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The Field Museum

The Field Museum is a collections-based research and educational institution devoted to natural and cultural diversity. Combining the fields of Anthropology, Botany, Geology, Zoology, and Conservation Biology, Museum scientists research issues in evolution, environmental biology, and cultural anthropology. Environmental and Conservation Programs (ECP) is the branch of the Museum dedicated to translating science into action that creates and supports lasting conservation. ECP collaborates with another branch, the Center for Cultural Understanding and Change, to ensure that local communities are involved in efforts for long-term protection of the lands on which they depend. With losses of natural diversity accelerating worldwide, ECP's mission is to direct the Museum's resources—scientific expertise, worldwide collections, innovative education programs—to the immediate needs of conservation at local, national, and international levels.

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Museo Nacional de Historia Natural de Cuba

The Museum's core mission is to collect, research, conserve, and exhibit natural objects to promote scientific and cultural knowledge of nature. It is an institution comparable, in structure and function, with the international model for this kind of museum; for that reason it includes the following among its fundamental objectives:

- Research on biogeography, paleogeography, and the biodiversity of Cuba and the Caribbean;
- Conservation of the collections of Cuban minerals, rocks, fossils, plants, and animals residing in the Museum, which are part of the National Heritage;
- Broadening of these collections so that they will be representative of Cuban nature, and systematic study of the collections and of the environment from which specimens were collected; and
- Creation of exhibits about nature, with emphasis on Cuban natural history, and the education of visitors and the general public in a culture of nature.

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**Ministerio de Ciencia, Tecnología y Medio Ambiente
de Ciénaga de Zapata (CITMA)**

CITMA de Ciénaga de Zapata has the following responsibilities:

- Enforcing the regulations established with respect to the environment and the wise use of natural resources in Zapata Swamp;
- Developing and setting objectives for conservation and sustainable development in the region;
- Evaluating all proposals for the introduction or modification of techniques or technologies to be used in the area, and proposing appropriate technological solutions;
- Participating in, evaluating, and regulating, within the guidelines of its jurisdiction, the design and implementation of development projects in the region; and
- Conducting systematic evaluations of the environmental conditions of the area and the status of its natural resources, as well as determining the requirements of highest priority for achieving conservation objectives set for the region, through adopting measures within its purview and proposing those that require approval at higher levels of organization.

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Cornell Lab of Ornithology

The “Lab” is a nonprofit membership institution whose mission is to interpret and conserve the earth’s biological diversity through research, education, and citizen science focused on birds. Our programs work with citizen scientists, government and nongovernment agencies across North America and beyond. We believe that bird enthusiasts of all ages and skill levels can and do make a difference. From backyards and city streets to remote forests, anyone who counts birds can contribute to the Lab’s research. Data from the projects are used to monitor bird populations and outline conservation efforts.

The Lab’s conservation work is based on sound science and draws extensively from the efforts of other Lab programs. Our conservation staff produces guidelines and manuals to help professional land managers and private landowners make informed, conservation-minded management decisions. Lab staff belong to a number of conservation alliances including Partners in Flight and the International Whaling Commission, which work hard to affect broad-scale conservation policy.

Education is a vital component of the Lab’s mission. We provide to the public a growing number of education projects and courses, and are committed to empowering educators with the tools they need to provide science-based programs to their students.

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Editors' Note: Jennifer Shopland revised, edited, or wrote all text and appendices except the plate captions. Because she had to leave the project before its conclusion, however, she contributed to the final editing of the English text only, and to none of the proofreading. The remaining errors in form and content are the sole responsibility of the other editors.

The goal of rapid biological and social inventories is to catalyze effective action for conservation in threatened regions of high biological diversity and uniqueness.

Approach

During rapid biological inventories, scientific teams focus primarily on groups of organisms that indicate habitat type and condition and that can be surveyed quickly and accurately. These inventories do not attempt to produce an exhaustive list of species or higher taxa. Rather, the rapid surveys (1) identify the important biological communities in the site or region of interest and (2) determine whether these communities are of outstanding quality and significance in a regional or global context.

