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Las Cabezas de San Juan Nature Reserve (El Faro)

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Abstract

The 178-hectare (ha) northeastern tip of Puerto Rico, which is known locally as "Las Cabezas de San Juan Nature Reserve," is managed by the Puerto Rican Conservation Trust to protect the area's scenic beauty and to provide environmental education and research opportunities to the island's residents and visitors. The highest point on the terrain is occupied by a lighthouse (El Faro). Constructed in 1880, El Faro provides a scenic panorama of the northeastern coast, offshore islands, and the Luquillo Mountains. The current state of knowledge regarding the environment, i.e., geology, physiography, soils, climate, flora, fauna, and past human influence, is summarized in this document as general information for the public and as a basis for further research. New information on plant species and their occurrence and relative abundance is also provided. The Reserve has at least 355 plant and 96 bird species. Continued protection will provide ample opportunity to expand educational opportunities on the Reserve to increase scientific knowledge of its terrestrial and aquatic resources.

Keywords: Climate, conservation, fauna, flora, history.

Introduction

The 178-hectare (ha) area known as "Las Cabezas de San Juan" Nature Reserve (hereafter called the Reserve) was established in 1986 to protect the natural beauty of the northeastern tip of Puerto Rico and to provide educational opportunities for the public (Fideicomiso de Conservación de Puerto Rico 1988) (fig. 1). The land is owned by the Corporation for the Development of the Marine, Lacustrine, and Fluvial Resources of Puerto Rico (CODREMAR), a public corporation attached to the Department of Natural and Environmental Resources (DNRA), and is administered by the Puerto Rico Conservation Trust.

An historic lighthouse (El Faro), constructed in 1880, stands atop the Reserve's 67-m highpoint from which visitors enjoy a panoramic view of several prominent ecosystems of northeastern Puerto Rico. Among these are 120 km² of offshore islands known as the Cordillera that begin 2 km northeast of the Reserve and extend southwest for nearly 30 km. Other major systems include the surrounding coastal waters with their coral reefs and sea grass and, to the southwest, the montane forests of the Luquillo Mountains. During the last 450 years, the offshore waters within a few

kilometers of the Reserve have served as the final resting place for numerous sunken vessels.

The Reserve is a mosaic of tropical coastal ecosystems. The highest terrain is dominated by secondary, semievergreen forest. Many of the rocky or sandy shorelines are covered by secondary littoral woodland. The lowest points include tidal flats, mangrove swamp, and three brackish-water lagoons. A canal connects Laguna Grande, the largest of these, to the Atlantic Ocean and Croabas Bay. Privately owned for many years, the Reserve was first threatened by urban development in the mid-1960's. It is now a major attraction for both island residents and tourists.

Puerto Rico's population density and continuing urban expansion are pressuring the island. Moreover, as the population grows, so does interest in and use of the 13 areas now managed by the Conservation Trust. An integral part of the island's heritage and the Trust's educational program, the Reserve receives nearly 50,000 visitors annually.

Objectives

The main purposes of an extensive literature review, comprehensive field inventories, research programs, and other activities undertaken on the Reserve have been to provide:

- A summary of the state of knowledge regarding natural resources;
- A preliminary listing of plant and animal species;
- A herbarium in the lighthouse;
- A tentative classification of the vegetation recognizing past land use;
- An overview of human activities;
- Permanent plot monitoring to determine tree species composition and stand dynamics in secondary, semievergreen seasonal forest;
- Restoration of six native tree species in an abandoned coconut plantation;

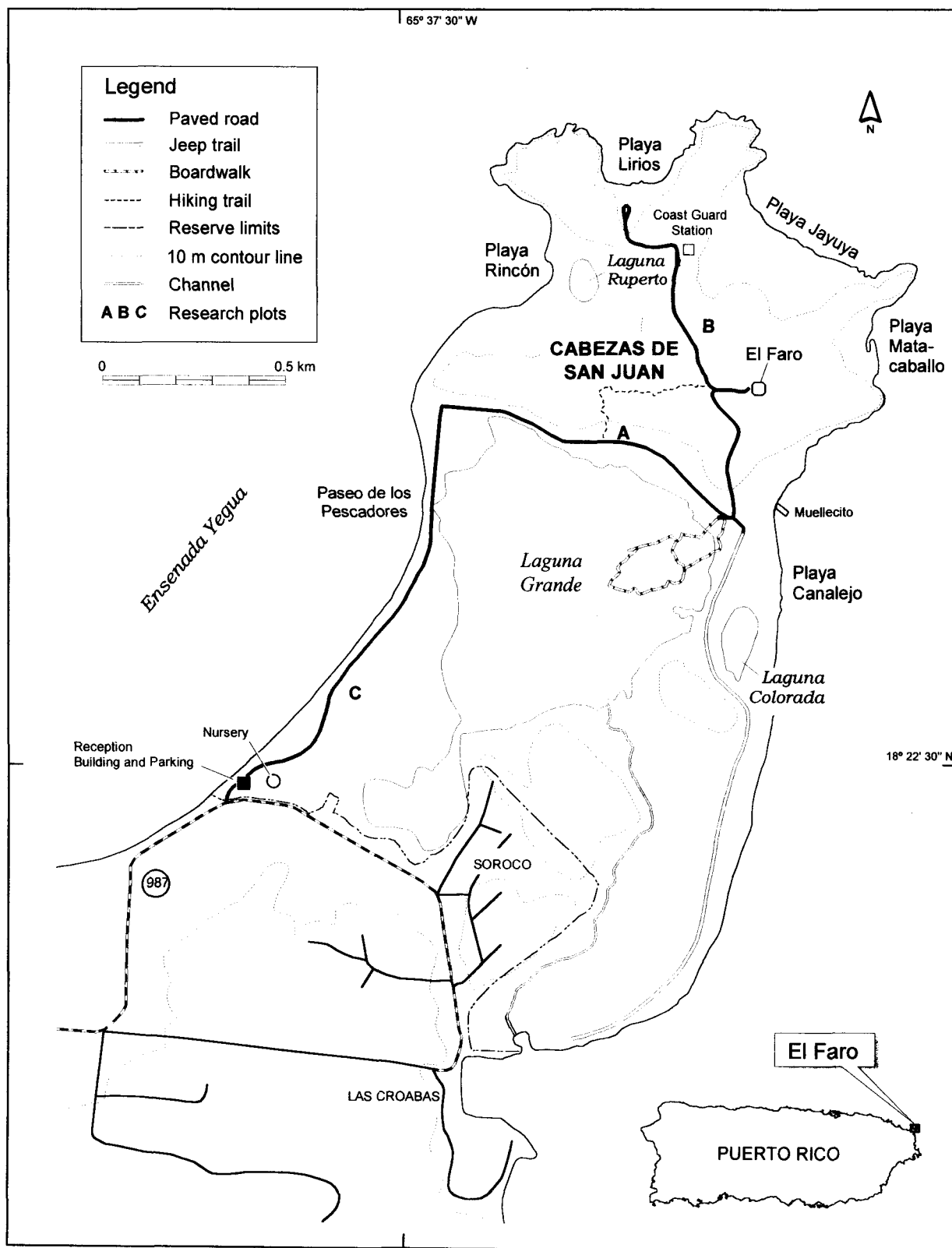


Figure 1—The Cabezas de San Juan Nature Reserve: location, place names, and structures.

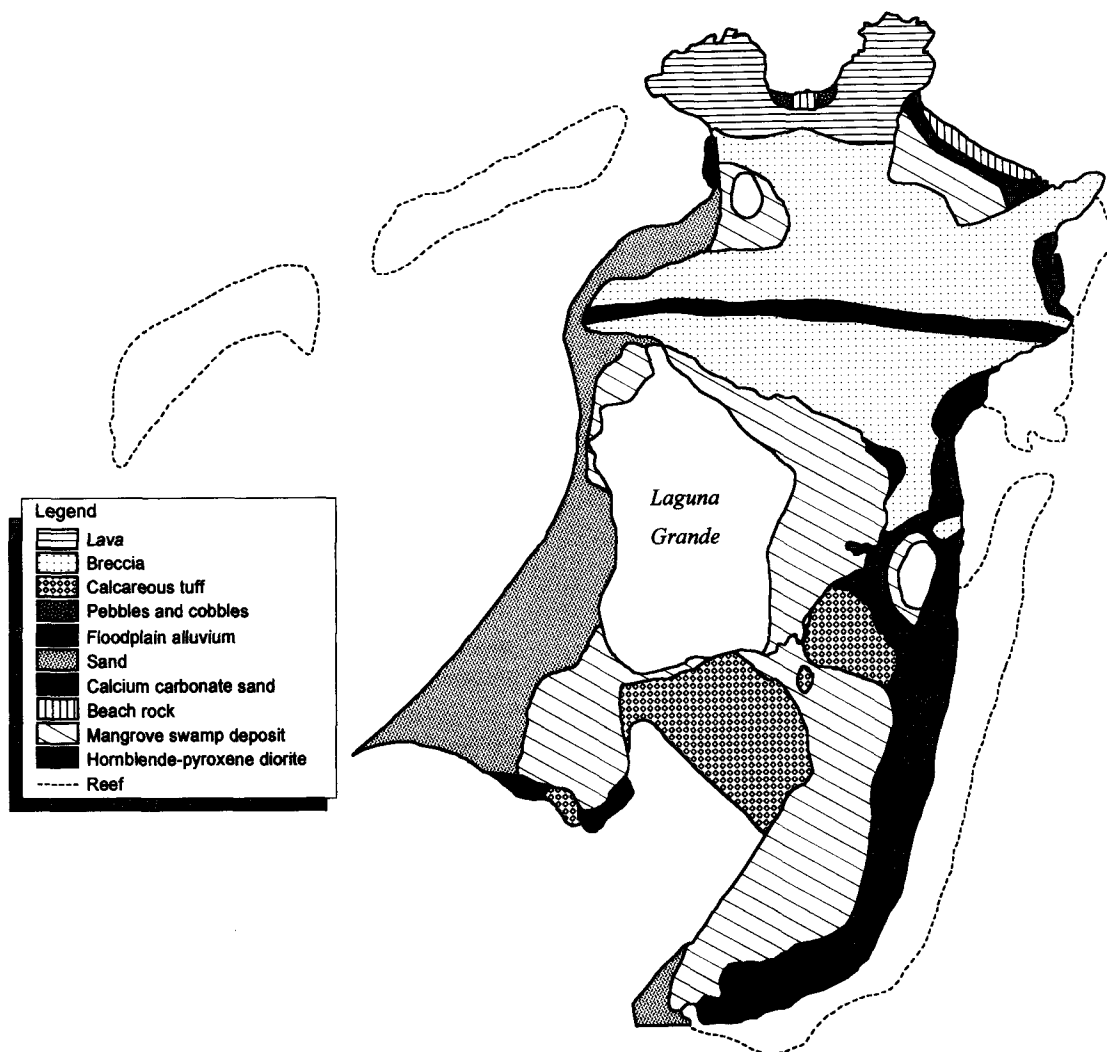


Figure 2—Geology of the Reserve and offshore reefs.

- A hiking trail through typical secondary, semievergreen seasonal forest; and
- Additional educational opportunities through the development of a slide program based on the Reserve's natural resources and the Conservation Trust's management program.

Geology

The area included in the Reserve has been classified as part of the northeastern Cretaceous section of the humid northern foothills of Puerto Rico (Picó 1974). Two major geologic areas have been recognized (Cox and Briggs 1973): undivided rocks of the northeastern volcanic plutonic subprovinces and surficial deposits. The first is composed

largely of volcanic breccias and tuffaceous sandstone and siltstone, which are primarily of marine origin. This section is probably more than 10,000 m deep. The second is composed mainly of alluvial, terrace, beach, swamp, lagoonal and dune deposits, and coastal eolianites (sand deposits cemented by calcium carbonate), which are not closely associated with surrounding outcrops. The latter are commonly less than 20 m deep. The following descriptions, derived from a geologic map of the Fajardo and Cayo Icacos quadrangles (Briggs and Aguillar-Cortés 1980), correspond numerically to areas displayed in figure 2.

Floodplain Alluvium

Floodplain alluvium is of Holocene (recent) origin and is mainly composed of unconsolidated, poorly to moderately

well sorted, thick-bedded sand, gravel, and clay. Covering about 1.2 percent of the Reserve, it is found on lower slopes adjacent to the lagoons or behind sandy shorelines.

Sand

Sand is classed as beach deposits of Holocene origin consisting of undivided coarse to finely grained, moderately well to well sorted calcium carbonate containing volcanic pebbles locally. Sand covers about 13.3 percent of the Reserve to a depth of 2 to 6 m.

Calcium Carbonate Sand

Calcium carbonate sand, Holocene in origin, is coarse to medium grained, commonly well sorted sand composed of fragments of coral, coralline algae, and shells of marine animals. Covering 12.4 percent of the Reserve, its depth ranges from 2 to 8 m.

Pebbles and Cobbles

Pebble and cobble deposits, moderately well to poorly sorted and occurring with some sand, are Holocene in origin. Pebbles and cobbles are composed mainly of volcanic rocks and coral that range in depth from 2 to 4 m. Representing the smallest geologic area, these deposits cover only 0.2 percent of the Reserve.

Beach Rock

Beach rock formed during the Holocene is mainly calcium carbonate sand cemented by calcium carbonate. Sand grains on the Reserve are derived from volcanic rock fragments. Covering 0.9 percent of the Reserve, beach rock ranges from 1 to 3 m.

The shoreline of Playa Lirios contains a small eolianite platform. Eolianite is a wind-deposited sand that has been cemented by calcium carbonate (Kaye 1959, Meyerhoff 1933, Meyerhoff and Smith 1931). Eolianite contains about 5 percent carbonate grains that are composed principally of land-snail shells (Kaye 1959). Blue-green algae may be responsible for some of the calcium carbonate deposits.

Mangrove Swamp Deposit

Holocene in origin, mangrove swamp deposits are chiefly sandy lime mud with organic material that has been saturated with brackish or salt water. Silt and clay constituents are

common near alluvium or weathered bedrock. Swamp deposits occupy 28.0 percent of the Reserve and range in depth from 2 to 5 m.

Lava (Andesitic)

Upper Cretaceous (about 100 million years ago) in origin, the lava of the Hato Puerco Formation is finely crystalline material with small and sparse phenocrysts (crystals larger than the crystals of surrounding materials) of plagioclase and rare pyroxene. Lava promontories, which are known as "Las Cabezas," cover 6.6 percent of the Reserve and are estimated to be at least 150 m thick.

Breccia

Breccia (sedimentary rock composed of angular fragments that are granule sized or larger) in the Hato Puerco formation is upper Cretaceous in origin. These rocks are chiefly massive volcanoclastic breccia that grade upward into massive tuff (rock consolidated from volcanic ash), tuffaceous breccia, and thin-bedded tuffaceous sandstone. Breccia covers 26.4 percent of the Reserve and is about 400 m thick.

Calcareous Tuff

The lower Cretaceous (about 120 million years ago) tabonuco formation is calcareous tuff composed of calcareous, thin- to thick-bedded, dark-gray to bluish-black tuffaceous siltstone and sandstone, interbedded with subordinate calcareous mudstone and breccia. The breccia is composed chiefly of fragments of calcareous siltstone a few centimeters across in a calcareous sandstone matrix. Occupying 8.6 percent of the Reserve, the depth of the formation ranges from 800 to 1000 m.

Hornblende-Pyroxene Diorite

The hornblende-pyroxene diorite dikes and sills of the Tertiary and Cretaceous age are finely to coarsely crystalline. These rocks are often porphyritic (a texture in which larger crystals are set in a finer mass of crystals) and with gabbro (coarse grained basalt) in certain localities. These formations cover 2.4 percent of the Reserve.

