project actions will likely increase the probability of invasive species expanding their range which may result in loss of critical habitat and competitive exclusion of viable SDF communities and the other endangered, rare, or threatened plant and animal species who utilize these communities for nesting, foraging and shelter.

Interdependent and Interrelated Effects

Project actions may result in interdependent and interrelated effects that may negatively impact SDF communities or other endangered, threatened or rare species and critical habitat

Conservation and Mitigation

To minimize the impacts of proposed munitions removal actions and to conserve SDF species and communities, some or all of the following measures and strategies could be incorporated into a conservation plan:

- Avoidance of known SDF communities
 - Conduct rigorous delineations of sensitive SDF communities
 - Ecological delineation
 - Munitions survey of delineated areas
 - Develop avoidance plan for delineated SDF communities and choose minimal impact munitions removal processes as dictated by presence of UXO
- Require on the ground active oversight by trained project personnel to support recommended avoidance activities during cleanup activities within sensitive plant communities or areas where protected plants or animals are expected.
- Create an emergency fire management plan to mitigate damage by accidental fires resulting from UXO removal and/or detonation. Fire may be beneficial to many of the communities found on Vieques but caution should be taken to reduce the intensity of fires that may result accidentally through project actions.
- Limit removal of large, mature trees that serve as soil stabilizers, seed sources, and nesting bird habitat

6.4.2 Mangrove Communities

6.4.2.1 Analysis of Effects

Direct Effects

Project actions may result in direct effects through the destruction of Mangrove communities.

Indirect Effects

Project actions may result in alterations to drainage patterns and surface hydrology and upslope erosion which could potentially impact the physical habitat necessary for the health of mangrove communities. Actions that result in opening the canopy will likely lead to erosion and reductions of root biomass, which together may reduce mangrove forest resilience. Sedimentation resulting from vegetation removal and

other proposed actions may alter micro- and macro-topography to an extent that influences natural succession and segregation of mangrove species. Project actions may increase the probability of invasion by other opportunistic and foreign species resulting in the loss of mangrove habitat and competitive exclusion of naturally occurring mangrove and associated species. These alterations will likely result in changes to the base and natural food web typically associated with mangrove communities.

Interdependent and Interrelated Effects

Project actions may result in interdependent and interrelated effects that may negatively impact mangrove communities or other associated endangered, threatened or rare species and critical habitat.

Conservation and Mitigation

To minimize the impacts of proposed munitions removal actions and to conserve mangrove species and communities, the following measures and strategies could be incorporated into a conservation plan:

- Avoidance of known mangrove areas if possible
 - Conduct rigorous delineations of mangrove communities
 - Ecological delineation
 - Munitions survey of delineated areas
 - Develop avoidance plan for mangrove communities and choose minimal impact munitions removal processes as dictated by presence of UXO
- Require on the ground active monitoring by trained project personnel to support recommended avoidance activities during cleanup activities within sensitive plant communities or areas where protected plants or animals are expected.
- Limit removal of large, mature trees that serve as soil stabilizers, seed producers, and nesting bird habitat
- Limit vegetation removal and implement erosion control measures in areas in close proximity and upslope of mangrove communities.

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APPENDICES

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APPENDIX A

Threatened and Endangered Birds and Plants of Puerto Rico
U.S. Fish and Wildlife Service's list of threatened and endangered bird and plant species
occurring or potentially occurring on Puerto Rico as of January 2007. (* - Listed PRDNER as
Endangered or Endangered)

Species	Status	Range & Habitat	Found on Vieques
BIRDS			
<i>Agelaius xanthomus</i> (yellow-shouldered blackbird)	E	<ul style="list-style-type: none"> mangrove zone or the arid coastal fringe. Nesting occurs in mangroves along the coast and on small off-shore islands 	Possible
<i>Buteo platypterus brunnescens</i> (Puerto Rican broad-winged hawk)	E	<ul style="list-style-type: none"> more often seen in the eastern side of the Caribbean National Forest, and the tabonuco and palo colorado forest types were reported to be the preferred habitats for the species (Wiley and Bauer 1985). Delannoy (1992) reported broad-winged hawks clustered in the north-central part of the Caribbean National Forest within the subtropical wet forest and subtropical rain forest life zones, where the tabonuco is the dominant forest type. In the Carite forest the species has been reported from the elfin, caimitillo, granadillo, tabonuco, and slope forest types (Hernandez 1980, Delannoy 1992). 	NO
<i>Accipiter striatus venator</i> (Puerto Rican sharp-shinned hawk)	E	<ul style="list-style-type: none"> located in the north-central and eastern parts of the Maricao forest, within the subtropical lower montane wet forest and subtropical wet forest life zones 	Possible
<i>Caprimulgus noctitherus</i> (Puerto Rican night jar)	E	<ul style="list-style-type: none"> presently found only in the dry limestone forests of the southwestern coast. In the Susua area nightjars occur primarily on the southern slopes, but could be found in the mature lower cordillera forest at somewhat higher elevations. In the Guánica Forest, where the nightjars are most common, elevations range from sea level to 230 meters. 	NO
<i>Amazona vittata</i> (Puerto Rican parrot)	E	<ul style="list-style-type: none"> Puerto Rican parrot is presently found only in Puerto Rico, but up until 1899 it was also found on nearby Culebra Island, and earlier on Vieques and Mona Islands. The present habitat consists of mature rain forest located between about 1,300 and 2,700 feet in elevation. 	Possible

Species	Status	Range & Habitat	Found on Vieques
<i>Columba inornata wetmorei</i> (Puerto Rican plain pigeon)	E	<ul style="list-style-type: none"> The plain pigeon historically was widespread in the western foothills and valleys of Puerto Rico General habitat types used in the past include lowland swamps and woodland, open woodland and cultivated land in the mountains, limestone karst, and coffee plantations in upland hills. The presently occupied habitat is located in the lower montane rainforest zone. 	NO
<i>Charadrius melodus</i> (piping plover)	T	<ul style="list-style-type: none"> populations inhabit beaches, mudflats, and sandflats 	YES
<i>Sterna dougallii dougallii</i> (roseate tern)	T	<ul style="list-style-type: none"> Roseate terns breed in colonies almost exclusively on small offshore islands, rarely on large islands. The northeastern colonies are on rocky offshore islands, barrier beaches, or salt marsh islands. Most colonies are close to shallow water fishing sites with sandy bottoms, bars, or shoals. The Caribbean birds nest in relatively open areas, often with no cover nearby. They breed on a variety of small cays or islands with rocky, grassy, coral rubble, or sand substrate. There is little information on the habitat of the wintering range. Some birds have been found roosting on sandbars or beaches at river mouths, estuaries, or ocean front. 	YES
<i>Corvus leucognaphalus</i> (white-necked crow)	T	<ul style="list-style-type: none"> Does not occur in Puerto Rico or vicinity 	NO
<i>Pelecanus occidentalis</i> (brown pelican)	Recently delisted	<ul style="list-style-type: none"> Habitat of the brown pelican is mainly coastal; these birds are rarely seen inland or far out at sea. They feed mostly in shallow estuarine waters, less often up to 40 miles from shore. Pelicans make extensive use of sand spits, offshore sand bars, and islets for nocturnal roosting and daily loafing, especially by nonbreeders and during the non-nesting season. Dry roosting sites are essential. Some roosting sites eventually may become nesting areas. 	YES
PLANTS			
<i>Adiantum vivesii</i> (Puerto Rico maidenhair)	E*	<ul style="list-style-type: none"> found only on privately owned land located on the north side of Puerto Rico Hwy found in the limestone or karst region up to 198 m in elevation 	NO