During social asset inventories, scientists and local communities collaborate to identify patterns of social organization and opportunities for capacity building. The teams use participant observation and semistructured interviews to evaluate quickly

the assets of these communities that can serve as points of engagement for long-term participation in conservation.

In-country scientists are central to the field teams. The experience of local experts is crucial for understanding areas with little or no history of scientific exploration. After the inventories, protection of wild communities and engagement of social networks rely on initiatives from host-country scientists and conservationists.

Once these rapid inventories have been completed (typically within a month), the teams relay the survey information to local and international decision makers who set priorities and guide conservation action in the host country.

REPORT AT A GLANCE

Dates of fieldwork	8–15 September 2002
Region	Republic of Cuba, Matanzas Province, <i>municipios</i> (comparable to counties) of Ciénaga de Zapata, Jagüey Grande, Unión de Reyes, and Pedro Betancourt. The Zapata wetland-and-forest complex occupies the entire southern end of the province, measuring 175 km in length from west to east, between Punta Gorda and Jagua. Its maximal width is 58 km, north to south, from the town of Torriente to Cayo Miguel, with an average width of 14–16 km.
Sites surveyed	The rapid biological inventory team surveyed six sites within the Zapata Peninsula: Bermeja (swamp forests), Peralta (swamp forests and marsh grasslands), Pálpite (tidal-swamp forests), the Hatiguanico River (marsh grasslands and mangrove swamps), Punta Perdíz (semideciduous forests), and Caleta Sábalo (swamp forests and semideciduous forests).
Organisms surveyed	Vascular plants, insects (ground beetles [family Carabidae], ants, dragonflies), mollusks, amphibians and reptiles, birds, and mammals
Highlights of results	<p>The rapid inventory team identified important opportunities for conservation in the Zapata Peninsula, where two vegetation types stand out at the highest priority: (1) lowland forests (the most extensive in the West Indies) and (2) grass-dominated wetlands (both western and eastern sectors). The latter are among the largest and most nearly intact of such habitats in the world. These ecosystems are a refuge for a rich and diverse biota, with high levels of endemism, primarily in the vertebrates. During eight days in the field, our team found geographically restricted species and new records for the locality. Below is a brief summary of the results for the areas and organisms studied.</p> <p>Plants: Although we focused on the most widespread vegetation types (see Sites Surveyed, above), the Zapata region harbors 17 recognized formations, including the unique Marsh Spring Vegetation Complex (Complejo de Vegetación de Manantial de Ciénaga) among the forest islands called <i>petenes</i>. Marsh grasslands (Fig. 2H), reminiscent of the sawgrass fields of the Florida Everglades (USA), are maintained by fire and are the sole habitat for some endemic birds and fishes, the endangered Cuban crocodile, and a notable population of the declining West Indian manatee. Mangrove swamps along rivers and the coast are crucial nurseries for much of the region's marine life. Upland forests are home to most of the region's endemic bird species, as well as most of its reptiles. Both swamp forest (Fig. 2C), seasonally or permanently flooded, and semideciduous forest (Fig. 2E) have been heavily disturbed in some areas, both by human activity and by hurricanes and wildfires.</p>

REPORT AT A GLANCE

Highlights of results
(continued)

We recorded 305 species of vascular plants, from an estimated 1,000 in the Zapata region. Among them were several tree species of ecological or economic significance, including mahogany and sabal palm. Previous studies have estimated that 13% of Zapata's plant species are found only in Cuba.

Insects: Our insect surveys covered only ground beetles (Carabidae), ants, and dragonflies, and all must be considered preliminary. The present inventory of carabids is the first of its type published for Zapata Swamp. We recorded 54 species of these beetles, of which 4 are endemic to Cuba and 1 is a new species of *Ardistomis*. We suspect that many more species will be found at Zapata when more habitats and sites (especially in the western part of the peninsula) have been inventoried. Zapata's ant fauna is dominated by widespread and introduced species. We recorded 17 of the 30 species expected to occur in the region, including 1 species endemic to Cuba and a native leafcutting ant new for Zapata. As Cuba's most extensive wetland, Zapata Swamp is a site of great importance for dragonfly conservation. We recorded 18 of the 50 species predicted for the region.