Reefs

Reefs of Holocene origin, composed chiefly of coral and coralline algae overlain by sand near the shore, are largely

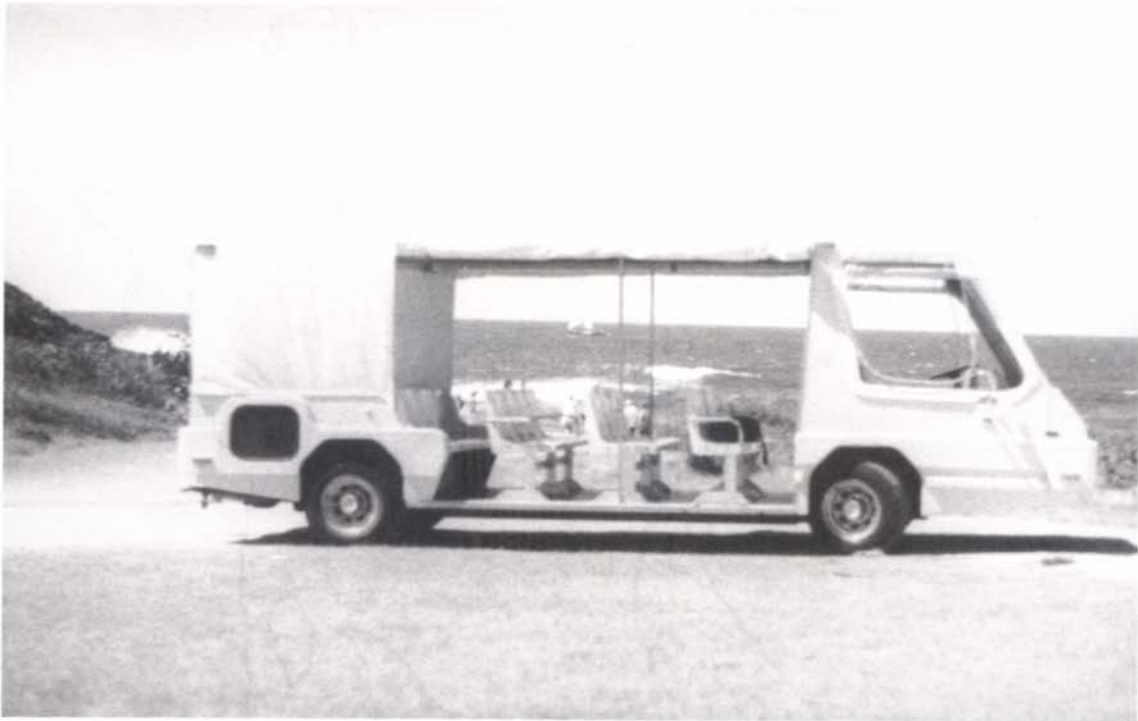


Photo: P.L. Weaver

Visitors are treated to a pleasant breeze and scenic vista of Lirios Beach, one of the regular tour stops. About 50,000 tourists and residents annually visit the Reserve's natural wonders.



Photo: R. Medina

Stately, round cactus (Melocactus intortus [Miller]) Urban grow on the exposed outcrop of the western promontory. The Reserve's promontories served as landmarks for native peoples during pre-Columbian times.

Elevation (m)	Land Area (%)
Water	28.0
0-10	44.9
10-20	11.5
20-30	8.2
30-40	4.1
40-50	1.9
50-60	0.9
60+	0.5
Total	100.0

Contour interval = 10 m

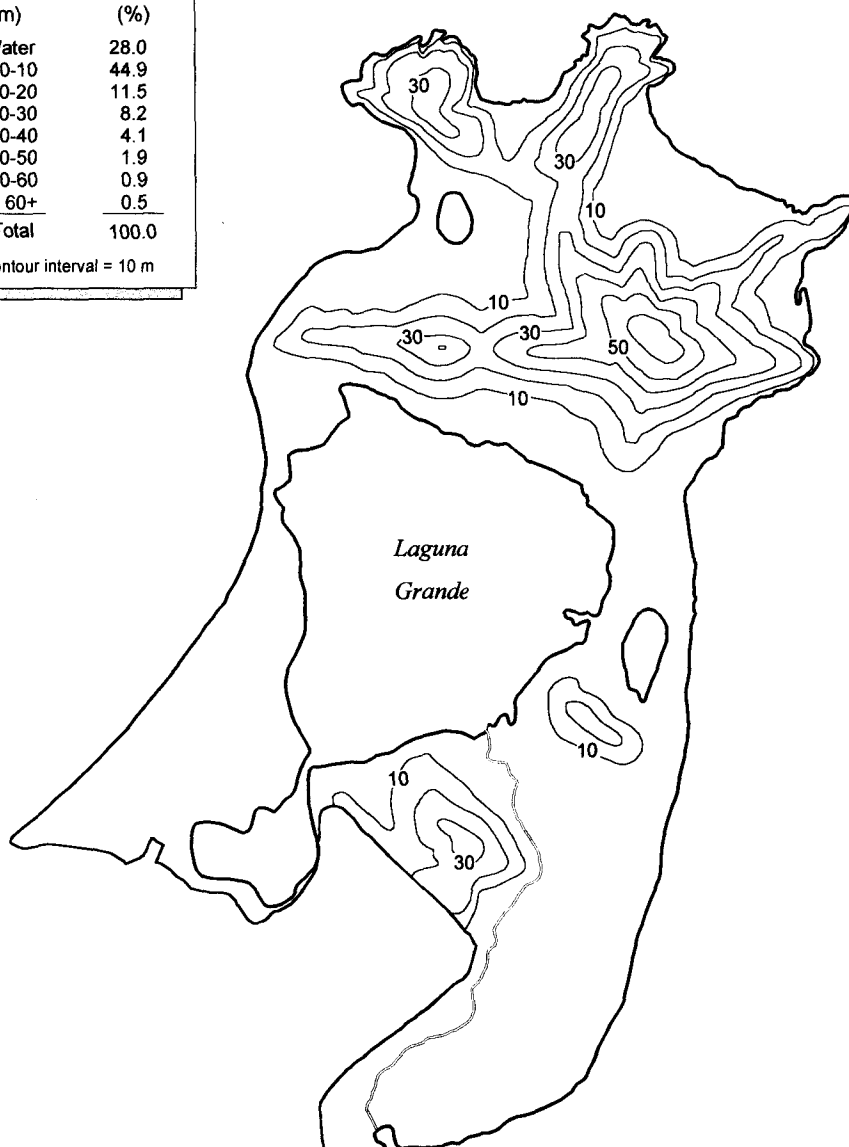


Figure 3—Physiography of the Reserve.

submarine even at low tide. Coral reefs lie off Playa Rincon and along the Reserve's eastern shoreline where they occupy about 70 ha.

Physiography

The shoreline of Puerto Rico's northeast coast, including that of the Reserve, is indented and dotted with small off-shore islands (Kaye 1959). The rocky headlands and rounded hills on both the mainland and the islands are formed by long spurs that fan out from the Luquillo Mountains. The low, wave-cut cliffs, or headlands, are separated by areas where some alluviation has occurred.

The Reserve contains 178 ha of which 72 percent is dry land. Remaining areas are occupied by three lagoons: Laguna Grande, Laguna Colorada, and Laguna Ruperto. Rainfall and tidal fluctuations may alter lagoonal water levels, particularly in Laguna Grande, which is connected to the sea. Three promontories known as Las Cabezas border the Atlantic Ocean. Two reach 30 m in elevation, and the third is about 10 m.

The average depth of Laguna Grande is 1.4 m; its maximum depth is 4 m. It occupies about 50 ha and contains about 720,000 m³ of water (Candelas and others 1968). One of the most transparent in Puerto Rico, Laguna Grande has a sandy bottom. Its southeastern part is linked to Las Croabas Bay

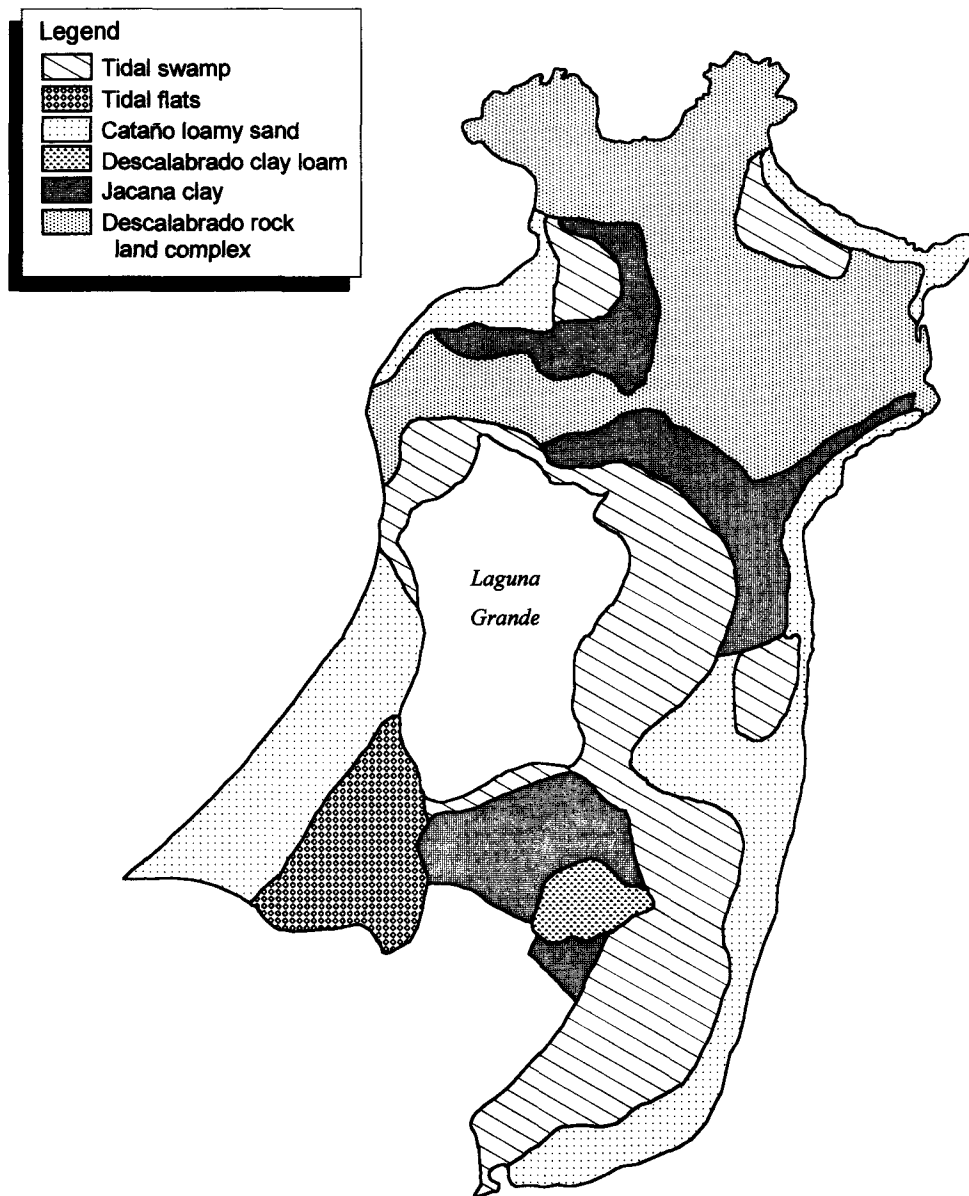


Figure 4—Soil types on the Reserve.

via a 1.5-km canal that averages about 8 m across and 0.7 m deep.

About 45 percent of the Reserve's dry land is between sea level and 10 m; 3 percent is above 40 m (fig. 3). At 67 m, the lighthouse is on the highest ground. There is another 30-m highpoint west of the lighthouse; and two more, which reach 20 and 30 m, are situated east and south of Laguna Grande, respectively.

There are also several beaches: Ensenada and Rincon border the western and northwestern parts of the property; Lirios and Jayuya face north between the three promontories; Mataballo and Canalejo are in the northeastern and eastern parts of the property, respectively.

Soils

Six soil types (fig. 4) and their past uses have been identified (Boccheciamp 1977):

Tidal Swamps

Tidal swamps, areas that are under salt water much of the year and covered by the Reserve's lagoons, occupy 27.8 percent of the Reserve. Their sandy or clayey soils are light colored and saline and contain considerable quantities of organic matter from decaying mangroves. They are underlain at varying depths by coral, shells, and marl. The land serves as a feeding and breeding ground for birds,



Photo: R. Medina

The oldest rocks of the Reserve are of volcanic origin and date from the upper Cretaceous era about 100 million years ago. Waves crash onto the shoreline creating splash pools where aquatic organisms abound.



Photo: R. Medina

Occupying nearly 50 ha and reaching a depth of 1.4 m, Laguna Grande is one of the most transparent lagoons in Puerto Rico. The lagoon contains 22 species of fish and bioluminescent organisms that emit light when the water is stirred.

oysters, and crabs. In the past, mangroves on these soils were harvested for making charcoal.

Tidal Flats

Slightly above sea level, tidal flats are affected by sea water at high tide. Salt concentrations in the soil are high, and only salt-tolerant plants are capable of surviving there. Covering 5.9 percent of the Reserve, tidal flats serve mainly as wildlife habitat.

Cataño Loamy Sand

Cataño loamy sand, covering 23.3 percent of the Reserve, is found in level areas along the coast. It has a low water-holding capacity, is rapidly permeable, and not very fertile. Coconut trees, some grass species, and adapted native vegetation occupy these soils. Historically, pasture, wildlife food and cover, and recreation have been the most common uses.

Descalabrado Clay Loam

Descalabrado clay loam occurs on eroded hilly ridges and side slopes between 5 and 60 percent. It is the smallest soil type on the Reserve covering 1.7 percent of the total area. The clay loams are formed in moderately fine textured residuum derived from volcanic rocks. They have a moderately available water capacity, a moderate shrink-swell potential, and medium natural fertility. They are susceptible to erosion and have been used as pasture or covered with brush for many years.

Jacana Clay

Jacana clay occurs on low rolling hills in semiarid areas. The soils are moderately deep, well drained, and often slowly permeable. They are formed in fine-textured sediment and residuum derived from basic volcanic rocks. The moderate slopes on which these soils are found covering 14.9 percent of the Reserve are easily eroded. They have been used mainly for pasture.



Photo: J.A. Colon

The great egret (Casmerodius albus), a permanent resident of Puerto Rico, is one of the 96 species of birds recorded on the Reserve. The Conservation Trust's management efforts have preserved critical habitat amid Puerto Rico's northeastern sprawl.

Descalabrado-Rock Land Complex

Descalabrado-rock land complex, found on ridgetops in semiarid volcanic uplands, is the most common soil type on the Reserve occupying 26.4 percent of the land area. The soils are shallow, well drained, and moderately permeable. Their rocky and shallow composition, combined with the steepness of areas where they are found, make these soils most suitable for wildlife habitat.

Climate

Climatic data have been collected at nearby sites and on the Reserve. The closest station for collection of long-term data is the city of Fajardo about 5 km south of the Reserve. Fajardo's 30-year mean annual rainfall and temperature are 1675 mm and 26.2 °C, respectively (Calvesbert 1970). Short-term records of rainfall on the Cordillera, a chain of islands 2 km east of the Reserve, have averaged only 900 mm per year (Goenaga and others 1990).

Short-term climatic records are also available for the Reserve, where the mean annual rainfall from 1993 to 1995 was 940 mm. A 1958 to 1962 record showed a mean annual rainfall of only 700 mm and a mean annual temperature of 25.6 °C (Briscoe 1966). Temperatures at the Reserve exceed 15.6 °C 100 percent of the time; 21.1 °C, 99 percent of the time; 26.7 °C, 50 percent of the time; and 32.2 °C, 2 percent of the time (Briscoe 1966).

Other short-term climatic data for the Reserve are also available (Briscoe 1966). The mean annual velocity for all hours when the wind was blowing was 21 km per hour. For all hours, including those when there was no wind, it was 16 km per hour. July and August have the highest mean wind velocity—29 km per hour; February, at 14.5 km per hour, has the lowest. Ninety-four percent of the time, the wind was blowing at ≥ 8 km per hour; 67 percent of the time, at ≥ 16 km per hour; 35 percent of the time, ≥ 24 km per hour; 18 percent of the time, ≥ 32 km per hour; 8 percent of the time, ≥ 40 km per hour; and 2 percent of the time, ≥ 48 km per hour (Briscoe 1966).

Mean annual relative humidity is 82 percent (Briscoe 1966). Monthly relative humidity ranges from a low of 80 percent in February and March to a high of 84 percent between July and October. Averaged diurnally for the year relative humidity ranges from 86 to 88 percent between 6:00 p.m. and 6:00 a.m. and between 73 and 84 percent during the day. The relative humidity is ≥ 50 percent, 99 percent of the time; ≥ 80 percent, 60 percent of the time; and ≥ 90 percent, 23

percent of the time. It reaches 100 percent only 4 percent of the time.