Species	Status	Range & Habitat	Found on Vieques
<i>Aristida chaseae</i> (Chase's threeawn)	E*	<ul style="list-style-type: none"> endemic to Puerto Rico and currently known from only two sites in the southwestern portion of the island located within the subtropical dry forest life zone 	Possible
<i>Aristida portoricensis</i> (pelos del Diablo)	E*	<ul style="list-style-type: none"> Pelos del diablo is found on serpentine slopes and red clay soils of southwestern Puerto Rico. In the Sierra Bermeja this grass is found growing on exposed rock crevices, frequently in association with <i>Aristida chaseae</i>, a candidate species, and <i>Digitaria eggertii</i>, at elevations between 180 and 301 meters. 	NO
<i>Auerodendron pauciflorum</i> (turtlefat)	E*	<ul style="list-style-type: none"> only known to exist in the limestone hills of Isabela in northwestern Puerto Rico restricted to semi-evergreen forests 	NO
<i>Banara vanderbiltii</i> (Vanderbilt's palo de ramon)	E*	<ul style="list-style-type: none"> plant is currently known from two privately-owned sites: in northern Puerto Rico, between Vega Baja and Bayamon, and in the Tetas de Cayey in the municipality of Salinas found in the semi-evergreen forests of the karst region of northern Puerto Rico and in one area in the central mountains 	NO
<i>Buxus vahlii</i> (Vahl's box)	E*	<ul style="list-style-type: none"> This plant is known from two locations in Puerto Rico Vahl's boxwood is found in semi-evergreen seasonal forests on limestone at elevations between 80 and 650 feet, where it is restricted to ravines and ledges. It grows as an understory shrub in semi-shaded conditions. 	Possible
<i>Callicarpa ampla</i> (caparosa)	E*	<ul style="list-style-type: none"> At present caparosa is known only from the palo colorado forest of the Luquillo Mountains in northeastern Puerto Rico. All known sites occur within the Caribbean National Forest, managed by the U.S. Forest Service. The palo colorado forest is found at elevations greater than 650 meters. 	NO
<i>Calyptanthes thomasi</i> (Thomas' lidflower)	E*	<ul style="list-style-type: none"> 300 – 800 feet in elevation in upland moist forest or semi-evergreen forests 	Possible
<i>Calyptronoma rivalis</i> (Puerto Rico manac)	T	<ul style="list-style-type: none"> located in the semi-evergreen, limestone forests of northwestern Puerto Rico. These forests are at elevations of 100 to 150 meters. The habitat areas are wet and humid, and the natural populations are found in level or almost level areas around stream banks. 	Possible

Species	Status	Range & Habitat	Found on Vieques
<i>Catesbaea melanocarpa</i> (tropical lilythorn)	E	<ul style="list-style-type: none"> subtropical dry forest of southwest PR 	NO
<i>Chamaecrista glandulosa</i> var. <i>mirabilis</i> (Jamaican broom)	E*	<ul style="list-style-type: none"> endemic to the silica sands of the northern coast of Puerto Rico previously found associated with mangroves in the southwest portion of former navy lands, Vieques 	YES
<i>Cordia bellonis</i> (serpentine manjack)	E	<ul style="list-style-type: none"> elevation 441 to 820 meters along river margins and on steep slopes 	NO
<i>Cornutia obovata</i> (nigua)	E*	<ul style="list-style-type: none"> Only seven trees are known to exist in three areas: five individuals from five different locations in the limestone hills of the R₁o Abajo Commonwealth Forest; one from the limestone hills near the Arecibo Observatory; and one from Barranquitas in the central mountains found in the semi-evergreen or evergreen seasonal forest of the subtropical moist forest life zone on limestone hills at elevations from 150 to 350 meters. 	Possible
<i>Cranichis ricartii</i> (Puerto Rico helmet orchid)	E*	<ul style="list-style-type: none"> reported from three locations in the moist serpentine scrub forests of the Maricao Commonwealth Forest found growing in the humus of moist serpentine scrub forests of montane ridges at elevations above 680 meters. 	NO
<i>Crescentia portoricensis</i> (higuero de sierra)	E*	<ul style="list-style-type: none"> found on only 12 sites in two areas of southwestern Puerto Rico inhabits montane, lower montane, mixed evergreen, semievergreen, and deciduous forests, which are underlain by serpentine. Within the two forests where it occurs, the species is restricted to sites along permanent or intermittent watercourses. 	NO
<i>Cyathea dryopteroides</i> (forest alsophila)	E	<ul style="list-style-type: none"> endemic to elfin forests of the Central Cordillera of Puerto Rico at elevations above 1,000 meters (3,280 feet). 	NO
<i>Daphnopsis hellerana</i> (no common name)	E*	<ul style="list-style-type: none"> endemic to Puerto Rico and restricted to the limestone hills of the northwestern coast of the island. found in the semi-evergreen or evergreen seasonal forest of the subtropical moist forest life zone on limestone hills at elevations from 150 to 350 meters. 	Possible
<i>Elaphoglossum serpens</i> (cerro de punta jayuya)	E*	<ul style="list-style-type: none"> found at a single site in the montane dwarf forest of the summit of Cerro Punta 	NO

Species	Status	Range & Habitat	Found on Vieques
<i>Eugenia haematocarpa</i> (Luquillo Mountain stopper)	E	<ul style="list-style-type: none"> occurs within the Caribbean National Forest within the palo colorado forest found at elevations greater than 650 meters 	NO
<i>Eugenia woodburyana</i> (Woodbury's stopper)	E	<ul style="list-style-type: none"> currently known only from the Sierra Bermeja in the municipalities of Cabo Rojo and Lajas and from the Gunica Commonwealth Forest in Gunica, all in southwestern Puerto Rico. subtropical dry forest life zone 	Possible
<i>Gesneria pauciflora</i> (yerba maricao de cueva)	T	<ul style="list-style-type: none"> found growing in rocky stream beds on wet serpentine rock, where water is constantly seeping 	Possible
<i>Goetzea elegans</i> (Beautiful goetzea)	E*	<ul style="list-style-type: none"> Forested area, within 50m of streams in alluvial soils Along quebradas or seasonal water courses 	YES
<i>Harrisia portoricensis</i> (Puerto Rico applecactus)	T	<ul style="list-style-type: none"> Once occurring on mainland Puerto Rico, the species has not been collected there since 1913, and is considered extirpated. The plant currently is restricted to three islands west of Puerto Rico Mona, Monito, and Desecheo. 	NO
<i>Ilex cookii</i> (no common name)	E*	<ul style="list-style-type: none"> endemic to elfin forests of the Central Cordillera of Puerto Rico at elevations above 1,000 meters (3,280 feet). 	NO
<i>Ilex sintenisii</i> (Sintenis' holly)	E*	<ul style="list-style-type: none"> found only in the Luquillo Mountains where it is restricted to the dwarf or elfin forest. found at elevations above 750 meters on windward, ridge and leeward areas of the mountain tops 	NO
<i>Juglans jamaicensis</i> (West Indian walnut)	E	<ul style="list-style-type: none"> found on lands adjacent to the Monte Guilarte Commonwealth Forest in the central mountains of Puerto Rico 	NO
<i>Lepanthes eltoroensis</i>	E*	<ul style="list-style-type: none"> found only in the sierra Palm, palo colorado, and dwarf forest associations of the Luquillo Mountains, all at elevations greater than 850 meters. 	NO
<i>Leptocereus grantianus</i> (Luquillo Mountain babyboot orchid)	E*	<ul style="list-style-type: none"> endemic to the island of Culebra which is located just off the northeastern corner of Puerto Rico. subtropical dry forest life zone. 	Possible
<i>Lyonia truncata var. proctorii</i> (Proctor's staggerbush)	E*	<ul style="list-style-type: none"> very steep slopes of Cerro Mariquita in the range of hills known as the Sierra Bermeja 	NO
<i>Mitracarpus maxwelliae</i> (Maxwell's girdlepod)	E*	<ul style="list-style-type: none"> known from only one location in the municipality of Guánica, in the southwestern part of the island subtropical dry forest life zone 	NO

Species	Status	Range & Habitat	Found on Vieques
<i>Mitracarpus polycladus</i> (cana gorda girdlepod)	E*	<ul style="list-style-type: none"> known from the island of Saba in the Lesser Antilles and from one locality in southwestern Puerto Rico within the subtropical dry forest life zone 	NO
<i>Myrcia paganii</i> (ausu)	E*	<ul style="list-style-type: none"> found in the semi-evergreen or evergreen seasonal forest of the subtropical moist forest life zone on limestone hills at elevations from 150 to 350 meters 	Possible
<i>Ottoschulzia rhodoxylon</i> (pincho palo de rosa)	E*	<ul style="list-style-type: none"> Found in three locations Different types of habitat exist at each of the three locations. The north coast, Bayamon site is situated in a semi-evergreen, seasonal forest at an elevation of 325 feet or 100 meters. In the southwestern coast Guanica Forest, the species occurs in a low elevation, semi-deciduous, dry forest on limestone. One tree in this population is located alongside a dry stream bed which carries water only during torrential rains. The individual in the Maricao Forest survives in a lower montane, semi-evergreen forest on serpentine outcrops. This location is at an elevation of about 1,960 feet or 600 meters. 	Possible
<i>Peperomia wheeleri</i> (Wheeler's peperomia)	E*	<ul style="list-style-type: none"> Wheeler's peperomia is only known from Culebra Andesitic lava underlies most of Culebra Island, and on the north coast it is overlain by andesitic tuff. In north central Culebra this tuff and lava has been intruded by diorite. This diorite has weathered to round boulders which may reach several feet in diameter. Between these boulders the soil is shallow and mixed with loose stones. 	NO
<i>Pleodendron macranthum</i> (chupa gallo)	E	<ul style="list-style-type: none"> subtropical wet and the subtropical montane wet forests of northern and eastern Puerto Rico elevations greater than 650 meters 	NO
<i>Polystichum calderonense</i> (Monte Guilarte hollyfern)	E*	<ul style="list-style-type: none"> found on moist, shaded, non-calcareous ledges on mountain tops at elevations of 1,000 to 1150 meters 	NO
<i>Schoepfia arenaria</i> (arena)	T*	<ul style="list-style-type: none"> known from four locations: Isabela, Piñones, Fajardo, and Río Abajo Commonwealth Forest found in low elevation evergreen and semi-evergreen forests of the limestone hills of northern Puerto Rico at elevations which vary from 150 to 350 meters 	Possible