Mollusks: Land snails dominate the mollusk fauna of Cuba. Most of the country's 1,300 species are endemic. Zapata has few species for an area of its size. We recorded 5 land snails, including a new Zapata record. We also noted 7 species of freshwater mollusks, including 2 new Zapata records. The most abundant of the freshwater species was *Pomacea palludosa*.

Amphibians and reptiles: We registered 14 of the 16 amphibian species predicted to occur in the Zapata Peninsula, exceeding the previous species list by 4. One-quarter of Cuba's 58 species of amphibians live in Zapata Swamp, representing all the families found in the country. Zapata's amphibians show the typically high degree of endemism found in Cuba (13 of the 14 species we recorded are restricted to Cuba). Of the 43 reptile species estimated for the region, we registered 41—an increase of 5 over the previous species count. Endemism is only moderate among Zapata's reptiles. We recorded the lizard *Sphaerodactylus richardi* (1 of the 2 reptile species restricted to the peninsula) as well as 4 reptile species and 1 subspecies never before observed in Zapata.

Birds: The Zapata Peninsula is the richest region in the country for birds endemic to Cuba, waterbirds, and migrant landbirds. We recorded 117 species of the 258 previously observed in the peninsula. We observed 2 of the 3 birds found only in Zapata (Zapata Wren [Fig. 5A] and the endemic subspecies of Zapata Sparrow, but not the nearly extinct Zapata Rail). In addition to these birds, the marshes are home to the Cuban endemic Red-shouldered Blackbird, as well as the threatened Sandhill Crane and West Indian Whistling-Duck. Zapata's forests are equally

significant for birds. Bermeja is considered the most important nesting area for endemic birds in Cuba—14 species breed in its forests. Of the 30 threatened species in Cuba, 16 nest in Zapata. During the inventory we observed 6 species of threatened Cuban endemics, as well as sole or extremely rare records for 3 migrant landbirds.

Mammals: Mammalian diversity in the Zapata region, as in Cuba, is low. Bats are richer in species than other groups. The peninsula's 3 species of hutias are representatives of a group of large-bodied rodents restricted to the Greater Antilles. One of these hutias, *Mesocapromys enanus*, is known in modern times only from Zapata. Of the region's 15 mammal species (both native and introduced), we recorded the relatively common native hutia *Capromys pilorides* and the introduced black rat, house mouse, and small Indian mongoose.

Human communities

In part because of our short time in the field, our work did not include a rapid social inventory. Human population density in Zapata Swamp is low—the extensive marshes limit access over a wide area. Nevertheless, the human communities of the peninsula depend on the natural resources provided by the swamp and surrounding forests. Inhabitants of the buffer zone subsist mainly through small-scale agriculture, exploitation of forests (lumber and charcoal), and fishing. On a much smaller scale they use the land and waters for silviculture, livestock production, sport hunting, apiculture, and tourism, the last of which is not yet producing economic incentives for conservation by local residents.

Main threats

The primary threats to the biological diversity and natural resources of the Zapata Peninsula are (1) damage to the water table, marshes, and swamps; (2) destruction or degradation of upland forests; and (3) invasive species. Excessive nutrient runoff, chemical contamination by agriculture upstream, and the drainage and diversion of waterways are concerns to be monitored. Any new construction of roads and canals must be planned carefully to minimize fragmentation of plant and wildlife habitat. Both selective logging of large timber species and clearcutting for firewood and charcoal exacerbate hurricane damage and leave forests vulnerable to devastation by fire. *Melaleuca*, an Australian tree that has penetrated the marshes, seems the most dangerous of the invasive species now present in Zapata. Introduced species of mammals (including the small Indian mongoose) and nonnative fish species also may pose problems if their populations increase.