Solar radiation totals about 5,000 langleys per year (Briscoe 1966). Mean monthly radiation averages about 420 langleys; the greatest insolation occurs in May, with 600 langleys, and the least in October, with 210 langleys. Averaged diurnally for the year, solar radiation ranged from 6 langleys at 6:00 a.m., to 540 langleys at 10:00 a.m., to 680 langleys at 1:00 p.m. It then declined to 380 langleys by 4:00 p.m. and to 3 langleys by 7:00 p.m. Sixty-four percent of the time, the radiation was ≥ 20 langleys; 47 percent of the time, ≥ 40 langleys; 30 percent of the time, ≥ 60 langleys; 13 percent of the time, ≥ 80 langleys; and 2 percent of the time, ≥ 100 langleys.

Hurricanes have had a major impact on the vegetation and wildlife in the Reserve (Bates 1929, Salivia 1972, Walker and others 1991). In 1867, San Narciso passed directly over the Reserve. San Nicolas passed just north of the Reserve in 1931, and, in 1932, San Cipriano passed a few kilometers south over the Luquillo Mountains. In September 1989, Hurricane Hugo, which had sustained winds > 225 km per hour and a trajectory over the Reserve, caused considerable damage to mangroves and other forest vegetation.

Human Influence

Human influence in the Reserve dates back to the island's settlement by native peoples. Since then, the area has been used as a lighthouse site and, ultimately, as a reserve that is renowned for its historical, cultural, and ecological values. Today, the Conservation Trust has safeguarded the Reserve's educational opportunities for present and future generations.

Pre-Columbian Activities

Native peoples crossing the Caribbean by canoe probably used the Reserve's highlands as reference points. Preliminary archaeological excavations on Jayuya Beach and in the abandoned coconut plantation have yielded artifacts from the Igneri, a phase of the Arawakan culture, that immigrated north through the Lesser Antilles at the beginning of the Christian era (Chanlatte Baik 1984, Robinson 1997).

In addition, as evidenced by the bones, ceramic vessels, and remains of marine shells found in the vicinity, the earliest natives utilized the areas in and around Playa Rincon and Playa Jayuya (Dávila 1976). Later surveys confirmed pre-



Figure 5—Potential and known archeological sites on the Reserve.

Columbian archeological sites and remnants of human activity at Playa Jayuya, Playa Canalejo, Playa Rincon, Playa Lirios, and the abandoned coconut plantation (fig. 5). These finds may be associated with early Saladoid sites used by the island's first sedentary agriculturalists (Pantel 1989, Rouse 1992). As noted nearly a half century ago, the archeology of Puerto Rico's east coast remains largely unexplored (Rodríguez 1990, Rouse 1952). Recent developments have transformed much of northeastern Puerto Rico into dredged bays, commercial docks, marinas, and hotels, adversely affecting the area's cultural resources (Rodríguez 1990) and highlighting the Reserve's importance in protecting valuable historic sites.

Shipwrecks

Several shipwrecks have been recorded in coastal waters near the Reserve (Cerame Vivas 1988). Among the earliest were a Spanish caravel near Vieques in 1553 and a 200-ton Swedish warship near Palominos in 1649 (Cardona Bonet 1989). The Spanish caravel, anchored for 3 days because of a storm, was attacked by more than 600 Caribs on the fourth day. In a struggle that lasted until sunset, most of the sailors were killed. The ship's masts and sails were removed, and metal parts were stripped for use as arrows, daggers, and lance points. The ship was later burned. The few captured survivors were delivered to the Carib chief as slaves.

In 1782, the flagship Admiral de Grasse went down northeast of the Reserve. Two Danish schooners sank in the 19th century, the first in 1825 and the second in 1841. The 20th century has been witness to five additional shipwrecks: an iron barge named Robert in 1907; an Indian schooner in 1921; another schooner called "Lloyd" in 1960; and the Virgin Gorda, a one-masted wooden schooner, in 1968 or 1969. In 1989, Hurricane Hugo stranded a cargo vessel on the beach just south of Canalejo.

Lighthouse

El Faro is the second oldest and best preserved of Puerto Rico's 20 lighthouses, which were built between 1846 and 1926 (Cerame Vivas 1988, Dillon 1926, Nistal-Moret 1977). Construction began on January 20, 1878, and was completed on May 30, 1880 (Gadea 1881). The facility first operated in May 1882 (Sanchez de Toca 1890). The original light source, installed at 15 m above the ground and 81 m above sea level, was visible at a distance of nearly 30 km. El Faro has been in use nearly 120 years, first by the Spanish, later by the U.S. Coast Guard, and, finally, by the Puerto Rico Conservation Trust.

On August 2, 1898, the Amphitrite, Puritan, Leyden, and Hannibal, ships of the North American fleet in the Spanish-American War, anchored off the coast in the vicinity of the Reserve (Rivero 1973). The marines landed and occupied the lighthouse and surrounding areas. All properties and information belonging to the Spanish Lighthouse Service were transferred to the U.S. Marines in 1899. In 1903, President Roosevelt declared the Cabezas de San Juan as lands for public use.

In 1937, El Faro was transferred to the U.S. Coast Guard, and, in 1981, it was included in the National Register of Historic Sites. Through the 1980's, the Coast Guard maintained El Faro along with a signal station on separate parcels totaling about 1 ha (Cardona and Nieves 1984). Under an agreement with the Coast Guard, El Faro now contains the offices of the Conservation Trust's administrative personnel. Since 1987, the University College at Humacao has conducted marine research at the Reserve. By 1991, a small marine research laboratory, an aquarium, wildlife interpretive displays, and overnight facilities for investigators had been installed. An inventory of Reserve vegetation was completed in 1995, and specimens were mounted in the El Faro herbarium.

El Faro is now open to the public during regularly scheduled visits. From its observation decks, visitors enjoy excellent

views of the Reserve, surrounding waters, offshore islands, and the Luquillo Mountains.

Conservation Trust

The property surrounding El Faro, which was in private hands for many years, was first cleared for timber and fuel; later it was used as domestic pasture. Grass and scrub vegetation covered the higher grounds and mangroves occupied wetlands around the lagoons. Local fishermen have traditionally harvested fish and crustaceans from the Reserve's waters. However, by the mid-1960's, its attractive setting had prompted local developers to submit proposals for urban expansion. Concerned citizens, realizing the value of the area for wildlife conservation, recreation, and environmental education, proposed that it be designated as a reserve or State park (Clements and Bunnell 1979).

The Puerto Rican Conservation Trust, created in 1970 to protect the island's natural resources and scenic areas, purchased the Reserve in 1975. Hunting was prohibited, but local fishermen may still use the Reserve's waterways and occasionally harvest fish and *Leucaena* poles. The Trust now manages the Reserve along with 12 other properties scattered throughout Puerto Rico.

Educational Facilities

Reception center—The reception center first opened to the public on April 10, 1991. It includes a gate to control access, a parking lot, and a pavilion where visitors are received and oriented. The building has wall maps of Conservation Trust properties in Puerto Rico, leisure chairs, a small counter for the sale of souvenirs and books, and rest rooms. An elevated wooden corridor extending toward the beach provides a scenic view of Ensenada Yegua. Educational facilities are also located at the lighthouse.

Roads and trails—The Reserve contains about 3.5 km of paved or gravel roads and 2 km of foot or jeep trails. A 0.5-km nature trail with interpretive signs traverses the secondary, semievergreen forest between the lighthouse and Laguna Grande.

Mangrove boardwalk—A 1-km boardwalk provides visitors with easy access to the Laguna Grande and the surrounding mangroves. Interpretive signs provide information on fauna and flora that are visible from the boardwalk: 8 on birds, 3 on crabs, 2 each on fish and lizards, 1 each on snails, spiders, dragonflies, and bees, and 5 on mangrove vegetation and its recovery after Hurricane Hugo. Land crabs, fish, and several bird species are readily



Photo: D. Schwartz

The reception center, opened to the public in 1991, is the gateway to the Reserve. The center provides visitors with a view of Ensenada Yegua and access to a small gift shop with books and souvenirs.



Photo: M. Schwartz

The boardwalk, about 1 km long, leads visitors on a 45-minute stroll through mangrove swamp and along the open waters of Laguna Grande. The boardwalk's 25 interpretative signs provide information on local wildlife and vegetation.

visible during the 30- to 40-minute walk along the scenic trail.

Terrestrial Plant Resources

Species Composition

Two sampling procedures were used to record the Reserve's flora. The first was plot sampling initiated in mid-December

1994 and continued intermittently until late June 1995. The Reserve was partitioned into 16 survey areas (fig. 6):

- Beach and littoral vegetation in areas 1, 2, and 4;
- Mangrove and littoral vegetation in areas 3, 12 through 14, and 16;
- Hillside vegetation in areas 5 through 11; and
- The abandoned coconut plantation and adjacent mangrove, 15.

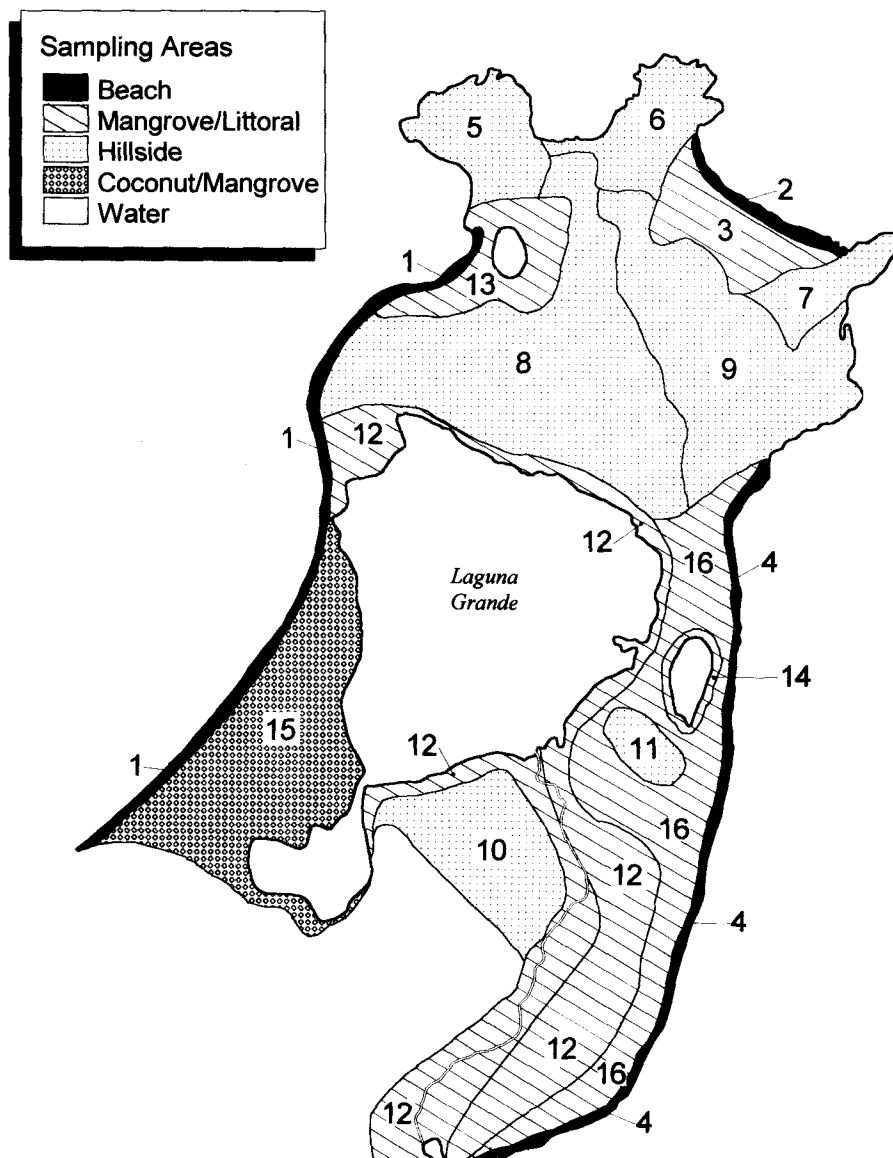


Figure 6—Vegetation sampling areas in the Reserve.

Each of the 16 areas was sampled with 20 plots measuring 10 by 10 m, for a total of 320 plots. All plant species were identified, and the following classification was used in estimating the relative abundance of each within the individual areas: 1 = rare; 2 = occasional; 3 = common; 4 = abundant; and blank = not recorded. Local dendrology and taxonomy texts were used to identify plant specimens (Acevedo-Rodríguez and Woodbury 1985; Howard 1979, 1988, 1989a, 1989b; Little and Wadsworth 1964; Little and others 1974; Liogier 1985, 1988, 1994, 1995, 1997; Liogier and Martorell 1982; Martorell and others 1981). Most plant specimens were collected from the established plots.

The second procedure, conducted during hikes through the Reserve, was a random collection of additional species not recorded on the plots, especially those specimens in fruit or flower or both. Each newly encountered species was classified by abundance and survey collection area. Many of these specimens were catalogued in the Reserve's herbarium.

Approximately 80 plant families, 244 genera, and 302 species were encountered during the survey (Appendix table 1). The 7 most common families, each with 10 or more species, accounted for 126 species, or 42 percent of all species tallied. They were Boraginaceae (10), Compositae (13), Convolvulaceae (13), Euphorbiaceae (23), Gramineae (18), Leguminosae (39, with 26 in the sub-family Papilionoideae), and Rubiaceae (10). The most common genera accounting for 4 or more species were: *Capparis* (4), *Chamaesyce* (4), *Cordia* (4), *Cyperus* (4), *Eugenia* (4), and *Ipomoea* (6).

The following 25 species, recorded on ≥ 15 survey areas, are well distributed within the Reserve (Appendix table 1): the trees *Capparis cynophallophora* L., *C. flexuosa* (L.) L., *C. indica* (L.) Fawc. & Rendle, *Coccoloba microstachya* Willd., *C. uvifera* (L.) L., *Cordia laevigata* Lam., *Jacquinia arborea* Vahl, *Leucaena leucocephala* (Lam.) DeWit, *Pithecellobium unguis-cati* (L.) Mart., and *Randia aculeata* L.; the shrubs *Corchorus hirsutus* L., *Jatropha gossypifolia* L., *Lantana involucrata* L., and *Opuntia dillenii* (Ker-Gawl.) Haw.; the vines *Cissus trifoliata* L., *Jasminum fluminense* Vell., *Macfadyena unguis-cati* (L.) A. Gentry, *Matelea maritima* (Jacq.) Woods, and *Trichostigma octandrum* (L.) H. Walt.; and the herbs *Argemone mexicana* L., *Bromelia pinguin* L., *Commelina elegans* Kunth, *Desmanthus virgatus* (L.) Willd., *Heliotropium angiospermum* Murray, *H. curassavicum* L., and *Portulaca oleracea* L. The only epiphytes recorded were in the Bromeliaceae or Cactaceae families: *Hylocereus trigonus* (Haw.) Safford, *Tillandsia recurvata* (L.) L., and *T.*

utriculata L. These were confined mainly to the secondary semievergreen forest.

Earlier investigators of the Reserve's flora identified more than 50 plant species not recorded in this survey (Appendix table 2). Continued sampling would undoubtedly expand the combined list beyond the 360 terrestrial plant species recorded to date.

Rare or Endangered Species or Both

Four endangered nonendemic plant species were encountered during the survey (Woodbury and others 1975): *Caesalpinia bonduc* (L.) Roxb., a woody vine, occasional in four areas; *C. melanosperma* (Eggers) Urban, a woody vine, rare in two areas; *Bastardia bivalvis* (Cav.) H.B.K., a shrub, was rare to common in 13 different areas; and *Ziziphus rignonii* Delp., a tree species, was rare in area 1.

Vegetation Types

Vegetation on the Reserve has been classified according to two major systems. According to the life zone system (Holdridge 1967), the Reserve contains subtropical dry forest (Ewel and Whitmore 1973). Subtropical dry forest usually receives from 500 to 1000 mm of rainfall per year and has a mean annual biotemperature between 12 and 24 °C. Notable differences in the vegetation, e.g., littoral woodland or mangroves, constitute specific associations within the life zone.

Another classification system widely used in the Caribbean Islands is one devised by Beard (1949, 1955) for climax vegetation in the Americas. According to this system, higher elevations in the Reserve are dominated by semievergreen seasonal forest and the coastal fringes, by littoral woodland. Mangroves surround brackish waters at sea level. These major systems, however, are of limited use when classifying transitional vegetation on small properties. Past human activity on the Reserve, including tree cutting, farming, and grazing, have altered all vegetation. Changes in the amount of tree and brush cover indicate that recovery has been underway for nearly 30 years.