Species	Status	Range & Habitat	Found on Vieques
<i>Solanum drymophilum</i> (Bahama nightshade)	E*	<ul style="list-style-type: none"> Only 100 to 150 plants still exist on a single, 2-acre site in the Sierra de Cayey in central Puerto Rico. Although Erubia is native to evergreen forests on volcanic soils from 1,000 to 3,000 feet, most of the shrub's remaining population is in a pasture on the area's southern hill. 	NO
<i>Stahlia monosperma</i> (Coban negra)	T*	<ul style="list-style-type: none"> Scattered populations survive in Puerto Rico, the island of Vieques, and in the eastern portion of the Dominican Republic. Cobana Negra is found on the edge of salt flats in brackish, seasonally flooded wetlands. Its associates are black mangrove and buttonwood mangrove. 	YES
<i>Styrax portoricensis</i> (palo de jazmin)	E*	<ul style="list-style-type: none"> only one immature tree is presently known and occurs in the palo colorado forest the palo colorado forest is found at elevations greater than 650 meters 	NO
<i>Tectaria estremerana</i> (no common name)	E*	<ul style="list-style-type: none"> found in moist, shaded humus on and among the limestone boulders at 250 to 300 meters 	NO
<i>Ternstroemia luquillensis</i> (palo Colorado)	E*	<ul style="list-style-type: none"> known only from the palo colorado and dwarf forests of the Luquillo Mountains in northeastern Puerto Rico 	NO
<i>Ternstroemia subsessilis</i> (el yunque Colorado)	E*	<ul style="list-style-type: none"> restricted to the palo colorado and dwarf forests of the Luquillo Mountains 	NO
<i>Thelypteris inabonensis</i> (cordillera maiden fern)	E*	<ul style="list-style-type: none"> is rare and localized in wet, montane forests at elevations of 1,120 to 1,250 meters 	NO
<i>Thelypteris verecunda</i> (Barrio Charcas maiden fern)	E*	<ul style="list-style-type: none"> is found at moist shaded limestone ledges at middle elevations of 200 meters 	NO
<i>Thelypteris yaucoensis</i> (Puerto Rico maiden fern)	E*	<ul style="list-style-type: none"> found in humus on steep, shaded rocky banks and ledges at high elevations of 850 to 1,200 meters. 	NO
<i>Trichilia triacantha</i> (bariaco)	E*	<ul style="list-style-type: none"> Bariaco is endemic to Puerto Rico and is restricted to dry limestone forests of the southwestern portion of the island. Bariaco is found in the deciduous and the semi-evergreen seasonal forests of the subtropical dry forest life zone of southwestern Puerto Rico at elevations of less than 100 meters. 	NO

Species	Status	Range & Habitat	Found on Vieques
<i>Vernonia proctorii</i> (no common name)	E*	<ul style="list-style-type: none"> ▪ endemic to Puerto Rico and known only from the summit area of Cerro Mariquita in the range of hills known as the Sierra Bermeja ▪ located within the subtropical dry forest life zone 	NO
<i>Zanthoxylum thomsonianum</i> (St. Thomas pricklyash)	E*	<ul style="list-style-type: none"> ▪ The species grows in rugged hilly areas in soils of volcanic origin, as well as in areas of limestone. These areas are distinguished by the low stature of the vegetation and by having more than 50 percent of the species losing their leaves during the dry season. Two strata of trees are usually present. The uppermost continuous stratum is located about 15 to 30 feet high and is mostly composed of deciduous species. The lower stratum, at or below 15 feet, is composed of evergreen species. An herbaceous layer is lacking for the most part. 	Possible

APPENDIX B

Observed Plant List

<u>Scientific name/Family</u>	<u>Common name in Spanish</u>	<u>Common name in English</u>	<u>Habit</u>
Acanthaceae			
<i>Oplonia spinosa</i>	Espinosa	Prickly bush	Shrub/Vine
<i>Ruellia tuberosa</i>		Many-roots	Herb
Aizoaceae			
<i>Sesuvium portulacastrum</i>	Verdolaga rosada	Sea purslane	Herb
Agavaceae			
<i>Agave sp.</i>			Herb
Amaranthaceae			
<i>Achyranthes aspera</i>	Rabo de gato	Man-better-man	Herb
<i>Blutaparon vermiculare</i>	Hierba de sal	Salt-weed	Herb
Amaryllidaceae			
<i>Hymenocallis sp.</i>			Herb
Anacardiaceae			
<i>Comocladia dodonaea</i>	Carrasco	Poison ash	Shrub/Tree
<i>Spondias mombin</i>	Jobillo	Hog-plum	Tree
Apocynaceae			
<i>Catharanthus roseus</i>	Playera	Periwinkle	Herb
<i>Metastelma decipiens</i>			Herb
<i>Pentalinon luteum</i>	Babeiro amarillo		Vine
<i>Plumeria alba</i>	Alhelí blanco	Milk tree	Tree
<i>Rauvolfia nitida</i>	Cachimbo	Milk bush	Tree
Araceae			
<i>Anthurium crenatum</i>	Moco de pavo	Laceleaf	Herb
Asclepiadaceae			
<i>Calotropis procera</i>	Algodón de seda	Giant milkweed	Shrub
<i>Matelea maritima</i>	Popón	Beach milk-vine	Vine
Avicenniaceae			
<i>Avicennia germinans</i>	Mangle negro	Black mangrove	Tree
Bataceae			
<i>Batis maritima</i>	Barilla	Saltwort	Shrub
Bignoniaceae			
<i>Distictis lactiflora</i>	Viuda		Vine
<i>Macfadyena unguis-cati</i>	Bejuco de gato	Cat's claw	Vine
<i>Tabebuia heterophylla</i>	Roble blanco	White cedar	Tree
Boraginaceae			
<i>Bourreria succulenta</i>	Palo de vaca	Pigeon berry	Tree