Recovery is affected by several factors including available seed sources from remnant and secondary vegetation in the vicinity, topography, soils, and exposure to wind and salt spray. During the recovery process, the abundance of secondary plant species gradually diminishes, and primary species increase. This process spans many years if seed sources are distant. For purposes of this report, the

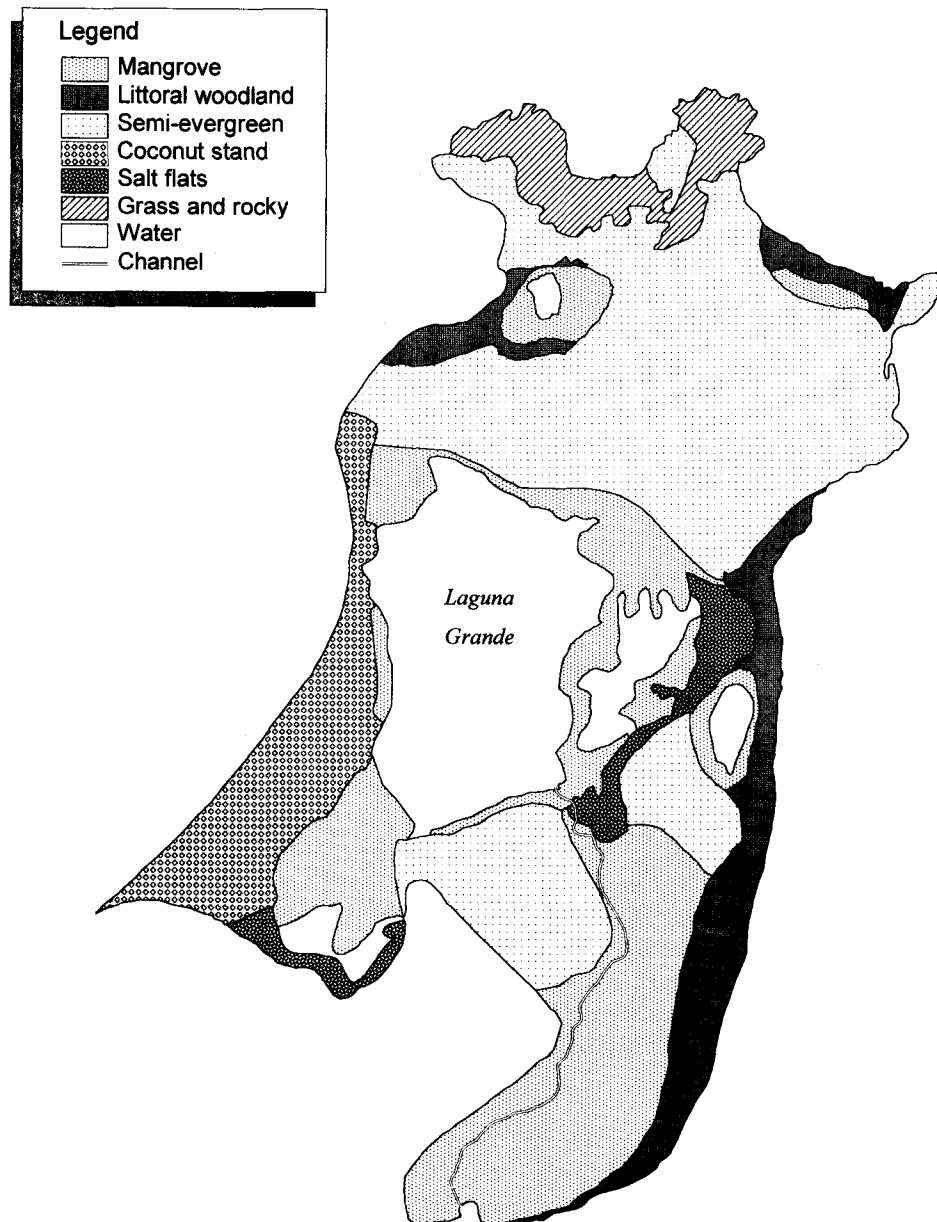


Figure 7—Vegetation types in the Reserve.

following five forest types, based on vegetation sampling, are recognized (fig. 7):

- Mangrove woodland and adjacent salt flats;
- Secondary littoral woodland;
- Secondary semievergreen forest;
- Abandoned coconut plantation; and
- Grassy areas.

Plants common to these vegetation types include the aforementioned 25 species of trees, shrubs, vines, and herbs

as well as the following species listed under their respective forest types.

Mangrove woodland—Despite past harvest of fuelwood and fenceposts in mangrove areas of the Reserve, mangroves continue to occupy tidal flats and saline soils. The dominant tree species are *Avicennia germinans* (L.) L., *Conocarpus erectus* L., *Laguncularia racemosa* (L.) Gaertn. f., and *Rhizophora mangle* L. Many dead stems within the mangrove woodland reflect damage caused by Hurricane Hugo. Other common plants are the shrubs *Batis maritima* L. and *Croton betulinus* Vahl, the vine *Distictis lactiflora* (Vahl) DC., and the herb *Sidastrum multiflorum* (Jacq.)

Fryxell. Mangrove is the second largest forest type, covering 29.4 percent of the Reserve.

Secondary littoral woodland—Mature littoral woodland consists of climax vegetation on sand dunes, salt flats, rock pavement, and rocky slopes (Beard 1949). *Cassine xylocarpa* Vent. and *Gymnanthes lucida* Sw. are common native trees, and *Morinda citrifolia* L., *Thespesia populnea* (L.) Soland. ex Correa, *Cocos nucifera* L., and *Dalbergia ecastaphylla* (L.) Taub. are common exotics. Other common terrestrial plants are: shrubs, *Chamaesyce mesembrianthemifolia* (Jacq.) Dugand, *Clerodendrum aculeatum* (L.) Schlecht., and *Wedelia calycina* L.C.; vines, *Canavalia rosea* (Sw.) DC., *Ipomoea pes-caprae* (L.) R. Br., *Metastelma parviflorum* (Sw.) R. Br., and *Tragia volubilis* (L.); and herbs, *Cenchrus echinatus* L., *Chamaesyce serpens* (H.B.K.) Small, *Cyperus ligularis* L., *Digitaria sanguinalis* (L.) Scop., *Portulaca oleracea* L., *Sesuvium portulacastrum* (L.) L., and *Sporobolus virginicus* (L.) Kunth. Much of this forest type, occupying 11.6 percent of the Reserve, has been disturbed by fire and grazing. The best littoral forest on sand occurs along the southeastern coastal fringe. Salt flats, just east of Laguna Grande, cover 3.8 percent of the Reserve.

Secondary semievergreen seasonal forest—The semievergreen forest, occupying 40.1 percent of the Reserve, now has a large component of deciduous species, some of which will be replaced by evergreen species in the future. Different successional patterns are likely to evolve according to topography (ravines, slopes, and exposed hilltops) and by aspect (windward- and leeward-facing terrain), resulting in different relative abundances of tree species. At the moment, *Acacia farnesiana* (L.) Willd., *Bursera simaruba* (L.) Sarg., *Capparis hastata* Jacq., *Cassine xylocarpa* Vent., *Erythroxylum brevipes* DC., and *Gymnanthes lucida* Sw. are common native tree species; *Gliricidia sepium* (Jacq.) Kunth ex Walp. and *Tamarindus indica* L. are common exotics.

Numerous other species are relatively common in secondary semievergreen forest: shrubs, *Argythamnia stahlii* Urban, *A. fasciculata* (Vahl) Muell. Arg., *Bastardia bivalvis* (Cav.) H.B.K., *Indigofera tinctoria* L., *Iresine angustifolia* Euphrasen, *Melochia tomentosa* L., *Rauvolfia viridis* Willd. ex Roem. & Schult., *Solanum persicifolium* Dunal, and *Tournefortia volubilis* L.; vines, *Abrus precatorius* L., *Distictis lactiflora* (Vahl) DC., *Galactia dubia* DC., *Rhynchosia reticulata* (Sw.) DC., and *Tragia volubilis* L.; and the herbs, *Bothriochloa pertusa* (L.) A. Camus, *Brachiaria plantaginea* (Link) Hitchc., *Celosia nitida* Vahl, *Chloris inflata* Link., *Desmodium incanum* DC., *Petiveria*

alliacea L., *Ruellia tuberosa* L., *Siphonoglossa sessilis* (Jacq.) Gibson, *Sporobolus virginicus* (L.) Kunth, *Tephrosia senna* H.B.K., and *Tridax procumbens* L.

Abandoned coconut plantation—The abandoned coconut plantation, previously harvested commercially, occupies sandy soils between the shorelines of Ensenada Yegua and Laguna Grande (figs. 1 and 7). The common native tree species that occur in the plantation are *Conocarpus erectus* L., *Cordia laevigata* Lam., and *Krugiodendron ferreum* (Vahl) Urban; the common exotics are *Cocos nucifera* L., *Gliricidia sepium* (Jacq.) Kunth ex Walp, *Morinda citrifolia* L., and *Terminalia catappa* L. Other common plant species include: the shrubs *Batis maritima* L., *Indigofera tinctoria* L., and *Lantana involucrata* L.; the vines *Centrosema virginianum* (L.) Benth and *Metastelma parviflorum* (Sw.) R. Br.; and the herbs *Boerhavia coccinea* Miller, *Ruellia tuberosa* L., and *Spermacoce verticillata* L. The stand covers 9.9 percent of the Reserve.

Grass and rocky areas—The Reserve has two grassy areas. The largest, covering 5.2 percent of the Reserve, is situated on the steep, wind-swept, rocky slopes surrounding Playa Lirios (fig. 1) and is dominated by *Bothriochloa pertusa* (L.) A. Camus. This grass-covered slope contains small patches of invading tree species including *Coccoloba uvifera* (L.) L. Littoral woodland was probably the dominant forest type in much of this area. During the past 25 years, recurrent fires, apparently set along the shoreline, have maintained a grass cover. The last fire was in spring 1995.

There is another small grass-covered area containing *Bothriochloa pertusa* (L.) A. Camus, just north of the paved road near the demonstration plot (fig. 1, research plot A). Topsoil was removed from the site during road construction and forest recovery on the exposed subsoil has been very slow. Several small-leaf mahogany seedlings, *Swietenia mahagoni* (L.) Jacq., which were planted just above the road, are growing slowly. Gradually, hardwood species are invading the site, and without fire, this area will eventually revert to semievergreen forest.

Terrestrial Animal Resources

Although it is relatively small, the Reserve has a great variety of wildlife and has been recognized as one of the island's critical wildlife areas (Puerto Rico Department of Natural Resources 1979).

Avifauna

The Reserve's bird life is quite diverse. As many as 269 species have been recorded on at least one occasion in Puerto Rico (Biaggi 1970; Bond 1971; Raffaele 1983; Wetmore 1916, 1925). Ninety-six species, or 36 percent of those documented, have been observed at least once within the Reserve or its coastal fringe (Appendix table 3). Of the species so far recorded, 63 percent are residents of Puerto Rico, 24 percent are regular migrants, and 8 percent are exotics.

Several additional species were identified during the 1994 and 1995 Christmas bird counts. The increase probably reflects not only gradual recovery of the area to secondary forest, but also the success of protecting species from hunting and other human disturbances. Although some sightings may reflect incidental visits, the recording of one-third of the island's bird species within such a small area is noteworthy.

Ten bird species found on the Reserve were cited as rare or possibly threatened in a 1977 wildlife report that was published in cooperation with the Department of Natural Resources (Raffaele and others 1977). Seven species were considered either rare or endangered in Puerto Rico: *Anas bahamensis*, *Ardea herodias*, *Egretta thula*, *Fregata magnificens*, *Nycticorax nycticorax*, and *Sterna albifrons*. All are common outside of Puerto Rico but are rarely permanent residents on the island. *Pandion haliaetus* is common outside of Puerto Rico but a rare migrant to the island. *Columba leucocephala* and *Pelecanus occidentalis* were considered peripheral on the North American continent and rare in Puerto Rico. The latter appears on the Federal list of threatened and endangered species (Delgado-Mendoza and others 1990). The status of *Falco sparverius* was considered as "undetermined" locally. It is common outside of Puerto Rico but a rare permanent resident on the island.

Mammals

Only four species of mammals have been reported within the Reserve; two species of bats, the mongoose, and the black rat (Appendix table 4). The mongoose was introduced to Puerto Rico from Asia between 1877 and 1879 to control rats in sugar cane fields (Raffaele 1983). Unfortunately, the mongoose is Puerto Rico's most detrimental wild predator on birds and has endangered ground-nesting species. The black rat is another introduced species that has had detrimental effects on birds.

Domestic animals may occasionally stray into the Reserve. The only living native mammals in all of Puerto Rico are bats (Starrett 1962). The greater bulldog bat (*Noctilio leporinus mastivus*), one of the largest New World bats (Emmons 1990), is often seen flying along the shoreline where it preys on fish. In addition, an unidentified bat species has been seen in December and January feeding on nectar and leaves in the Ceiba tree. Marine mammals are considered in the section on marine resources.

Reptiles, Amphibians, Mollusks and Arthropods

Eight species of reptiles, four in the genus *Anolis*, and five species of amphibians have been identified on the Reserve (Appendix, table 4), but no snakes or nesting turtles have been reported. Numerous mollusks and arthropods have also been noted. All species are common in Puerto Rico's coastal areas.

Ameiva exsul feeds indiscriminately on invertebrates and fruits. *Anolis* species feed on invertebrates, occasionally on small frogs and vegetable matter, foraging on the ground, in bushes, on lower trunks, and in tree crowns (Rivero 1978). Both species of *Sphaerodactylus* are ground dwelling, hiding under logs, rocks, and leaf litter. The *Eleutherodactylus* species hide in bromeliads or under other plant materials, whereas *Leptodactylus* often confines itself to wetter habitats.

Bufo marinus, *Igaun iguana* and *Rana catesbeiana* are introduced species. *Bufo*, often found swimming or floating, feeds on insects and is large enough to swallow mice and bird chicks. *Iguana*, originally brought to Puerto Rico from Central and South America as pets, may grow to 1.5 m. It spends much time in trees eating fruits and leaves. *Rana*, strongly aquatic, seldom ventures far from water where it consumes insects and vegetable matter.

Brackish Water Resources

The temperature of Laguna Grande varies between 25 and 31 °C, contains from 2.0 to 7.2 mg per liter of dissolved oxygen, and has salinities between 20 and 54 parts per thousand (Candelas and others 1968, Díaz-Pifferar 1968, Zayas 1979). Such favorable conditions support large populations of benthic and planktonic organisms, among them *Pyrodinium bahamense*, a bioluminescent micro-organism that emits light when disturbed (Carvajal-Zamora 1975).

Water temperature, light penetration, salinity, dissolved oxygen, and phosphate contents vary seasonally (Zayas 1979). By contrast, ammonia and silica contents are more stable, as is the species composition of plankton. Heavier rainfall in the spring and autumn signal peaks in planktonic productivity.

Fish

Twenty-two fish species have been identified in Laguna Grande (Appendix table 5). Many others that live along the Reserve's shoreline in the *Thalassia* beds, sandy areas, and coral reefs, some of which may occasionally enter the mouth of the canal, have not been recorded in this report (Goenaga and others 1990, Randall 1968). For many economically important species of fish, crustaceans and mollusks, *Thalassia* beds serve as breeding grounds, nesting sites, or as shelters against predators (Goenaga and others 1990).

Benthic and Planktonic Organisms

The results of several earlier studies demonstrate the extent of Laguna Grande's biodiversity. Three surveys of benthic flora revealed 6 phyla, 14 classes, 24 families, and at least 64 species (Appendix table 6). Four surveys of benthic fauna recorded 9 phyla, 7 classes, and 60 species (Appendix table 7). Finally, 3 surveys of planktonic organisms recorded 21 species of plants and 26 species of animals (Appendix table 8).

Marine Resources

Northeast of the Reserve, waters are influenced by the Caribbean Current, which flows northward along Puerto Rico's east coast and the Virgin Islands (Goenaga and others 1990). Tides have a mean amplitude of 0.3 m. Visibility in waters of the nearby off-shore islands, the Cordillera, is between 12 and 15 m except during heavy surf.

Fringing reefs with a regular zonation of coralline species (Pressick 1970) characterize the waters of northeastern Puerto Rico and the Cordillera where 33 species of corals have been identified (Almy and Carrión-Torres 1963, Goenaga and others 1990). The reefs serve not only as habitat for numerous marine species of commercial or sport value, but also to exchange nutrients with terrestrial systems. Reefs protect the shoreline from wave action and redirect coastal currents. Their diversity of lifeforms and spectacular colors are also a scenic resource.

To the west of the Reserve, the quiet waters of Ensenada Yegua are protected by a fringing reef (fig. 1). Several species of benthic macroalgae reported for the northeastern and eastern coastal waters (Almodovar and Ballantine 1983) were also observed in Laguna Grande (Appendix table 6). Along the Reserve's eastern shoreline, the reefs are heavily silted, and some areas are characterized by sparse growth or dead and overturned corals (Goenaga and Cintrón 1979). The most likely source of contamination is discharge from the Fajardo River.

Whales frequent Caribbean waters probably because of an abundance of squid and fish (Rathjen and Sullivan 1970). Sperm, humpback, and pilot whales, as well as speckled dolphins, have been seen near the Reserve. Sperm whales (*Physeter catodon*), largest of the toothed cetaceans, feed on squid and fish. Humpback whales (*Megoptera novaeangliae*), identified by their winglike fins, are filter feeders. Pilot whales (*Globicephala melaena*) are noted for beaching themselves in shallow waters. Speckled dolphins (*Tursiops truncatus*) have been recorded near the Cordillera (Goenaga and others 1990) and manatees have been sighted from aircraft in offshore waters. Several other marine mammals have been reported in Puerto Rican waters (Erdman 1970, Erdman and others 1973), some of which might be viewed occasionally offshore from the Reserve.

In June 1985, an 11-m sperm whale was reported as stranded on the shores of Cayo Santiago, about 25 km south of the Reserve (Mignucci Giannoni 1988a). Other species beached in the vicinity of Fajaro include the Atlantic spotted dolphin (*Stenella frontalis*), spinner dolphin (*S. longirostris*), gooseback whale (*Ziphius cavirostris*), and the Antillean manatee (*Trichechus manatus*) (Mignucci Giannoni 1988b).

Conservation Efforts

Management

A preliminary management plan was developed for the Reserve in 1990. It contained the following management direction that is now being implemented:

- Protection and access control. The Conservation Trust's objectives have been explained to the adjacent community, and special uses are allowed through permits. Spiny vegetation has been planted along the beach front, and barbed-wire fencing has been installed at critical locations to impede unauthorized access. Both are maintained on a regular basis.

- Training of security personnel. Personnel have been educated about the Reserve's resources and their public use. Adherence to laws and regulations and helping the public during their visits have been emphasized.
- Program implementation. The Reserve is patrolled to control crab harvests and exotic predators such as the mongoose and domestic animals.
- Habitat conservation. Trees that serve as hawk-nesting sites are protected. Native species that are used as food sources by wildlife are being planted.
- Research activities. All research proposals are reviewed for compliance with Conservation Trust objectives. All reports and publications must be submitted for filing in the Trust archives. Pertinent research information is used for management, education, and interpretation on the Reserve.

Research

Several long-term terrestrial research projects already initiated on the Reserve, e.g., monitoring of avifauna, forest plots, and climatic data, should continue. Other proposed activities may be supported when they are congruent with the Reserve's objectives. Among those already begun are:

- Lighthouse laboratory. El Faro serves as a field laboratory for the marine sciences program of Humacao College. El Faro is also the preferred site for air quality studies conducted by the University of Puerto Rico Medical Campus and the Environmental Quality Board.
- Tree nursery. The Conservation Trust maintains a small nursery near the Reception Center for the production of tree seedlings, some of which have been used in roadside plantings and restoration studies.
- Climatic data. Local personnel are collecting daily rainfall amounts and temperature information that may be stored in a data base and forwarded to the U.S. Weather Bureau.
- Herbarium. Herbarium specimens collected include numerous species previously unidentified on the Reserve. The herbarium should be maintained and updated when feasible.
- Secondary forest growth plot. Secondary forest monitoring started with this research project will determine growth rates for common tree species found on the Reserve. Changes in species composition and forest structure may be monitored at 5-year intervals (fig. 1, research plot B). Field data should be published. Reports or publications will be filed at the Reserve.

- Restoration studies. Monitoring of the restoration study began when this research project was situated in the abandoned coconut plantation (fig. 1, research plot C). The species planted were: *Andira inermis* (W. Wright) H.B.K., *Bucida buceras* L., *Byrsonima coriacea* (Sw.) DC., *Calophyllum brasiliense* Jacq., *Roystonea borinquena* O.F. Cook, and *Vitex divaricata* Sw. Monitoring should continue at 6-month intervals for 5 years, and results will be published and filed at the Reserve.
- Vegetation map. A tentative vegetation map was developed based on past information and current studies. It should be reviewed periodically to determine recovery of the Reserve's native vegetation.
- Wildlife inventories. Regular surveys of bird species, e.g., the annual Christmas bird count, and other organisms has begun and should be continued with outside cooperators.

A variety of other studies could be conducted on the Reserve. Some of the more feasible under consideration are:

- Tree planting. Select tree species could be planted along cleared lines in the secondary forests to stimulate the recovery of native vegetation.
- Phenology. Phenological trails could be developed to record flowering and fruiting of major plant species.
- Lagoon. The environmental factors that affect the abundance of bioluminescent and other lagoon organisms could be monitored.
- Migratory and resident bird species. A chronology of migratory bird species arrivals and departures as well as a record of resident species' reproductive cycles could be compiled.
- Other wildlife. Animals not yet studied on the Reserve such as the insects, ants, and butterflies (references include Ramos 1982; Smith 1936; Wolcott 1923, 1936, 1948) or partially studied, such as the mollusks (Arnold and others 1963), iguanas, and crabs, could be collected, catalogued, and their temporal and spatial variations observed.
- Archaeology. Identified sites could be excavated to determine possible relationships with other known east coast sites, e.g., Sorce (La Hueca in Vieques) and Punta Candalero in Humacao. Archeologists could interpret available information in the context of other locations in Puerto Rico and the Caribbean.

- Catastrophic events. The effects of hurricanes and other major climatic events on Reserve ecosystems could be documented and recovery monitored.

Education and Interpretation

Reserve personnel are available for regularly scheduled tours. Tours include visits to the shorelines littoral vegetation, the boardwalk along Laguna Grande, and El Faro. Discussions of the Reserve's history, major attractions, and wildlife are included.

In addition, the following activities were designed to enhance public education:

- Demonstration plot. All trees situated on a small plot (fig. 1, research plot A) have been identified and tagged to demonstrate forest monitoring and determine typical growth rates. The established plot will be maintained and remeasured at 5-year intervals, and the information will be analyzed for public interpretation.
- Slide show. A program containing 80 slides was developed to demonstrate the Reserve's scenic shorelines, forests, wildlife, and history. The Conservation Trust's role in environmental protection and education is highlighted.
- Hiking trail. A hiking trail (fig. 1) was designed and established for environmental interpretation. The trail, beginning at a large fig tree near the entrance to El Faro, passes through several large boulders and along scenic viewpoints, descending then to the main road near the boardwalk. Several interpretive signs will be installed to describe the site's vegetation.

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Appendix

Table 1—Terrestrial plant species recorded on the Reserve

Families and species	Life forms					Sampling areas																
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
ACANTHACEAE																						
<i>Blechnum browniei</i> Juss.				x					1	1					3	2	1				2	
<i>Ruellia tuberosa</i> L.				x		2	2	2		3	2	2	3	3	2	2	1			3	1	
<i>Siphonoglossa sessilis</i> (Jacq.) Gibson				x					3				3	2	4							
AGAVACEAE																						
<i>Furcraea tuberosa</i> (Miller) Ait. f.				x									3									
AIZOACEAE																						
<i>Mollugo nudicaulis</i> Lam.				x						1												
<i>Sesuvium portulacastrum</i> (L.) L.				x		4	4		4	3	1	2	1				1			2		
<i>Trianthema portulacastrum</i> L.				x		1	1			3			1	2	2						2	
ALOEACEAE																						
<i>Aloe vera</i> (L.) Burm. f.				x									2	1								
AMARANTHACEAE																						
<i>Achyranthes aspera</i> L.				x		2	2	3	2	4					4	1		1				
<i>Amaranthus dubius</i> Mart.				x											1							
<i>Celosia nitida</i> Vahl				x		1		3	2	3	1	2	3	2	2					1	3	
<i>Gomphrena serrata</i> L.				x					1					4	2						2	
<i>Iresine angustifolia</i> Euphrasen		x				2				2	2	2	3	3	1	1		1			1	
AMARYLLIDACEAE																						
<i>Hymenocallis caribaea</i> (L. emend. Gawl.) Herb.				x					1	3	3											
ANACARDIACEAE																						
<i>Comocladia dodonaea</i> (L.) Urban	x	x										1										
<i>Mangifera indica</i> L.	x													1								
ANNONACEAE																						
<i>Annona muricata</i> L.	x																					
<i>Annona reticulata</i> L.	x																					

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas															
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
APOCYNACEAE																					
<i>Caltharanthus roseus</i> (L.) G. Don			x												4					2	
<i>Pentalinon luteum</i> (L.) Hansen & Wunderlin		x						3		2						1					
<i>Plumeria alba</i> L.	x								2	3	3			1						1	
<i>Prestonia agglutinata</i> (Jacq.) Woods.													3	3						1	2
<i>Rauvolfia viridis</i> Willd. ex Roem. & Schult.		x				1	2	2	2	3	3	2	1	1	2		2				2
ASCLEPIADACEAE																					
<i>Calotropis procera</i> (Ait.) Ait. f.	x					1	2	2	2	3	3	1	2	3		1	1	1		1	
<i>Matelea maritima</i> (Jacq.) Woods						3	3	2	3	1	2	1	2	2	1		2	2	1	1	2
<i>Metastelma parviflorum</i> (Sw.) R. Br.						3	1	2	2				3	3	3	1		1	2	3	1
BATACEAE																					
<i>Batis maritima</i> L.		x					1		1						3		4	2	3	3	3
BIGNONIACEAE																					
<i>Crescentia cujele</i> L.	x																				
<i>Distictis laticiflora</i> (Vahl) DC.			x							4	2	2	2	2	2		3		1		
<i>Jacaranda mimosifolia</i> D. Don	x											1									
<i>Macfadyena unguis-cati</i> (L.) A. Gentry			x				2	2	1	1	1	3	3	3	3	2	2	2	2	2	1
<i>Tabebuia heterophylla</i> (DC.) Britton	x										2	2	2	2	2		3	1		1	2
<i>Tecoma stans</i> (L.) H.B.K.	x	x												1						1	
BOMBACACEAE																					
<i>Ceiba petandra</i> (L.) Gaertn.	x													1						1	
BORAGINACEAE																					
<i>Argusia gnaphalodes</i> (L.) Heine		x						2		1											
<i>Bourreria succulenta</i> Jacq.	x	x											2	2	2						
<i>Cordia laevigata</i> Lam.	x						2	1	1	2	2	2	2	4	4	2	2	1	2	4	2
<i>Cordia obliqua</i> Willd.	x						2	1		1				1	1	3		1		2	1
<i>Cordia polycephala</i> (Lam.) I.M. Johnston.		x												1							
<i>Cordia rickseckeri</i> Millsp.	x								1					3							
<i>Heliotropium angiospermum</i> Murray							3	1	1	1	4	4	4	1	2	1	1	2	3		2
<i>Heliotropium curassavicum</i> L.							4	4	1	4	3	3	3	1	1	1		3	4	2	1

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas															
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
BORAGINACEAE (continued)																					
<i>Tournefortia volubilis</i> L.			x				2														
BROMELIACEAE																					
<i>Bromelia pinguin</i> L.				x									3		4					2	
<i>Tillandsia recurvata</i> (L.) L.					x									1							
<i>Tillandsia utriculata</i> L.					x				1				2			2					
BURSERACEAE																					
<i>Bursera simaruba</i> (L.) Sarg.	x						1	1	1	1	1	1	3	3	3					2	
CACTACEAE																					
<i>Consoletia moniliformis</i> (L.) Britton	x								1												
<i>Hylocereus trigonus</i> (Haw.) Safford			x		x				2	1	2	1	2	1	1			2			
<i>Melocactus intortus</i> (Miller) Urban				x			2	1	3	2	2	3	2	2	2		1	1	1	1	1
<i>Opuntia dillenii</i> (Ker-Gawl.) Haw.		x					1		3	2	1	1	3	3	4		1	2		1	2
<i>Opuntia repens</i> Bello				x										1							
<i>Pilosocereus royerii</i> (L.) Byles & Rowley	x													1							
CANELLACEAE																					
<i>Canella winterana</i> (L.) Gaertn.	x									1			2							2	
CAPPARACEAE																					
<i>Capparis cynophallophora</i> L.	x	x					2	2	2	3	2	2	4	3	2	2	2	1	1	2	1
<i>Capparis flexuosa</i> (L.) L.	x	x					1	1	2	2	1	1	2	3	3	1	1	2		1	2
<i>Capparis hastata</i> Jacq.	x	x											2	2	3	1	1				
<i>Capparis indica</i> (L.) Fawc. & Rendle	x	x					1	1	2	2	3	2	3	3	4	3	2	1	3	1	3
<i>Cleome viscosa</i> L.				x			1														
CARICACEAE																					
<i>Carica papaya</i> L.	x																			1	
CELASTRACEAE																					
<i>Cassine xylocarpa</i> Vent.	x	x					1		1	2	2	2	3	3	2	3				1	1
<i>Crossopetalum rhucoma</i> Crantz		x					2						1	1						2	

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas															
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CELASTRACEAE (continued)																					
<i>Maytenus cymosa</i> Krug & Urban	x													1							
<i>Schaefferia frutescens</i> Jacq.	x	x											4	3		2	2			2	
CHENOPODIACEAE																					
<i>Atriplex pentandra</i> (Jacq.) Standl.				x					2	2											
COMBRETACEAE																					
<i>Conocarpus erectus</i> L.	x								2	4	2	2				3				3	4
<i>Conocarpus erectus</i> var. <i>sericeus</i> Griseb.	x																		1		
<i>Laguncularia racemosa</i> (L.) Gaertn. f.	x							2	2	3	2	2					2	3	2	2	
<i>Terminalia catappa</i> L.	x									2		3								3	
COMMELINACEAE																					
<i>Commelina diffusa</i> Burm. f.				x										2						2	
<i>Commelina elegans</i> Kunth				x					2	2	2	2	2	4	2	2	2	2	2	3	2
COMPOSITAE																					
<i>Borrchia arborescens</i> (L.) DC.		x						1		1											
<i>Emilia fosbergii</i> Nicols.				x					3					2	3			1			
<i>Eupatorium odoratum</i> L.		x							1				2	2	2	3					
<i>Parthenium hysterophorus</i> L.				x																	
<i>Pectis humifusa</i> Sw.				x					3	2											
<i>Piptocoma antillana</i> Urban				x					2				2								
<i>Pluchea symphytifolia</i> (Miller) Gillis		x												2			2				
<i>Synedrella nodiflora</i> (L.) Gaertn.				x					2					2			2				
<i>Tridax procumbens</i> L.				x					2	2	2		2	3						2	
<i>Yernonia cinerea</i> (L.) Less.				x						3										2	
<i>Wedelia calycina</i> L.C.		x							3							2				2	
<i>Wedelia trilobata</i> (L.) A.S. Hitchc.				x					4											3	
<i>Youngia japonica</i> (L.) DC.				x											1						
CONVOLVULACEAE																					
<i>Convolvulus nodiflorus</i> Desr.			x					2		3				2							
<i>Cuscuta americana</i> L.		x											3	4						2	