<i>Cordia collococca</i>	Cerezo	Red manjack	Tree
<i>Cordia polycephala</i>	Basora prieta	Black sage	Shrub/Vine
<i>Cordia rickeseckeri</i>	San Bartolomé	Manjack	Tree
<i>Heliotropium curassavicum</i>	Cotorrera de playa	Seaside heliotrope	Herb
<i>Heliotropium indicum</i>	Pico de cotorra	Indian heliotrope	Herb
<i>Tournefortia hirsutissima</i>	Nigua	Chiggery grapes	Vine
<i>Tournefortia volubilis</i>	Nigua enredadera		Vine
Bromeliaceae			
<i>Bromelia pinguin</i>	Maya	Pinguin	Herb
<i>Tillandsia recurvata</i>	Nidod de gungulén	Bunch moss	Herb
<i>Tillandsia utriculata</i>			Herb
Burseraceae			
<i>Bursera simaruba</i>	Almácigo	Gumbo limbo	Tree
Cactaceae			
<i>Melocactus intortus</i>	Melón de costa	Turk's head	Shrub
<i>Opuntia dillenii</i>	Tuna brava	Prickly pear	Shrub
<i>Opuntia repens</i>	Gatos	Suckers	Vine
<i>Opuntia rubescens</i>	Tuna de petate	Tree cactus	Tree
<i>Pilosocereus royenii</i>	Sebucán		Tree
Canellaceae			
<i>Canella winterana</i>	Barbasco	Pepper cinnamon	Tree
Capparaceae			
<i>Capparis cynophallophora</i>	Burro prieto	Black wattle	Shrub/Vine
<i>Capparis flexuosa</i>	Palinguán	Caper tree	Tree
<i>Capparis hastata</i>	Burro	Broad-leaved caper	Shrub
<i>Capparis indica</i>	Sapo prieto		Shrub/Tree
Celastraceae			
<i>Crossopetalum rhacoma</i>	Coral	Poison cherry	Shrub/Tree
<i>Elaeodendron xylocarpum</i>	Guayarote	Spoon tree	Tree
<i>Gyminda latifolia</i>	Mala mujer	False boxwood	Tree
<i>Schaefferia frutescens</i>	Jibá	Florida boxwood	Tree
Chrysobalanaceae			
<i>Chrysobalanus icaco</i>	Icaco	Coco-plum	Shrub
Combretaceae			
<i>Bucida buceras</i>	Ucar	Oxhorn bucida	Tree
<i>Conocarpus erecta</i>	Mangle botón	Button mangrove	Tree
<i>Laguncularia racemosa</i>	Mangle blanco	White mangrove	Tree
<i>Terminalia catappa</i>	Almendro	Indian almond	Tree
Commelinaceae			
<i>Commelina diffusa</i>	Cohitre	French weed	Herb
Compositae (Asteraceae)			
<i>Bidens alba</i>	Romerillo	Shepherd's needle	Herb
<i>Bidens cynapiifolia</i>	Alfilerillo	Beggar-ticks	Herb
<i>Borrhchia arborescens</i>	Clavelón de playa	Sea ox-eye	Shrub
<i>Lauanea intybacea</i>	Achicoria azul	Wild lettuce	Herb
<i>Sonchus oleraceus</i>	Chicoria	Sow-thistle	Herb

<i>Vernonia cinerea</i>	Rabo de buey	Little ironweed	Herb
Convolvulaceae			
<i>Evolvulus sericeus</i>			Herb
<i>Ipomoea alba</i>	Bejuco de vaca	Moon vine	Vine
<i>Ipomoea eggersii</i>			Vine
<i>Ipomoea indica</i>	Bejuco de gloria		Vine
<i>Ipomoea pes-caprae</i>	Bejuco de playa	Bay hops	Vine
<i>Ipomoea tiliacea</i>	Bejuco de puerco		Vine
<i>Ipomoea violacea</i>	Bejuco de luna	Coast moon-vine	Vine
<i>Jacquemontia pentanthos</i>	Aguinaldo azul		Vine
<i>Merremia dissecta</i>	Noyó	Know-you	Vine
Cucurbitaceae			
<i>Cayaponia americana</i>	Bejuco de torero		Herb
Cuscutaceae			
<i>Cuscuta americana</i>	Fideos	Yellow love	Vine
Cyperaceae			
<i>Cyperus brunneus</i>			Sedge
<i>Cyperus compressus</i>			Sedge
<i>Cyperus ligularis</i>	Junco de agua		Sedge
<i>Fimbristylis cymosa</i>			Sedge
<i>Fimbristylis ferruginea</i>			Sedge
<i>Fimbristylis spadicea</i>			Sedge
<i>Rhynchospora</i> sp.			Sedge
<i>Scleria lithosperma</i>			Sedge
Erythroxylaceae			
<i>Erythroxylum brevipes</i>		Brisselet	Tree
Euphorbiaceae			
<i>Adelia ricinella</i>	Escambrón, cotorro		Tree
<i>Argythamnia candicans</i>			Herb
<i>Chamaesyce articulata</i>			Shrub
<i>Chamaesyce hyssopifolia</i>	Lechera		Herb
<i>Chamaesyce mesembrianthemifolia</i>			Herb
<i>Croton astroites</i>	Maná		Shrub
<i>Croton betulinus</i>			Shrub
<i>Croton discolor</i>	Lehecillo		Shrub
<i>Croton lobatus</i>	Croton lobulado		Shrub
<i>Euphorbia heterophylla</i>	Lehecilla	Mexican fireplant	Herb
<i>Euphorbia petiolaris</i>	Indio desnudo	Manchineel berry	Tree
<i>Gymnanthes lucida</i>	Yaití	Crabwood	Tree
<i>Hippomane mancinella</i>	Manzanillo	Manchineel	Tree
<i>Jatropha gossypifolia</i>	Higuereta cimarrona		Herb
<i>Margaritaria nobilis</i>	Millo	Roehout	Tree
<i>Pedilanthus tithymaloides</i>			Herb
<i>Savia sessiliflora</i>	Amansa guapo		Tree
<i>Taglia volubilis</i>	Pringamoza	Stinging vine	Vine
Flacourtiaceae			
<i>Samyda</i> sp.			Shrub
Goodeniaceae			
<i>Scaevola frutescens</i>	Coralillo		Shrub

<i>Scaevola plumieri</i>		Ink berry	Shrub
Leguminosae-Caesalpinioideae			
<i>Caesalpinia bonduc*</i>	Mato de playa	Gray nickers	Vine
<i>Caesalpinia ciliata</i>	Mato negro	Black nickers	Vine
<i>Chamaecrista portoricensis</i>			Shrub
<i>Parkinsonia aculeata</i>	Palo de rayo	Jerusalme thorn	Tree
<i>Senna bicapsularis</i>			Shrub
<i>Tamarindus indica</i>	Tamarindo	Tamarind	Tree
Leguminosae-Mimosoideae			
<i>Acacia muricata</i>	Cojoba	Spineless Acacia	Tree
<i>Acacia retusa</i>	Zarza brava	Catch and keep	Vine
<i>Acacia tortuosa</i>	Casia	Twisted Acacia	Tree
<i>Desmanthus virgatus</i>	Desmanto		Shrub
<i>Leucaena leucocephala</i>	Acacia palida	Wild tamarind	Tree
<i>Pithecellobium unguis-cati</i>	Escambron colorado	Cat's claw	Tree
<i>Zapoteca portoricensis</i>	Zarza boba	White anneslia	Shrub
Leguminosae-Papilionoideae			
<i>Abrus precatorius</i>	Perona	Jumbee bead	Vine
<i>Aeschynomene americana</i>	Morivivi bobo		Shrub
<i>Canavalia rosea</i>	Haba de playa	Bay-bean	Herb
<i>Centrosema pubescens</i>	Flor de pito	Butterfl pea	Vine
<i>Centrosema virginianum</i>	Conchita de Virginia	Wist vine	Vine
<i>Crotalaria retusa</i>	Cascabelillo	Rattleweed	Herb
<i>Dalbergia ecastaphyllum</i>	Palo de pollo		Shrub/Tree
<i>Galactia dubia</i>			Vine
<i>Macroptilium lathyroides</i>	Habichuela parada	Wild bush bean	Herb
<i>Pictetia aculeata</i>	Tachuelo	Fustic	Tree
<i>Piscidia carthagenensis</i>	Ventura	Fish poison	Tree
<i>Poitea</i> sp.			Tree
<i>Prosopis juliflora</i>	Bayahonda	Mesquite	Tree
<i>Rhynchosia reticulata</i>	Frijolillo		Vine
<i>Sesbania sericea</i>	Papagayo		Shrub
<i>Stylosanthes hamata</i>	Zarabacoa enana	Pencil flower	Herb
<i>Vigna luteola</i>	Frijol silvestre		Vine
Liliaceae			
<i>Aloe vera</i>	Sabila	Aloe	Herb
<i>Sansevieria</i> sp.			Herb
Loranthaceae			
<i>Dendropemon</i> sp.			Herb
Lythraceae			
<i>Ginoria rohrii</i>	Rosa de cinaga	Bastard gregre	Tree
Malvaceae			
<i>Abutilon umbellatum</i>	Malvavisco cimarron		Shrub
<i>Gossypium barbadense</i>	Algodon silvestre	Wild cotton	Shrub
<i>Hibiscus phoeniceus</i>			Herb
<i>Sida</i> sp.			Shrub
<i>Thespesia populnea</i>	Emajaguilla	Spanish cork	Shrub
<i>Urena lobata</i>	Cadillo	Bur	Shrub

Malpighiaceae

<i>Malpighia woodburyana</i>	Olaga	Caowage cherry	Tree
<i>Stigmaphyllon emarginatum</i>	Bejuco de San Pedro		Vine
<i>Stigmaphyllon ovatum</i>			Vine

Melastomataceae

<i>Tetrazygia elaeagnoides</i>	Verdiseco	Kre-kre	Tree
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Moraceae