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas																
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
CONVOLVULACEAE (continued)																						
<i>Ipomoea alba</i> L.				x		1																
<i>Ipomoea batatas</i> (L.) Lam.				x											1							
<i>Ipomoea pes-caprae</i> (L.) R. Br.				x		3	2		3	3												
<i>Ipomoea repanda</i> (Griseb.) Powell				x		2							2	2			1			1		
<i>Ipomoea tiliacea</i> (Willd.) Choisy				x																1		
<i>Ipomoea triloba</i> L.				x										1								
<i>Jacquemonia pentanthes</i> (Jacq.) G. Don				x				2					2				2			2		
<i>Merremia dissecta</i> (Jacq.) Hall. f.				x									2									
<i>Merremia quinquefolia</i> (L.) Hall. f.				x													2					
<i>Merremia umbellata</i> (L.) Hall. f.				x									2									
<i>Turbina corymbosa</i> (L.) Raf.				x					2					2								
CURCUBITACEAE																						
<i>Cucurbita moschata</i> (Duch.) Poir.				x										2								
<i>Doyerea emetocathartica</i> Grosourdy				x									2									
<i>Melothria pendula</i> L.					x						4		3									
<i>Mormodica charantia</i> L.				x							3											
CRASSULACEAE																						
<i>Kalanchoë pinnata</i> (Lam.) Pers.					x									1								
<i>Kalanchoë tubiflora</i> (Harvey) Hamet					x										1							
CRUCIFERAE																						
<i>Cakile lanceolata</i> (Willd.) O.E. Schulz					x	2			2													
<i>Lepidium virginicum</i> L.					x	2																
CYPERACEAE																						
<i>Cyperus ligularis</i> L.					x	3			3	2						2						
<i>Fimbristylis cymosa</i> R. Br.					x					3												
<i>Kyllinga brevifolia</i> Rottb.					x											3						
<i>Pycnus polystachyas</i> (Rottb.) P. Beauv.					x											2						
<i>Scleria pterota</i> Presl					x									1								

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas																
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
ERYTHROXYLACEAE																						
<i>Erythroxylum brevipes</i> DC.	x	x											3	3	3	2						
<i>Erythroxylum rufum</i> Cav.	x	x																		1		
EUPHORBIACEAE																						
<i>Acalypha chamaedrifolia</i> (Lam.) Muell.-Arg.				x									1									
<i>Argythamnia fasciculata</i> (Vahl) Muell. Arg.		x											3	3	2	2				2		
<i>Argythamnia stahlia</i> Urban		x								3	4	1	2	1								
<i>Chamaesyce articulata</i> (Aubl.) Britton		x								2	2	2	3									
<i>Chamaesyce hirta</i> (L.) Millsp.				x										3						3		
<i>Chamaesyce hyssopifolia</i> (L.) Small				x										3						3		
<i>Chamaesyce mesembrianthemifolia</i> (Jacq.) Dugand		x							4													
<i>Chamaesyce serpens</i> (H.B.K.) Small				x					3	3						1						
<i>Croton astroites</i> Dryand.		x							3	4	2											
<i>Croton betulinus</i> Vahl		x							4	1	3	3	3	3	2	2	3	2	2	3		
<i>Croton lobatus</i> L.				x							3	2			2			2		2	2	
<i>Euphorbia heterophylla</i> L.				x											4	3						
<i>Euphorbia lactea</i> Haw.	x	x												1								
<i>Gymnanthes lucida</i> Sw.	x													3	2	2	1	2		2	1	
<i>Hippomane mancinella</i> L.	x																					
<i>Jatropha gossypifolia</i> L.		x																				
<i>Margaritaria nobilis</i> L. f.	x												1									
<i>Pedilanthus tithymaloides</i> (L.) Dressler		x											2	2								
<i>Phyllanthus acidus</i> (L.) Skeels	x														1							
<i>Phyllanthus amarus</i> Schumacher				x																	1	1
<i>Phyllanthus niruri</i> L.				x												1						
<i>Securinega acidoton</i> (L.) Fawc. & Rendle		x																				
<i>Tragia volubilis</i> L.			x																			
FLACOURTIACEAE																						
<i>Casearia guianensis</i> (Aubl.) Urban	x														2							
<i>Samyda dodecandra</i> Jacq.		x							2				2	2	2					2	1	
GOODENIACEAE																						
<i>Scaevola plumieri</i> (L.) Vahl		x							2	1												

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas															
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
GRAMINEAE																					
<i>Anethphora hermaphrodita</i> (L.) Kuntze				x					1												
<i>Bothriochloa pertusa</i> (L.) A. Camus				x					1	4		4	4							1	3
<i>Brachiaria fasciculata</i> (Sw.) S.T. Blake				x						3		2	3	3					1	1	2
<i>Brachiaria plantaginea</i> (Link.) Hitchc.				x					2	4	4	4	2	2						1	1
<i>Cenchrus echinatus</i> L.				x					4	3	2	1							1	1	1
<i>Chloris inflata</i> Link.				x					2	1	3	2	2	3	4	3				1	2
<i>Cynodoc dactylon</i> (L.) Pers.				x											1						
<i>Dactyloctenium aegyptium</i> (L.) Beauv.				x					1	1	1	1	1								2
<i>Digitaria insularis</i> (L.) Mez				x							1										3
<i>Digitaria sanguinalis</i> (L.) Scop.				x					3	2		2			2						
<i>Eleusine indica</i> (L.) Gaertn.				x											1						
<i>Eriochloa punctata</i> (L.) Desv.				x											1						
<i>Lasiacis divaricata</i> (L.) Hitchc.				x									2	2	1						
<i>Panicum maximum</i> Jacq.				x						1			2	2						1	
<i>Paspalum pleostachyum</i> Doell				x					4	2				2	3						3
<i>Sporobolus indicus</i> (L.) R. Br.				x					3			4	4		3						
<i>Sporobolus virginicus</i> (L.) Kunth				x					3	3		2	3		2	2	1				1
<i>Zoysia matrella</i> (L.) Merrill				x								1									
GUTTIFERAE																					
<i>Calophyllum brasiliense</i> Jacq.	x																				
HIPPOCRATEACEAE																					
<i>Hippocratea volubilis</i> L.			x											1	1						
LABIATAE																					
<i>Hyptis pectinata</i> (L.) Poit.				x									1					1			
<i>Plectranthus amboinicus</i> (Lour.) Launert				x											1						
<i>Ocimum campechianum</i> Mill.				x											1						
<i>Ocimum santum</i> L.				x																	
LAURACEAE																					
<i>Licaria parvifolia</i> (Lam.) Kostermans	x																				1

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas																
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
LEGUMINOSAE-CAESALPINIOIDEAE																						
<i>Caesalpinia bonduc</i> (L.) Roxb.		x					2		2					2	2							
<i>Caesalpinia melanosperma</i> (Eggers) Urban		x								1	1											
<i>Chamaecrista nictitans</i> (L.) Moench				x			2	2	2	2				2						2		
<i>Delonix regia</i> (Bojer ex Hook.) Raf.	x												1	1								
<i>Macropitium lathyroides</i> (L.) Urban				x			2			2				2			1		1	1	1	
<i>Senna obtusifolia</i> (L.) Irwin & Barneby				x				1										1				
<i>Tamarindus indica</i> L.	x														4							
LEGUMINOSAE-MIMOSOIDEAE																						
<i>Acacia farnesiana</i> (L.) Willd.		x					2	2	2	3		2	3	3	3						2	
<i>Albizia lebeck</i> (L.) Benth.	x																			2		
<i>Desmanthus virgatus</i> (L.) Willd.				x			3	3	3	3	2	2	1	1	2	2		1	1	2	2	
<i>Leucaena leucocephala</i> (Lam.) DeWit	x						2	2	2	2	3	2	4	4	4	4	3	2	1	3	3	
<i>Mimosa pudica</i> L.				x						2					2					2		
<i>Pithecellobium unguis-cati</i> (L.) Mart.	x	x					2	2	2	2	3	3	4	4	4	2	2	2	1	2	2	
LEGUMINOSAE-PAPILIONOIDEAE																						
<i>Abrus precatorius</i> L.																						
<i>Alysicarpus vaginalis</i> (L.) DC.		x					1	1		1	1	1	3	3	2					2	2	
<i>Cajanus cajan</i> (L.) Millsp.				x						2				2						2		
<i>Canavalia rosea</i> (Sw.) DC.		x													1						1	
<i>Centrosema pubescens</i> Benth			x						1											2		
<i>Centrosema virginianum</i> (L.) Benth			x													2	1		3	4	3	
<i>Clitoria ternatea</i> L.			x							3	2	2		3								
<i>Coursetia caribaea</i> (Jacq.) Lavin		x					3						1	1								
<i>Crotalaria retusa</i> L.				x						4					3							
<i>Dalbergia ecastaphylla</i> (L.) Taub.	x	x					4	3	2	3												
<i>Desmodium incanum</i> DC.				x						3	3	3		2								
<i>Desmodium triflorum</i> (L.) DC.				x						3			3									
<i>Galactia dubia</i> DC.																						
<i>Galactia striata</i> (Jacq.) Urban			x				2	2		2	2	4	4	4	4				3			
<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp.			x				1	1				2	2	2	3					1		
<i>Indigofera tinctoria</i> L.															3					4		
<i>Lonchocarpus latifolius</i> (Willd.) DC.	x	x						2		2	2	3	3	3	3					4	2	

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas																
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
LEGUMINOSAE-PAPILIONOIDEAE (continued)																						
<i>Pictetia aculeata</i> (Vahl) Urban	x	x											3	3	2			2	2			
<i>Pterocarpus macrocarpus</i> Kurz	x																			1		
<i>Rhynchosia minima</i> (L.) DC.			x						3	1	1				2							
<i>Rhynchosia reticulata</i> (Sw.) DC.			x						2				3	3	3						3	
<i>Sesbania sericea</i> (Willd.) Link		x							2	3	2				2						1	
<i>Sylosanthes hamata</i> (L.) Taub.				x						4					3	2					2	
<i>Tephrosia cinerea</i> (L.) Pers.				x				2		3	2	2									2	
<i>Tephrosia senna</i> H.B.K.				x				1	1	2	2	2	3	3	4					1	3	
<i>Vigna luteola</i> (Jacq.) Benth.			x												2					3	2	
LILIACEAE																						
<i>Sansevieria hyacinthoides</i> var. <i>laurentii</i> (L.) Druce				x																	3	
<i>Sansevieria trifasciata</i> Prain				x																	4	
LORANTHACEAE																						
<i>Dendropemon purpureus</i> (L.) Krug & Urban		x												1				1				
<i>Phoradendron piperoides</i> (H.B.K.) Trel.		x																1				
LYTHRACEAE																						
<i>Ginoria rohrii</i> (Vahl) Koehne	x	x							4				2	4	3							
MALPIGHIACEAE																						
<i>Bunchosia glandulosa</i> (Cav.) L.C. Rich.	x													3	3	3						
<i>Heteropteris purpurea</i> (L.) Kunth			x								2				2			2			2	
<i>Stigmaphyllon floribundum</i> (DC.) Anders.								2	3				2	2	2			2				
<i>Stigmaphyllon emarginatum</i> (Cav) A. Juss.			x					2	3				2	2	2			2				
MALVACEAE																						
<i>Bastardia bivalvis</i> (Cav.) H.B.K.				x																		
<i>Gossypium barbadense</i> L.		x												1								
<i>Hibiscus rosa-sinensis</i> L.		x													1							
<i>Sida acuta</i> Burm. f.		x									2											
<i>Sida ciliaris</i> L.				x																		
<i>Sida stipularis</i> Cav.				x					2									1		2	2	

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas															
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MALVACEAE (continued)																					
<i>Sidastrum multiflorum</i> (Jacq.) Fryxell				x							3				3			3			
<i>Thespesia populnea</i> (L.) Soland. ex Correa	x	x				4	1	3						2	3					2	2
<i>Wissadula periplocifolia</i> (L.) Presl				x					1						2						
MELIACEAE																					
<i>Swietenia mahagoni</i> (L.) Jacq.	x												1							1	
<i>Trichilia hirta</i> L.	x												1	1						1	
<i>Trichilia pallida</i> Sw.	x													1							
MENISPERMACEAE																					
<i>Cissampelos pareira</i> L.			x										2	2							1
MORACEAE																					
<i>Artocarpus altilis</i> (S. Park) Fosb.	x														1						
<i>Ficus citrifolia</i> P. Miller	x														1						
MUSACEAE																					
<i>Musa</i> sp.				x											1						
MYOPORACEAE																					
<i>Bontia daphnoides</i> L.	x	x						1										2			
MYRTACEAE																					
<i>Eugenia biflora</i> (L.) DC.	x					2		2					3	3	3						
<i>Eugenia monticola</i> (Sw.) DC.	x												2								
<i>Eugenia procera</i> (Sw.) Poir.	x												1								
<i>Eugenia sessiliflora</i> Vahl	x						4							4							
<i>Myrcianthes fragrans</i> (Sw.) Mc Vaugh	x						1														
NYCTAGINACEAE																					
<i>Boerhavia coccinea</i> Miller				x					3					4	4					3	
<i>Guapira fragrans</i> (Dum.-Cours.) Little	x					1	1	1					3	3	3					2	2
<i>Pisonia borinquena</i> Proctor (ined.)	x							2	2	2	2	1						1			

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas															
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
OLEACEAE																					
<i>Jasminum fluminense</i> Vell.			x			1	1	2	2	2	2	2	3	4	3	2	2	1	2	2	2
PALMAE																					
<i>Coccothrinax alta</i> (O.F. Cook) Becc.	x												1								
<i>Cocos nucifera</i> L.	x					2	4	3	2				1		1	1	1	2	1	4	1
PANDANACEAE																					
<i>Pandanus utilis</i> Bory		x																		1	
PAPAVERACEAE																					
<i>Argemone mexicana</i> L.				x		1	1	1	2	3	2	2	3	3	2		1	1	2	1	1
PASSIFLORACEAE																					
<i>Passiflora suberosa</i> L.			x					1					2	2	2	1			1		
PHYTOLACCACEAE																					
<i>Petiveria alliacea</i> L.				x				2	2	2	2	2	4	4	4	1	1	1	1	2	2
<i>Rivina humilis</i> L.				x		2		1					2	2	2			1		2	
<i>Trichostigma octandrum</i> (L.) H. Walt.			x			1	1	1	2	2	2	2	2	3	3	2	1	1	1	2	1
PIPERACEAE																					
<i>Piper amalago</i> L.		x																		1	
POLYGALACEAE																					
<i>Polygala paniculata</i> L.				x																1	
POLYGONACEAE																					
<i>Coccoloba microstachya</i> Willd.	x	x				2	2	2	3	2	2	2	3	2	1	1	1	2	1	1	1
<i>Coccoloba uvifera</i> (L.) L.	x	x				2	4	4	4	3	3	3	2	2	1	2	2	3	1	3	3
PORTULACACEAE																					
<i>Portulaca oleracea</i> L.				x		3	2	2	2	3	3	3	1	1	1	1	1	2	2	1	1
<i>Portulaca pilosa</i> L.				x							1										
<i>Portulaca rubricaulis</i> H.B.K.				x							1		1								
<i>Talinum paniculatum</i> (Jacq.) Gaertn.				x																	

Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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Table 1—Terrestrial plant species recorded on the Reserve (continued)

Families and species	Life forms					Sampling areas															
	Tree	Shrub	Vine	Herb	Epip	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
VERBENACEAE (continued)																					
<i>Lippia nodiflora</i> (HBK.) Kuntze				x			3														
<i>Priva lappulacea</i> (L.) Pers.				x					2	2			1	2	2						
<i>Stachytarpheta jamaicensis</i> (L.) Vahl				x						3				2	2					1	2
VITACEAE																					
<i>Cissus sicyoides</i> L.			x										1	1	1						
<i>Cissus trifoliata</i> L.			x			2	2	3	1	1	1	1	4	4	2	3	2	2	1	1	2

Table 2—Plant species not recorded during the IITF survey of the Reserve but reported in previous surveys^a

Species by family	Tree	Shrub	Vine	Herb
AMARANTHACEAE				
<i>Philoxerus vermicularis</i> (L.) Nutt	X			
APOCYNACEAE				
<i>Rauvolfia nitida</i> Jacq.	X			
ASARACEAE				
<i>Aristolochia trilobata</i> L.			X	
ASCLEPIADACEAE				
<i>Metastelma decipiens</i> Schltr.			X	
<i>Metastelma grisebachianum</i> Schltr.			X	
BORAGINACEAE				
<i>Heliotropium fruticosum</i> L.				X
<i>Heliotropium procumbens</i> Miller				X
<i>Tournefortia hirsutissima</i> L.			X	
CACTACEAE				
<i>Lemaireocereus huxtrix</i> (Haw.) Britton & Rose	X			
CASSYTHACEAE				
<i>Cassytha filiformis</i> L.			X	
COMPOSITAE				
<i>Bidens pilosa</i> L.				X
<i>Melanthera nivea</i> (L.) Small				X
<i>Wadelia lanceolata</i> D.C.				X
CYPERACEAE				
<i>Cyperus planifolius</i> L.				X
<i>Cyperus pluchea</i> L.				X
<i>Cyperus spicatus</i> Rottb.				X
<i>Fimbristylis dichotoma</i> (L.) Vahl.				X
<i>Fimbristylis spadiosa</i> R. Br.				X
EUPHORBIACEAE				
<i>Adelia ricinella</i> L.	X			
<i>Argythamnia candicans</i> Sw.		X		
<i>Chamaesyce hypericifolia</i> (L.) Millsp.				X
<i>Chamaesyce thymifolia</i> (L.) Millsp.				X
GRAMINAE				
<i>Brachiaria echinulata</i> (Mez) Parodi				X
<i>Digitaria bicornis</i> (Lam.) R. & S.				X
<i>Eragrostis ciliaris</i> (L.) R. Br.				X
<i>Panicum densus</i> Poir				X
<i>Sporobolus jacquemontii</i> Kunth				X