<i>Ficus citrifolia</i>	Jagüey		Tree
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Myrtaceae

<i>Eugenia axillaris</i>	Grajo	White stopper	Tree
<i>Eugenia biflora</i>	Hoja menuda	Black rod-wood	Tree
<i>Eugenia cordata</i>		Lathberry	Tree
<i>Eugenia foetida</i>	Hoja menuda	Spanish stopper	Tree
<i>Eugenia ligustrina</i>	Palo de murta	Privet-stopper	Shrub
<i>Myrciaria floribunda</i>	Mirto	Guavaberry	Tree
<i>Myrciaria myrtifolia</i>			Tree

Nyctaginaceae

<i>Boerhavia</i> sp.			Herb
<i>Neea buxifolia</i>	Nía		Tree
<i>Pisonia subcordata</i>	Corcho blanco	Water mampoo	Tree
<i>Trichostigma octandrum</i>	Bejuco de paloma		Vine

Olacaceae

<i>Schoepfia schreberi</i>			Tree
<i>Ximenia americana</i> *			Tree

Orchidaceae

<i>Oeceoclades maculata</i>		Monk orchid	Herb
<i>Tolumina variegata</i>	Angelitos		Herb
<i>Psychilis macconnielliae</i>			Herb
<i>Vanila</i> sp.			Vine

Palmae (Arecaceae)

<i>Coccothrinax alta</i>	Palma de abanico	Teyer palm	Palm
<i>Cocos nucifera</i>	Palma de coco	Coconut palm	Palm
<i>Thrinax morrisii</i>	Palma de escoba		Palm

Polypodiaceae

<i>Microgramma heterophylla</i>			Vine
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Passifloraceae

<i>Passiflora suberosa</i>	Flor de pasión	Passion flower	Vine
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Phytolaccaceae

<i>Rivina humilis</i>	Carmín	Cat's blood	Shrub
<i>Petiveria alliacea</i>	Anamú	Garlic weed	Shrub

Poaceae

<i>Bothriochloa pertusa</i>	Yerba amarga	Hurricane grass	Grass
<i>Cenchrus echinatus</i>	Cadillo	Bur grass	Grass
<i>Chloris</i> sp.			Grass
<i>Distichlis spicata</i>		Saltgrass	Grass

<i>Eustachys petraea</i>	Yerba de deo	Finger grass	Grass
<i>Lasiacis</i> sp.			Grass
<i>Panicum maximum</i>	Hierba de guinea	Guinea grass	Grass
<i>Paspalum laxum</i>	Matojo de arena		Grass
<i>Paspalum vaginatum</i>			Grass
<i>Spartina patens</i>	Yerba de sal	Salt grass	Grass
<i>Sporobolus virginicus</i>	Matojo de playa	Sea-shore rush grass	Grass
<i>Uniola virgata</i>	Lágrimas de San Pedro	Wire grass	Grass
Polygonaceae			
<i>Coccoloba diversifolia</i>			Tree
<i>Coccoloba microstachya</i>	Uverillo	Pockhout	Tree
<i>Coccoloba krugii</i>			Tree
<i>Coccoloba uvifera</i>	Uvero	Seagrape	Tree
<i>Coccoloba</i> sp.			Tree
Rhamnaceae			
<i>Colubrina arborescens</i>	Abejuelo	Greenheart	Tree
<i>Colubrina elliptica</i>	Mabí	Naked wood	Shrub/Tree
<i>Krugiodendron ferreum</i>	Palo de hierro	Ironwood	Tree
<i>Reynosia uncinata</i>	Cascarroya		Tree
<i>Ziziphus reticulata</i>	Cascarroya		Tree
Rhizophoraceae			
<i>Rhizophora mangle</i>	Mangle rojo	Red mangrove	Tree
Rubiaceae			
<i>Chiococca alba</i>	Bejuco de berac		Vine
<i>Erithalis fruticosa</i>	Manglillo	Black torch	Tree
<i>Ernodea littoralis</i>		Golden creeper	Shrub
<i>Exostema caribaeum</i>	Cuero de sapo	Yellow torch	Tree
<i>Randia aculeata</i>	Tintillo	Ink berry	Tree
<i>Spermacoce</i> sp.			
<i>Scolosanthus versicolor</i>	Alfiler	Shrub	
Rutaceae			
<i>Amyris elemifera</i>	Tea	Torchwood	Tree
<i>Pilocarpus racemosus</i>	Aceitillo		Tree
<i>Zanthoxylum monophyllum</i>	Espino rubial	Yellow prickle	Tree
<i>Zanthoxylum punctatum</i>			Tree
Sapotaceae			
<i>Sideroxylon obovatum</i>	Alquitrán	Break hill	Tree
Scrophulariaceae			
<i>Capraria biflora</i>	Té del país	Goat-weed	Shrub
Simaroubaceae			
<i>Suriana maritima</i>	Temporana	Bay cedar	Shrub
Solanaceae			
<i>Datura inoxia</i>	Campana de pasto	Prickly bur	Vine
<i>Solanum</i> sp.			Shrub
Sterculiaceae			
<i>Gauzuma ulmifolia</i>	Guácima	Bastard cedar	Tree

<i>Melochia nodiflora</i>	Bretónica prieta		Shrub
<i>Melochia tomentosa</i>	Bretónica afelpada	Broom weed	Shrub
<i>Waltheria indica</i>	Basora prieta		Shrub
Theophrastaceae			
<i>Jacquinia arborea</i>	Azúcares	Torchwood	Tree
<i>Jacquinia berterii</i>	Mercocha		Tree
Tiliaceae			
<i>Corchorus hirsutus</i>	Malvavisco	Jack-switch	Herb
Turneraceae			
<i>Turnera diffusa</i>	Damiana		Shrub
Verbenaceae			
<i>Citharexylum fruticosum</i>	Péndula	Florida fiddlewood	Tree
<i>Clerodendrum aculeatum</i>	Escambrón blanco	Crab prickly	Shrub
<i>Lantana camara</i>	Cariaquillo	Yello sage	Shrub
<i>Lantana involucrata</i>	Santa María	Button sage	Shrub
<i>Stachytarpheta jamaicensis</i>	Bretónica		Shrub
Vitaceae			
<i>Cissus trifoliata</i>	Bejuco de caro		Vine
<i>Cissus verticillata</i>	Bejuco de caro	Pudding vine	Vine
Zygophyllaceae			
<i>Guaiaicum officinale</i> *	Guayacán	Lignum vitae	Tree

* "Elemento crítico" according to PRDNER list

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APPENDIX C

Observed Birds List

<u>Scientific name/Family</u>	<u>Common name</u>
Acciptridae	
<i>Buteo jamaicensis</i>	Red-tailed Hawk
<i>Accipiter striatus venator</i>	Puerto Rican Sharp-shinned Hawk
Anatidae	
<i>Anas bahamensis bahamensis</i>	Lesser White-cheeked Pintail
Ardeidae	
<i>Ardea herodias</i>	Great Blue Heron
<i>Egretta caerulea</i>	Little Blue Heron
<i>Egretta tricolor</i>	Tricolored Heron
<i>Ardea alba</i>	Great Egret
<i>Butorides virescens</i>	Green Heron
Cerylidae	
<i>Megaceryle alcyon</i>	Belted Kingfisher
Charadriidae	
<i>Pluvialis dominica</i>	American Golden Plover
<i>Charadrius wilsonia</i>	Wilson's Plover
Columbidae	
<i>Columbina passerina</i>	Ground Dove
<i>Zenaida aurita</i>	Zenaida Dove
<i>Patagioenas leucocephala</i>	White-crowned Pigeon
<i>Patagioenas squamosa</i>	Scaly-naped Pigeon

Cuculidae

<i>Coccyzus minor</i>	Mangrove Cuckoo
<i>Crotophaga ani</i>	Smooth-billed Ani

Falconidae

<i>Falco sparverius</i>	American Kestrel
<i>Falco columbarius</i>	Merlin

Fregatidae

<i>Fregata magnificens</i>	Magnificent Frigatebird
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Haematopodidae

<i>Haematopus palliatus</i>	American Oystercatcher
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Icteridae

<i>Quiscalus niger</i>	Greater Antillean Grackle
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Mimidae

<i>Margarops fuscatus</i>	Pearly-eyed Thrasher
<i>Mimus polyglottos</i>	Northern Mockingbird

Pandionidae

<i>Pandion haliaetus</i>	Osprey
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Parulidae