Table 2—Plant species not recorded during the IITF survey of the Reserve but reported in previous surveys^a (continued)

Species by family	Tree	Shrub	Vine	Herb
LEGUMINOSAE - CAESALPINIOIDAE				
<i>Cassia difusa</i> D.C.		X		
<i>Cassia tora</i> L.		X		
LEGUMINOSAE - MIMOSOIDEAE				
<i>Acacia tortuosa</i> (L.) Willd	X			
<i>Pithecellobium dulce</i> (Roxb.) Benth	X			
LEGUMINOSAE - PAPILIONOIDEAE				
<i>Indigofera suffruticosa</i> Min.		X		
LORANTHACEAE				
<i>Dendropemon caribaeus</i> Krug & Urb.				X
MALVACEAE				
<i>Abutilon umbellatum</i> (L.) Sweet		X		
<i>Gossypium hirsutum</i> L.	X			
<i>Sida erecta</i> Macf.		X		
<i>Sida glomerata</i> Cav.		X		
<i>Sida pyramidata</i> Cav.		X		
MYRTACEAE				
<i>Psidium guajava</i> L.	X			
NYCTAGINACEAE				
<i>Boerhavia erecta</i> L.				X
PASSIFLORACEAE				
<i>Passiflora foetida</i> L.			X	
POLYPODIACEAE				
<i>Acrosticum aureum</i> L.				X
PORTULACACEAE				
<i>Portulaca halimoides</i> L.				X
<i>Portulaca teretifolia</i> H.B.K.				X
RUBIACEAE				
<i>Borreria verticillata</i> (L.) J.D.C.				X
<i>Hamelia erecta</i> Jacq.		X		
<i>Psychotria pubescens</i> Sw.		X		
SAPINDACEAE				
<i>Dodonaea viscosa</i> Jacq.		X		
SOLANACEAE				
<i>Solanum seaforthianum</i> Andr.			X	

Table 2—Plant species not recorded during the IITF survey of the Reserve but reported in previous surveys^a (continued)

Species by family	Tree	Shrub	Vine	Herb
TYPHACEAE				
<i>Typha dominguensis</i> L.				X
URTICACEAE				
<i>Pilea microphylla</i> (L.) Leimb.				X
ZYGOPHYLLACEAE				
<i>Kallstroemia maximea</i> (L.) Torrey & A. Gray				X

^a Sources: Rivera and others 1981. Also, collections made on January 29, 1992, and June 9 and 11, 1993, by F. Axelrod. Voucher specimens for the latter were deposited in the herbarium of the Biology Department, University of Puerto Rico, Río Piedras. Only plants in fruit or flower were collected.

Table 3—Bird species recorded on the Reserve^a

Genus species	English name	Spanish name
<i>Actitis macularia</i> ^b	Spotted sandpiper	Playero colector
<i>Amazona ochrocephala</i> ^c	Yellow-headed parrot	Cotorra cabeciamarilla
<i>Anas bahamensis</i> ^{d e}	White-cheeked pintail	Pato quijada colorada
<i>A. discors</i> ^b	Blue-winged teal	Pato zarcel
<i>Anous stolidus</i> ^d	Brown noddy	Cervera
<i>Anthracothorax dominicus</i> ^d	Antillean mango	Zumbador dorado
<i>Aratinga canicularis</i> ^c	Orange-fronted parakeet	Periquito frentianarajado
<i>Ardea herodias</i> ^{b e}	Great blue heron	Garzón cenizo
<i>Arenaria interpres</i> ^b	Ruddy turnstone	Playero turco
<i>Asio flammeus</i> ^d	Short-eared owl	Múcaro de sabana
<i>Brotogeris versicolurus</i> ^c	Canary-winged parakeet	Perico aliamarillo
<i>Bubulcus ibis</i> ^d	Cattle egret	Garza ganadera
<i>Buteo jamaicensis</i> ^d	Red-tailed hawk	Guaraguo común
<i>Butorides striatus</i> ^d	Green heron	Martinete
<i>Calidrus alba</i> ^b	Sanderling	Playero arenero
<i>Capella gallinago</i> ^b	Common snipe	Becasina
<i>Casmerodius albus</i> ^d	Great egret	Garza real
<i>Charadrius semipalmatus</i> ^b	Semipalmated plover	Playero acollarado
<i>C. vociferous</i> ^d	Killdeer	Playero sabanero
<i>C. wilsonia</i> ^d	Wilson's plover	Playero marítimo
<i>Chlorostilbon maugaeus</i> ^d	Puerto Rican Emerald	Zumbadorcito
<i>Coccyzus minor</i> ^d	Mangrove cuckoo	Pajaro bobo menor
<i>Coerba flaveola</i> ^d	Bananaquit	Reinita común
<i>Columba leucocephala</i> ^{d f}	White-crowned pigeon	Paloma cabeciblanca
<i>C. livia</i> ^c	Rock dove	Paloma casera
<i>C. squamosa</i> ^d	Scaly-naped pigeon	Paloma turca (rubia)
<i>Columbina passerina</i> ^d	Common ground dove	Rolita
<i>Crotophaga ani</i> ^d	Smoothed-billed ani	Judio
<i>Dendroica adelaidae</i> ^d	Adelaide's warbler	Reinita mariposera
<i>D. discolor</i> ^d	Prairie warbler	Reinita galana
<i>D. dominica</i> ^b	Yellow-throated warbler	Reinita gargatiamarilla
<i>D. petechia</i> ^d	Yellow warbler	Canario de mangle
<i>Egretta thula</i> ^{d e}	Snowy egret	Garza blanca
<i>Elaenia martinica</i> ^d	Caribbean elaenia	Juí blanco
<i>Estrilda melpoda</i> ^c	Orange-cheeked waxbill	Veterano mejillianaranjado
<i>Euplectes afer</i> ^c	Yellow-crowned bishop	Napoleón
<i>Falco culumbarius</i> ^b	Merlin	Esmerejón
<i>F. peregrinus</i> ^b	Peregrine falcon	Falcon de patos
<i>F. sparverius</i> ^{d i}	American kestrel	Falcón común
<i>Florida caerulea</i> ^d	Little blue heron	Garza azul
<i>Fregata magnificens</i> ^{d e}	Magnificent frigatebird	Tijerilla
<i>Fulica americana</i> ^d	American coot	Gallinazo americano
<i>Gallinula chloropus</i> ^d	Common gallinule	Gallareta común
<i>Haematopus ostralegus</i> ^d	American oystercatcher	Ostrero

Table 3—Bird species recorded on the Reserve^a (continued)

Genus species	English name	Spanish name
<i>Himantopus mexicanus</i> ^d	Black-necked stilt	Viuda
<i>Hirundo rustica</i> ^b	Barn swallow	Golondrina de horquilla
<i>Hydranassa tricolor</i> ^d	Louisiana heron	Garza pechiblanca
<i>Icterus dominicensis</i> ^d	Black-cowled oriole	Canandria capuchinegra
<i>I. galbula</i> ^b	Northern oriole	Calandria del norte
<i>Ixobrychus exilis</i> ^b	Least bittern	Martinetito
<i>Larus argentatus</i> ^b	Herring gull	Gaviota argétea
<i>L. atricilla</i> ^d	Laughing gull	Gaviota gallega
<i>Lonchura cucullata</i> ^{b d}	Bronze mannikin	Diablito
<i>L. punctulata</i> ^{b c d}	Nutmeg mannikin	Gorrión canela
<i>Margarops fuscatus</i> ^d	Pearly-eyed thrasher	Zorzal pardo
<i>Megaceryle alcyon</i> ^b	Belted kingfisher	Martín pescador
<i>Melanerpes portoricensis</i> ^d	Puerto Rican woodpecker	Carpintero de Puerto Rico
<i>Melospiza undulatus</i> ^c	Budgerigar	Periquito de Australia
<i>Mimocichla plumbea</i> ^d	Red-legged thrush	Zorzal de patas coloradas
<i>Mimus polyglottos</i> ^d	Northern mockingbird	Ruiseñor
<i>Mniotilta varia</i> ^b	Black-and-white warbler	Reinita trepadora
<i>Molothrus bonariensis</i> ^d	Shiny cowbird	Tordo lustroso
<i>Myiarchus antillarum</i> ^d	Puerto Rican flycatcher	Juí de Puerto Rico
<i>Myiopsitta monachus</i> ^c	Monk parakeet	Perico monje
<i>Nyctanassa violacea</i> ^d	Yellow-crowned night heron	Yaboa común
<i>Nycticorax nycticorax</i> ^{d e}	Black-crowned night heron	Yaboa real
<i>Orthorhynchus cristatus</i> ^d	Antillean crested hummingbird	Zumbadorcito crestado
<i>Pandion haliaetus</i> ^{b g}	Osprey	Aguila de mar
<i>Parula americana</i> ^b	Northern parula	Reinita pechidorada
<i>Pelecanus occidentalis</i> ^{d f i}	Brown pelican	Pelicano pardo
<i>Petrochelidon fulva</i> ^d	Cave swallow	Golondrina de cuevas
<i>Phaethon lepturus</i> ^d	White-tailed tropicbird	Chirre de cola blanca
<i>Pluvialis squatarola</i> ^b	Black-bellied plover	Playero cabezón
<i>Quiscalus niger</i> ^d	Greater Antillean grackle	Chango
<i>Rallus longirostris</i> ^d	Clapper rail	Pollo de mangle
<i>Riparia riparia</i> ^b	Bank swallow	Golondrina parda
<i>Seiurus noveboracensis</i> ^b	Northern waterthrush	Pizpita de mangle
<i>Sericotes holosericeus</i> ^d	Green-throated Carib	Zumbador pechiazul
<i>Setophaga ruticilla</i> ^b	American redstart	Candelita
<i>Sterna albifrons</i> ^{d e}	Least tern	Gaviota chica
<i>S. fuscata</i> ^d	Sooty tern	Gaviota oscura
<i>S. maxima</i> ^d	Royal tern	Gaviota real
<i>S. sandvicensis</i> ^d	Sandwich tern	Gaviota piquiaguda
<i>Sula leucogaster</i> ^d	Brown booby	Boba parda
<i>Tiarus bicolor</i> ^d	Black-faced grassquit	Chamorro negro
<i>Todus mexicanus</i> ^d	Puerto Rican tody	San Pedrito
<i>Tringa flavipes</i> ^b	Lesser yellowlegs	Playero guineilla pequeña

Table 3—Bird species recorded on the Reserve^a (continued)

Genus species	English name	Spanish name
<i>T. melanoleuca</i> ^b	Greater yellowlegs	Playero guineilla grande
<i>T. solitaria</i> ^b	Solitary sandpiper	Playero solitario
<i>Tyrannus domincensis</i> ^d	Gray kingbird	Pitirre
<i>Vireo altiloquus</i> ^b	Black-whiskered vireo	Julián Chiví
<i>V. griseus</i> ^h	White-eyed vireo	Juiaán chivi ojiblanco
<i>V. latimeri</i> ^d	Puerto Rican vireo	Bien-te-veo
<i>Zenaida asiatica</i> ^d	White-winged dove	Tórtola aliblanca
<i>Z. aurita</i> ^d	Zenaida dove	Tórtola cardosantera
<i>Z. macroura</i> ^d	Mourning dove	Tórtola rabilarga

^a Sources of information for bird species at the Reserve: Checklist of birds on the Cabezas de San Juan Nature Reserve (Fideicomiso de Conservación de Puerto Rico, no date); Hoja de documentación (Cardona and Nieves 1984); letter from Keith L. Pardieck, U.S. Department of the Interior, Fish and Wildlife Service, August 15, 1991; unpublished list of the Fajardo Christmas bird count, 1994 and 1996; observations of Jorge L. Coll Rivera.

^b Migrant species.

^c Exotic species.

^d Resident species.

^e Species recorded in Puerto Rico that are either in danger of extinction or at the point of being endangered: common outside of Puerto Rico, rare permanence in Puerto Rico (Raffaele and others 1977).

^f Species recorded in Puerto Rico that are peripheral in the United States and rare in Puerto Rico (Raffaele and others 1977).

^g Species recorded in Puerto Rico that are either in danger of extinction or at the point of being endangered: common outside of Puerto Rico, rare migrant to Puerto Rico (Raffaele and others 1977).

^h Undetermined status, common outside of Puerto Rico, rare permanence in Puerto Rico (Raffaele and others 1977).

ⁱ Federal list of threatened and endangered species found in Puerto Rico (Delgado-Mendoza and others 1990).

Table 4—Mammals, reptiles, amphibians, mollusks, arthropods, and crustaceans reported for the Reserve^a

Phylum Class Genus/species	Common name	
	English	Spanish
Chordata		
Mammalia		
<i>Herpestes javanicus</i>	Mongoose	Mangota
<i>Rattus rattus</i>	Roof rat	Rata
<i>Noctilio leporinus mastivus</i>	Greater Bulldog Bat	Murciélago pescador
Unidentified species	Bat	Murciélago
Reptilia		
<i>Ameiva exsul</i>	—	Siguana común
<i>Anolis cristatellus</i>	Crested lizard	Lagartijo común
<i>A. cristatellus wileyae</i>	Crested lizard	Lagartijo común
<i>A. pulchellus</i>	Garden lizard	Lagartijo jardinero
<i>A. stratulus</i>	Spotted lizard	Lagartijo manchado
<i>Iguana iguana</i>	Green iguana	Gallina de palo
<i>Sphaerodactylus macrolepis</i>	—	Salamanquita común
<i>S. nicholsi townsendi</i>	—	Salamanquita pigmea
Amphibia-Anura		
<i>Bufo marinus</i>	Common toad	Sapo común
<i>Eleutherodactylus antillensis</i>	—	Churi
<i>E. cochranae</i>	—	Pitito
<i>Leptodactylus albilabris</i>	—	Sapito de labio blanco
<i>Rana catesbeiana</i>	—	Rana toro (Sapo yure)
Mollusca		
Gastropoda		
<i>Acmaea antillarum</i>	Antillean limpet	—
<i>Astraea caelata</i>	Carved star-shell	—
<i>Biulimulus quadalupensis</i>	West Indian bulimulus	—
<i>Cassis tuberosa</i>	King's helmet	Gallineta
<i>Charonia variegata</i>	Trumpet triton	Tritón
<i>Cittarium pica</i>	West Indian top-shell	—
<i>Cymatium caribbaeum</i>	Dog-head triton	—
<i>C. femorale</i>	Angular triton	—
<i>C. pileare</i>	Atlantic hairy triton	—
<i>Cyphoma gibbosum</i>	Flamingo tongue	—
<i>Cypraea zebra</i>	Measled cowrie	—
<i>Echininus nodulus</i>	False prickly-winkle	—
<i>Fasciolaria tulipa</i>	True tulip	—
<i>Fissurella fascicularis</i>	Wobbly keyhole limpet	—
<i>F. nodosa</i>	Knobby keyhole limpet	—
<i>Hemitoma octoradiata</i>	Eight-ribbed limpet	—
<i>Littorina angulifera</i>	Angulate periwinkle	—
<i>L. ziczac</i>	Zebra periwinkle	—
<i>Melampus coffeus</i>	Coffee bean melampus	—
<i>Murex brevifrons</i>	West Indian murex	—
<i>M. pomum</i>	Apple murex	—
<i>Nerita peloronta</i>	Bleeding tooth	—

Table 4—Mammals, reptiles, amphibians, mollusks, arthropods, and crustaceans reported for the Reserve^a
(continued)