<i>Dendroica petechia</i>	Yellow Warbler
<i>Dendroica adalaidae</i>	Adelaide's Warbler

Pelecanidae

<i>Pelecanus occidentalis</i>	Brown Pelican
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Recurvirostridae

Himantopus himantopus mexicanus *Black-necked Stilt*

Scolopocidae

Tringa melanoleuca Greater Yellowlegs
Phalaropus lobatus Red-necked Phalarope
Actitis macularius Spotted Sandpiper
Arenaria interpres Ruddy Turnstone

Sulidae

Sula leucogaster Brown Booby

Thraupidae

Coereba flaveola Bananaquit
Tiaris bicolor Black-faced Grassquit

Trochilidae

Orthorhyncus cristatus Antillean Crested Hummingbird

Tyrannidae

Elaenia martinica Caribbean Elaenia
Tyrannus dominicensis Gray Kingbird

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APPENDIX D

Figures

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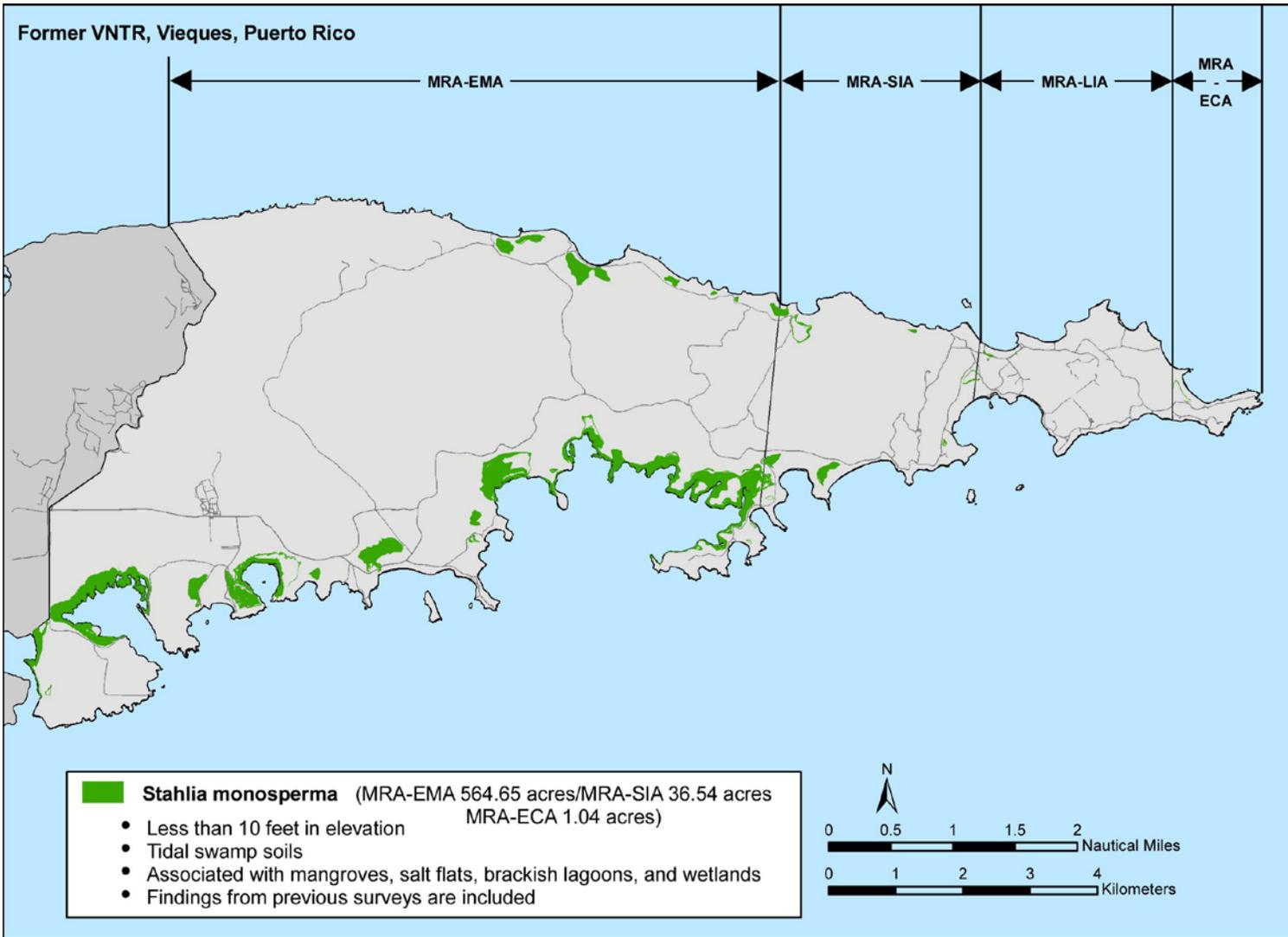


Figure 1. Map showing areas of high probability for the presence of *Stahlia monosperma* on Vieques, Puerto Rico.

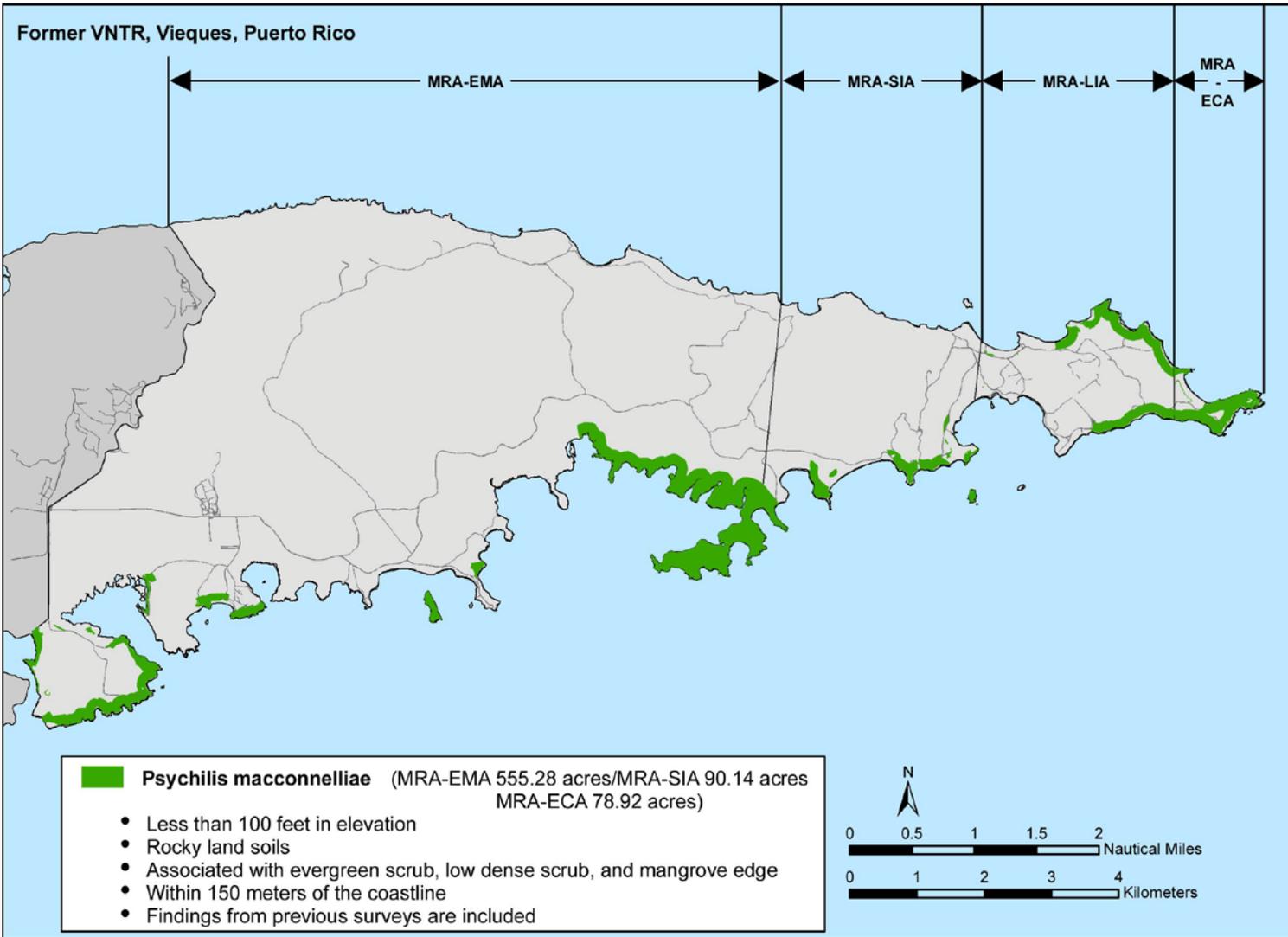


Figure 2. Map showing areas of high probability for the presence of *Psychilis macconnelliae* on Vieques, Puerto Rico.

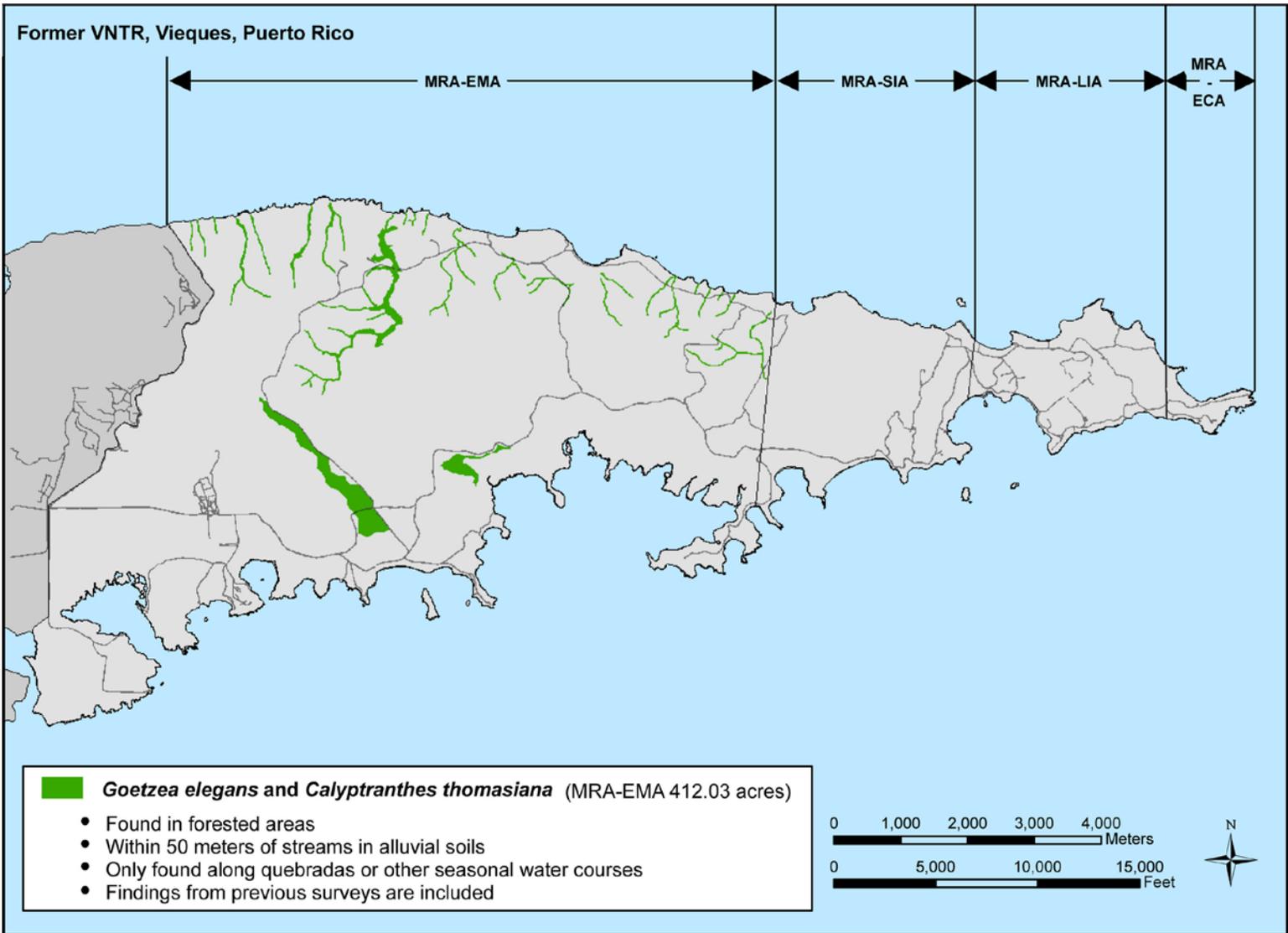


Figure 3. Map showing areas of high probability for the presence of *Goetzea elegans* on Vieques, Puerto Rico.

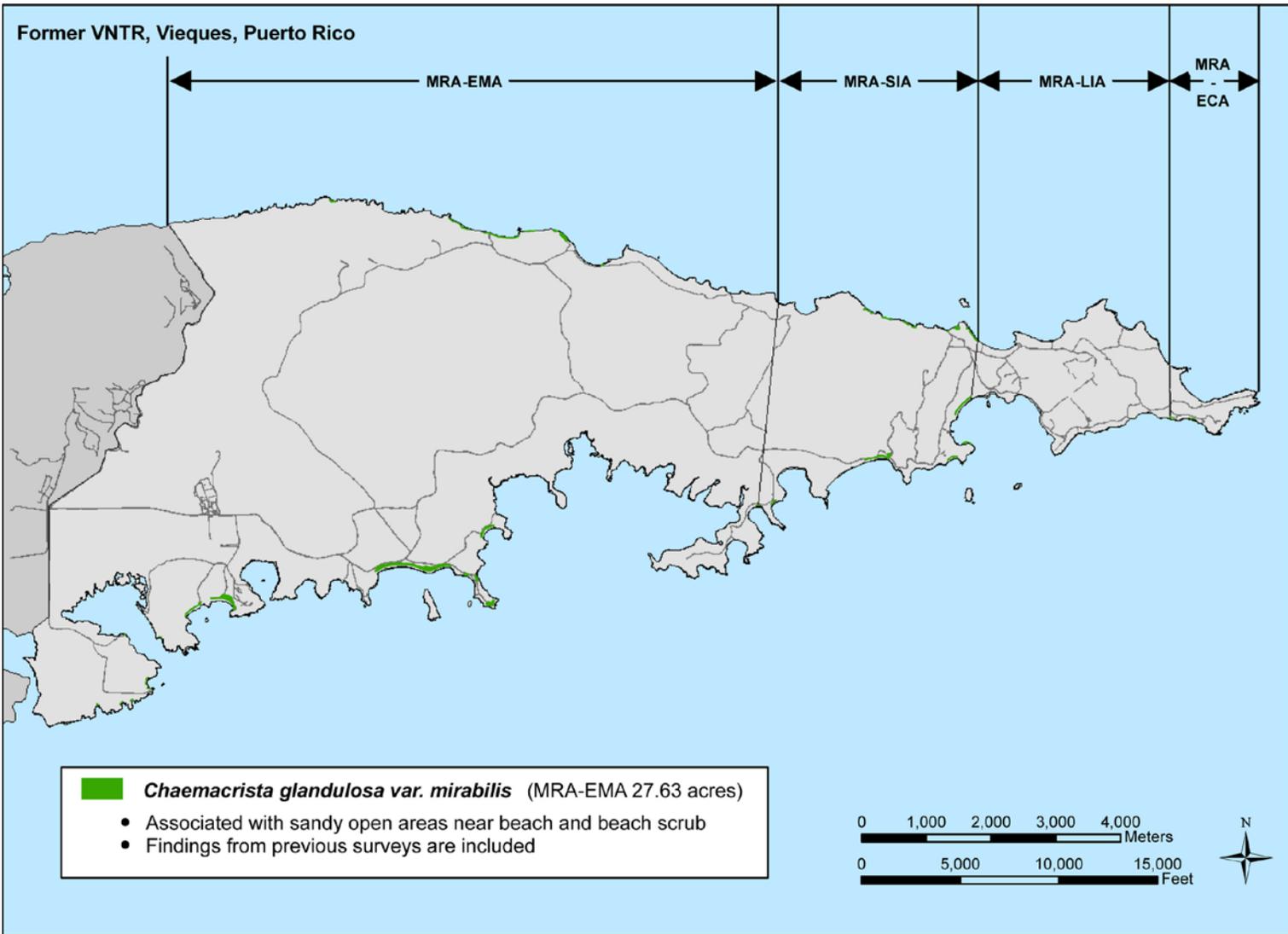


Figure 4. Map showing areas of high probability for the presence of *Chaemacrista glandulosa var. mirabilis* on Vieques, Puerto Rico.



Figure 5 (Map D1). Species Survey Locations and Observations.