Phylum Class	Common name	
	English	Spanish
Gastropoda (continued)		
<i>N. tessellata</i>	Tessellated nerite	—
<i>N. versicolor</i>	Four-toothed nerite	—
<i>Olivia reticularis</i>	Netted olive	—
<i>Phalium granulatum</i>	Scotch bonnet	—
<i>Pleurodonte caracolla</i>	True caracolus snail	—
<i>Spirula spirula</i>	Common spirula	—
<i>Strombus costatus</i>	Milk conch	—
<i>S. gallus</i>	Rooster-tail conch	—
<i>S. gigas</i>	Queen conch	Carrucho
<i>S. pugilis</i>	West Indian fighting conch	—
<i>S. raninus</i>	Hawk-wing conch	—
<i>Tectarius muricatus</i>	Beaded periwinkle	—
<i>Tegula lividomaculata</i>	West Indian tegula	—
<i>Thais rustica</i>	Rustic rock shell	—
<i>Tonna maculosa</i>	Atlantic partridge	—
<i>Turbo canaliculatus</i>	Channeled turban	—
Bivalvia		
<i>Anadara notabilis</i>	Eared ark	—
<i>Anomalocardia brasiliana</i>	West Indian pointed venus	—
<i>Arca zebra</i>	Turkey wing	—
<i>Brachidontes exustus</i>	Scorched mussel	—
<i>Crassostrea rhizophorae</i>	Caribbean oyster	—
<i>Lima scabra</i>	Rough lima	—
<i>Pitar dione</i>	Royal comb venus	—
<i>Trachycardium isocardia</i>	Prickly cockle	—
Arthropoda		
Arachnida		
<i>Argiope argentata</i>	Silver spider	Araña plateada
<i>Cyrtopholys</i> sp.	—	—
<i>Gasteracantha tetracantha</i>	—	—
<i>Pleciometes algira</i>	—	—
Crustacea		
<i>Aratus pisoni</i>	Mangrove crab	—
<i>Callinectes sapidus</i>	Blue crab	Cocolía
<i>Cardiosma guanhumi</i>	Great land crab	Juey común
<i>Clibanarius cubensis</i>	—	—
<i>Coenobita clieatus</i>	Land hermit crab	Cobo, cangrejo ermitaño
<i>Gecarcinus lateralis</i>	Black land crab	—
<i>Goniopsis cruentata</i>	Spotted mangrove crab	Cangrejo de mangle
<i>Grapsus grapsus</i>	Sally lightfoot	—
<i>Sesarma ricordi</i>	Beach crab	—
<i>S. roberti</i>	—	—

Table 4—Mammals, reptiles, amphibians, mollusks, arthropods, and crustaceans reported for the Reserve^a
(continued)

Phylum Class Genus/species	Common name	
	English	Spanish
Crustaceae (continued)		
<i>Uca rapax</i>	Fiddler crab	Cangrejo violinista
<i>U. pugnax</i>	Fiddler crab	Cangrejo violinista
<i>Ucides cordatus</i>	Hairy land crab	Juey pelú

^a Rivera and others 1981; Abbott 1989; Voss 1976; Warmke and Abbott 1962; personal observations by Jorge L. Coll Rivera.

Table 5—Fish species recorded for Laguna Grande^a

Genus and species	English name	Spanish name
<i>Achirus lineatus</i>	Lined sole	Lenguado
<i>Centropomus undecimalis</i>	Snook	Róbalo
<i>Cetengraulis edentulus</i>	Whalebone anchovy	Bocua
<i>Eucinostomus gula</i>	Silver Jenny	Blanquilla
<i>Gobiosoma</i> sp.	Gobby	Gobio
<i>Haemulon sciurus</i>	Bluestriped	Boqui-colorado
<i>Harengula clupeiola</i>	False pilichard	Cascarua
<i>Hyporhamphus unifasciatus</i>	Common halfbeack	Balajú
<i>Jankinsia lamprotanenia</i>	Dwarf herring	Mijua
<i>Lupinoblennius</i> sp.	Blenny	Viejita
<i>Lutjanus synagris</i>	Lana snapper	Pargo manchego
<i>Megalops atlanticus</i>	Tarpon	Sábalo
<i>Mugil curema</i>	White mullet	Jarea
<i>M. liza</i>	Liza	Liza
<i>M. trichodon</i>	Fantail mullet	Lisa amarilla
<i>Oligoplites saurus</i>	Leatherjacket	Cueriduro
<i>Opisthonema oglinum</i>	Thread herring	Arranque
<i>Pomacentrus fuscus</i>	Dusky damselfish	Burrito
<i>Sardinella aurita</i>	Spanish sardine	Española
<i>Sphaeroides testudineus</i>	Checkered puffer	Tamboril
<i>Sphyræna barracuda</i>	Great barracuda	Picúa
<i>S. picudilla</i>	Southern sennet	Picudilla

^a Rivera and others 1981; observations by Jorge L. Coll Rivera.

Table 6—Benthic flora reported for Laguna Grande^a

Phylum	Class	Family	Species
Chlorophyta (green algae)	Cladophorales	Cladophoraceae	<i>Cladophora fascicularis</i>
			<i>Chaetomorpha brachygona</i>
			<i>C. crassa</i>
	Siphonales	Bryopsidaceae	<i>Bryopsis hypnoides</i>
			<i>B. pennata</i>
		Caulerpaceae	<i>Caulerpa cupressoides</i>
			<i>C. microphysa</i>
			<i>C. racemosa</i>
			<i>C. sertularioides</i>
			<i>C. verticillata</i>
		Cordiaceae	<i>Avrainvillea nigricans</i>
			<i>A. rawsonii</i>
			<i>Codium istmocladum</i>
			<i>Halimeda opuntia</i>
			<i>Penicillus capitatus</i>
			<i>Udotea flabellum</i>
		Derbesiaceae	<i>Desbesia vaucheriaformis</i>
	Siphonocladiales	Dascladaceae	<i>Acetabularia crenulata</i>
			<i>Acicularia shenckii</i>
			<i>Batophora oerstedii</i>
		Valoniaceae	<i>Cladophoropsis membranaceae</i>
			<i>Ernodesmis verticillata</i>
			<i>Struvea anastomosans</i>
			<i>Ventricaria ventriculosa</i>
	Ulotrichales	Ulvaceae	<i>Enteromorpha flexuosa</i>
			<i>E. intestinalis</i>
			<i>Ulva lactuca</i>
Cyanophyta (blue-green algae)	Nostocales	Nostocaceae	<i>Hermothamnion enteromorphoides</i>
		Rivalariaceae	<i>Calothrix aeruginea</i>
		Scytonemataceae	<i>Brachytrichia queyi</i>

Table 6—Benthic flora reported for Laguna Grande^a (continued)

Phylum	Class	Family	Species
	Oscillatoriales	Oscillatoriaceae	<i>Hydrocoleus glutinosus</i> <i>Lyngbia conferveides</i> <i>L. mayuscula</i> <i>Symploca hydroides</i>
Phaeophyta (brown algae)	Dictyotales	Dictyotaceae	<i>Dictyota bartayresii</i> <i>D. divaricata</i> <i>D. dichotoma</i>
	Ectocarpales	Ectocarpaceae	<i>Giffordia mitchellae</i>
Rhodophyta (red algae)	Bangiales	Bangiaceae	<i>Asterocytis ramosa</i>
	Ceramiales	Ceramiaceae	<i>Callithamnion byssoides</i> <i>Centroceras clavulatum</i> <i>Ceramium byssoideum</i> <i>C. fastigiatum</i> <i>Crouania attenuata</i> <i>Spyridia filamentosa</i>
		Rhodomelaceae	<i>Acanthophora spicifera</i> <i>Bostrychia tenella</i> <i>Herposiphonia tenella</i> <i>Polysiphonia howei</i> <i>P. ramentaceae</i> <i>P. subtilissima</i>
	Cryptonemiales	Melobesieae	<i>Fosliella farinosa</i>
	Rhodymeniales	Champiaceae	<i>Champia parvula</i> <i>C. sp.</i>
Xanthophyta (yellow-green algae)	Heterosiphonales	Vauchoriaceae	<i>Vaucheria dichotoma</i>

Table 6—Benthic flora reported for Laguna Grande^a (continued)

Phylum	Class	Family	Species
Spermatophyta (marine herbs)			
	Butomales	Hydrocharitaceae	<i>Halophila decipiens</i>
	Najadales	Cynodoceaceae	<i>Halodule wrightii</i> <i>Thalassia testudinum</i> <i>Syringodium filiforme</i>
		Ruppiaceae	<i>Ruppia maritima</i>
Mastigophora ^b			
	Phytomastigophorea	Peridinaea	<i>Ceratium furca</i> <i>C. longirostris</i> <i>C. macrocerus</i> <i>Pyrodinium bahamense</i>

^a Sources: Almodovar and Ballantine 1983; Clements and Bunnell 1979; Diaz-Pifferer 1968; García Ríos 1990; Holt and others 1994; Littler and others 1989; Taylor 1979; Trieckhard and Bradt 1984; Zayas 1979; observations by Jorge L. Coll Rivera.

^b Classified under Protista but located here for convenience.

Table 7—Benthic fauna reported for Laguna Grande^a

Phylum	Class	Family	Species
Porifera (sponges)			
			<i>Callyspongia</i> sp.
			<i>Cliona</i> sp.
			<i>Dysidea</i> sp.
			<i>Halisarsa</i> sp.
			<i>Mycale</i> sp.
			<i>Pellina</i> sp.
			<i>Tedania</i> sp.
			<i>Tethya</i> sp.
Cnidaria (cnidarians)			
	Anthozoa (sea anemones and stone corals)		
			<i>Parazoanthus</i> sp.
			<i>Zoanthus</i> spp. (2 unidentified)
	Hydrozoa (hydroids)		
			unidentified genera
	Scyphozoa (jellyfishes)		
			<i>Cassiopeia xamachana</i>
Platyhelminthes (flatworms)			
			<i>Pseudocarpus</i> sp.
Bryozoa (moss animals)			
			<i>Bugula neritina</i>
			<i>Membranipora</i> sp.
Echinodermata (echinoderms)			
	Echinoidea		
			<i>Lytechinus variegatus</i>
Mollusca (mollusks)			
	Gastropoda		
		Acmaeidae	<i>Acmea pustulata</i>
		Atlantidae	<i>Natica canrena</i>
		Atyidae	<i>Haminoea elegans</i>
		Bullidae	<i>Bulla striata</i>
		Calyptraeidae	<i>Crepidula glauca</i>
		Cassidae	<i>Drupa nodulosa</i>
		Cerithiidae	<i>Cerithium algicola</i> <i>C. variabile</i>
		Chamidae	<i>Chama macerophyta</i>
		Columbellidae	<i>Collumbella mercatori</i>

Table 7—Benthic fauna reported for Laguna Grande^a (continued)

Phylum	Class	Family	Species
		Cypraeidae	
			<i>Cypraea zebra</i>
		Fascioliidae	
			<i>Fasciolaria tulipa</i>
		Fissurellidae	
			<i>Fisserella fascicularis</i>
		Littorinidae	
			<i>Littorina angulifera</i>
		Lucinidae	
			<i>Codakia orbiculata</i>
			<i>C. orbicularis</i>
		Modulidae	
			<i>Mudulus modulus</i>
		Mytilidae	
			<i>Bracidontes exustus</i>
		Naticidae	
			<i>Polinices lacteus</i>
		Neritidae	
			<i>Neritina virginea</i>
		Tellinidae	
			<i>Macoma constricta</i>
			<i>Strigilla carnaria</i>
			<i>Teliina alternata</i>
		Tonnidae	
			<i>Tonna maculosa</i>
		Triphoridae	
			<i>Triphora nigrocincta</i>
			<i>T. thurris-Thomae</i>
		Turbinidae	
			<i>Turbo castanea</i>
		Vitrinellidae	
			<i>Parviturboides comptus</i>
	Pelecypoda (bivalve mollusks)		
		Anomiidae	
			<i>Podesesmus rudis</i>
		Arcidae	
			<i>Arca zebra</i>
		Isogmonidae	
			<i>Isognomun alatus</i>
		Nuculidae	
			<i>Nucularna acuta</i>
Annelida (segmented worms)			
	Polychaeta (sandworms)		
		Maldanidae	
		Nereidae	
		Sabellidae	
		Serpulidae	
		Terebellidae	

Table 7—Benthic fauna reported for Laguna Grande^a (continued)

Phylum	Class	Family	Species
Arthropoda (joint-footed animals), subphylum Crustacea (crustaceans)			
		Amphipoda	
			<i>Amphitoe</i> sp.
		Anthuridae	
			<i>Apanthurus</i> sp.
		Cirripedia	
			<i>Balanus</i> sp.
		Cumacea	
			<i>Cumacea</i> sp.
			<i>Hyperpche</i> sp.
		Decopoda	
			<i>Callinectes sapindus</i>
			<i>Carcinus tubicen</i>
			<i>Pachygrapsus gracilis</i>
		Mysidacea	
			<i>Neomysis</i> sp.
Chordata (chordates), sub-phylum Urochordata (tunicates)			
		Ascidiacea	
		Asciidiidae	
			<i>Ascidia nigra</i>
			<i>Ecteinascidia turbinata</i>
		Botryllidae	
			<i>Botryllus panas</i>

^a Sources: Clements and Bunnell 1979; Díaz-Pifferer 1968; Negrón and others 1982; Nybakken 1982; Viera 1979; observations by Jorge L. Coll Rivera.

Table 8—Planktonic organisms reported for Laguna Grande^a

Phylum	Class	Order	Species
Kingdom Plantae			
	Bacillariophyceae (Diatoms)		
		Centrales	<i>Amphiprora</i> sp. <i>Bacteriastrum</i> sp. <i>Biddulphia</i> sp. <i>Chaetoceros</i> sp. <i>Cosinodiscus</i> sp. <i>Cyclotella</i> sp. <i>Istimia</i> sp. <i>Rhizoselenia</i> sp. <i>Triceratium</i> sp.
		Pennales	<i>Asterionella</i> sp. <i>Bacillaria</i> sp. <i>Grammatophora</i> sp. <i>Licmophora</i> sp. <i>Meridiom</i> sp. <i>Nitzchia longissima</i> <i>Striatella</i> sp. <i>Thalassiothrix</i> sp.
Kingdom Animalia			
	Annelida		
		Polychaete	Polychaete larvae
	Arthropoda, sub-phylum Crustaceae		
		Cirripedia	
		Thoracica	Barnacle larvae
		Copepoda	<i>Acartia lilljerorgii</i> <i>A. tonsa</i> <i>Calanus</i> sp. <i>Euchaeta</i> sp. <i>Euterpina acutifrons</i> <i>Labidocera scotti</i> <i>Oithona nana</i> <i>O. oculata</i> <i>Paracalanus crassirostris</i> <i>P. parvus</i> <i>Temora stylefera</i> Copepod nauplii
		Malacostraca	
		Amphipoda	<i>Porima</i> sp. <i>Podon</i> sp.
		Decapoda	<i>Lucifer</i> sp. Crab zoea Lobster zoea

**Table 8—Planktonic organisms reported for Laguna Grande^a
(continued)**

Phylum	Class	Order	Species
Chaetognatha			<i>Kronitta pacifica</i>
Cnidaria	Scyphozoa		
Ctenophora			
Echinodermata	Stellerioidea, subclass Asteroidea		Starfish larvae
Chordata	Osteichthyes		Fish larvae Fish eggs
Urochordata (sub-phylum)		Larvacea	<i>Oikopluera</i> sp.
Kingdom Protista			
Mastigophora	Phytomastigophora		
		Dinoflagellida	<i>Ceratium furca</i> <i>C. longirostris</i> <i>C. macroceros</i> <i>Pyrodinium bahamense</i>
Sarcodina	Rhizopodea		
		Formamini	

^a Sources: Cements and Bunnell 1979; Diaz-Pifferer 1968; Nybakken 1982; Smith 1977; Zayas 1979.

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The 178-hectare (ha) northeastern tip of Puerto Rico, which is known locally as "Las Cabezas de San Juan Nature Reserve," is managed by the Puerto Rican Conservation Trust to protect the area's scenic beauty and to provide environmental education and research opportunities to the island's residents and visitors. The highest point on the terrain is occupied by a lighthouse (El Faro). Constructed in 1880, El Faro provides a scenic panorama of the northeastern coast, offshore islands, and the Luquillo Mountains. The current state of knowledge regarding the environment, i.e., geology, physiography, soils, climate, flora, fauna, and past human influence, is summarized in this document as general information for the public and as a basis for further research. New information on plant species and their occurrence and relative abundance is also provided. The Reserve has at least 365 plant and 96 bird species. Continued protection will provide ample opportunity to expand both educational opportunities on the Reserve and scientific knowledge of its terrestrial and aquatic resources.

Keywords: Climate, conservation, fauna, flora, history.



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