Figure 6 (Map D2). Species Survey Locations and Observations.



Figure 7 (Map D3). Species Survey Locations and Observations.



Figure 8 (Map D4). Species Survey Locations and Observations.

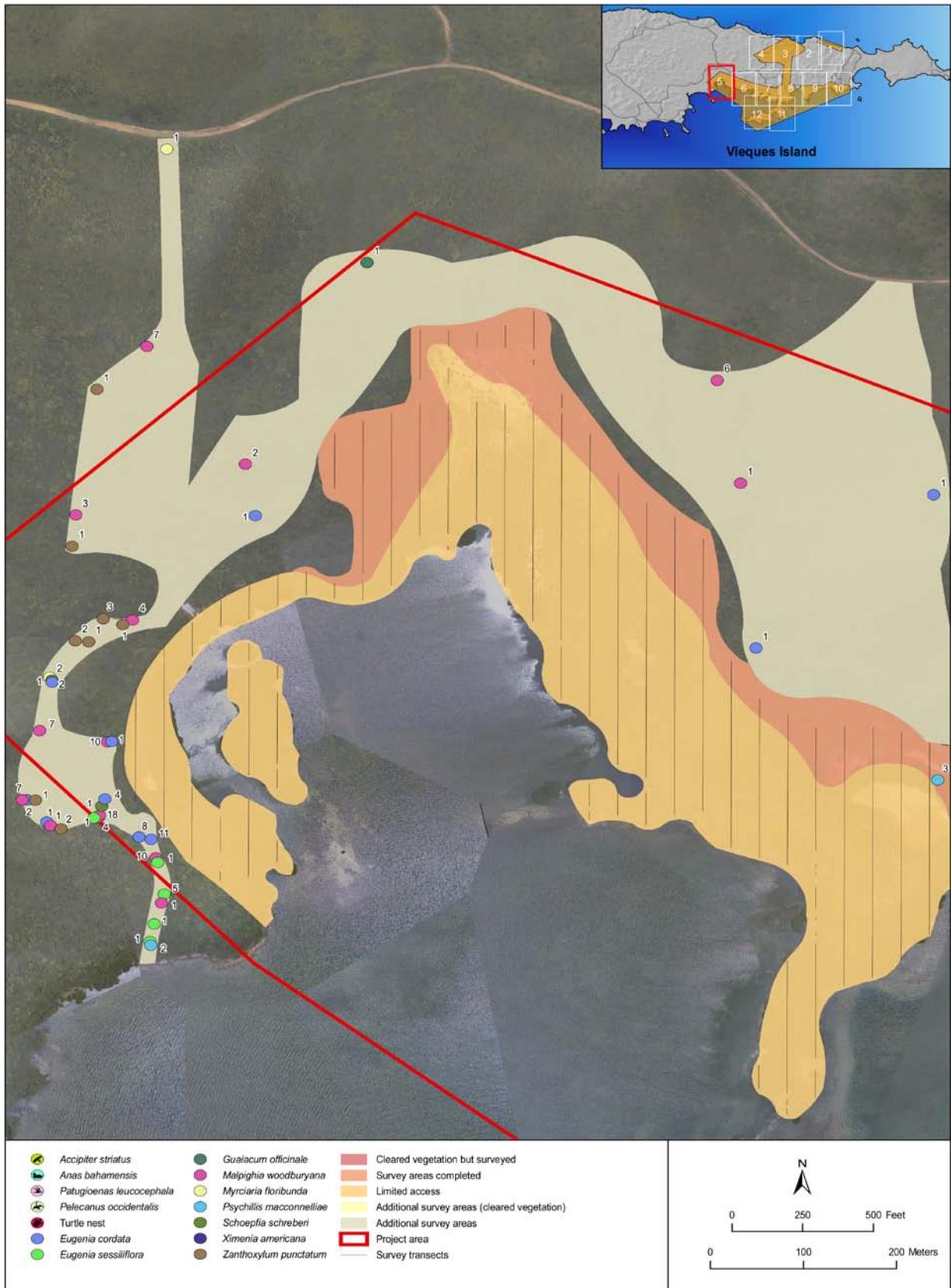


Figure 9 (Map D5). Species Survey Locations and Observations.



Figure 10 (Map D6). Species Survey Locations and Observations.



Figure 11 (Map D7). Species Survey Locations and Observations.



Figure 12 (Map D8). Species Survey Locations and Observations.



Figure 13 (Map D9). Species Survey Locations and Observations.



Figure 14 (Map D10). Species Survey Locations and Observations.

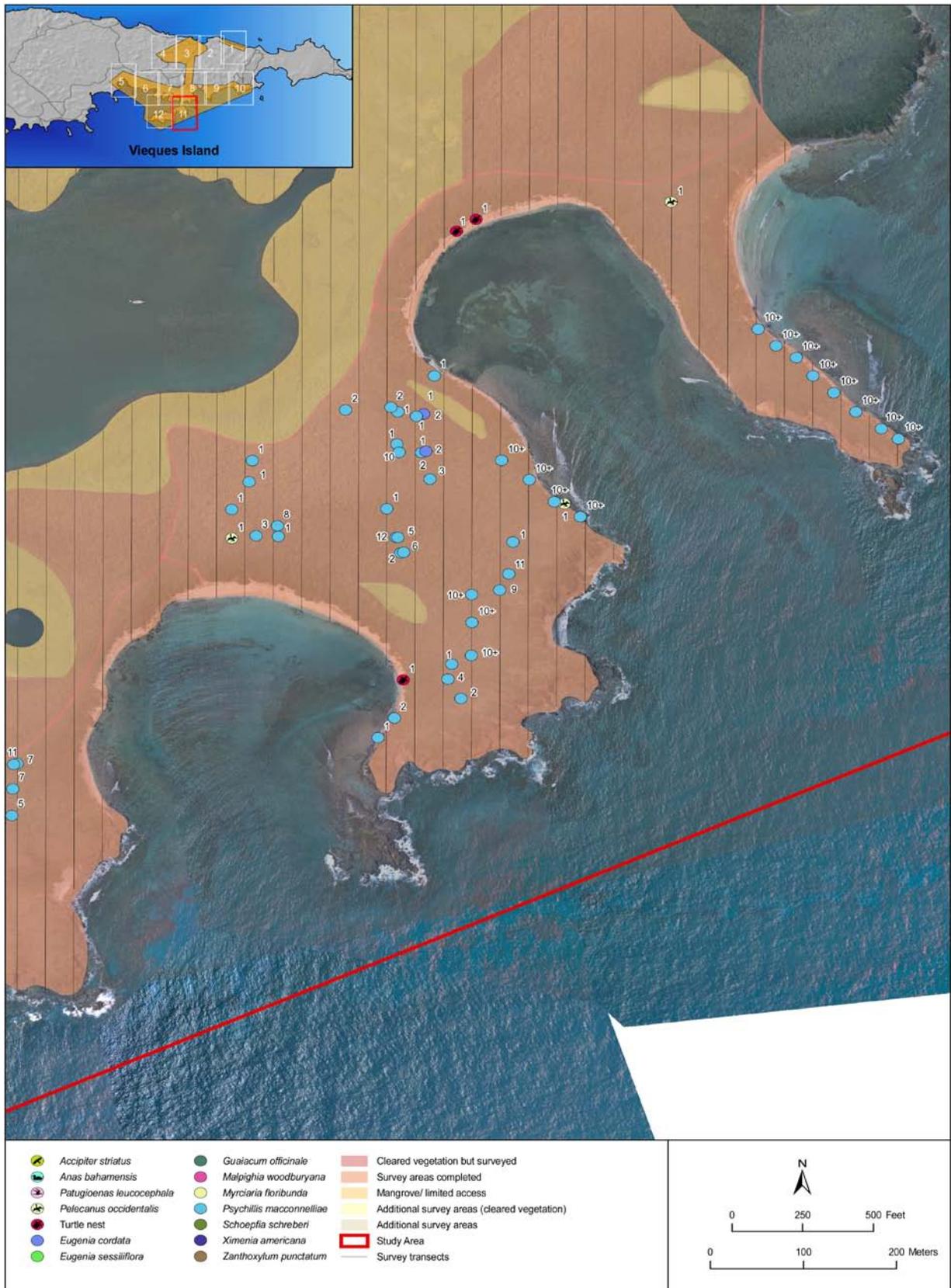


Figure 15 (Map D11). Species Survey Locations and Observations.



Figure 16 (Map D12). Species Survey Locations and Observations.