Other threats to the conservation of Zapata's wild species and communities include (1) fires at unnatural frequencies that may lead to changes in vegetation, (2) desiccation and salinization of soils, (3) free-ranging livestock and

REPORT AT A GLANCE

Main Threats (continued)

feral mammals, (4) damage to sabal and royal palms, (5) hunting of threatened species, (6) uncontrolled tourism, and (7) limitations on human resources for conservation (for example, public education, staff training, and funds).

Current status

Four core areas—Zapata Swamp National Park, the Zapata Cave-Lake System (Sistema Espeleolacustre de Zapata), and Bermeja and Los Sábalos Wildlife Refuges—protect 434,546 hectares. These protected areas are entrusted to four agencies: the National Center for Protected Areas (Centro Nacional de Áreas Protegidas) through the Estación de la Ciénaga de Zapata; the Ministry of Science, Technology, and the Environment of Zapata Swamp (Ministerio de Ciencia, Tecnología, y Medio Ambiente de Ciénaga de Zapata); and the Protected Areas Unit of Matanzas Province's Municipal Agricultural Agency (Unidad de Áreas Protegidas de la Empresa Municipal Agropecuaria). Zapata Swamp also is a UNESCO Man and the Biosphere Reserve and a Ramsar site (an internationally important wetland). Most of the protected land, however, lies in the swamp itself; forests remain vulnerable to unmanaged human use.

Principal recommendations for protection and management

Discussions with staff from the above agencies have led to the following principal recommendations:

- 01 **Increase the effectiveness of the Biosphere Reserve as a management unit by expanding the intensity and extent of conservation action to the entire Zapata Peninsula.** Focus initial efforts on strengthening protection and management outside the national park.
- 02 **Zone the entire peninsula for appropriate land uses.** Zoning will decrease pressures on ecosystems throughout the peninsula and will facilitate management, even outside formally protected areas.
- 03 **Manage the local extraction of wood,** especially in the forests at Bermeja, **so that the ecosystem can tolerate subsistence use.** Develop alternative fuel sources. Intensify efforts to restore degraded forests.
- 04 **Control invasive species,** focusing on species that cause significant ecosystem damage.
- 05 **Reduce or eliminate hunting of species overharvested** for commercial trade. Introduce management of species harvested for subsistence.
- 06 **Experiment with the management of fire frequency** in marshes, swamps, and forests.

Principal
recommendations
for protection
and management
(continued)

- 07 **Evaluate the threats from pollution, channelization, and drainage to Zapata's wetlands.** Develop protocols to monitor and manage these potential threats.
- 08 **Strengthen local capacity for conservation** through public education, local and regional management plans, regulation of tourism, agency collaboration, and an infusion of resources for conservation staff.
- 09 **Develop long-term financial resources** to support the protection and management of the entire peninsula.

**Long-term
conservation
benefits**

- 01 **A globally outstanding conservation area** that includes (1) one of the world's largest and most nearly intact marsh ecosystems; (2) the largest remaining expanse of lowland forest in Cuba, if not in the Caribbean; and (3) the largest cave-lake system in Cuba.
- 02 **Protection for significant populations of more than 80% of Cuba's endemic birds**, as well as habitat for endemic amphibians, reptiles, mammals, and insects.
- 03 **Natural resources** — wood, food (including marine nurseries), and water — **on which local human communities depend.**

Why The Zapata Peninsula?

Three centuries ago, the vast marshes and mangroves of Cuba's Zapata Swamp were the hideout of Caribbean pirates. Today, this wet wilderness—just 160 km south of Havana on the island's south-central coast—is another kind of refuge. The same hidden waterways, tangled vegetation, and soggy ground that shielded the high-seas marauders have protected Zapata's wild inhabitants. Here, human population density is among the lowest in the country. Plants and animals found nowhere else, or vanishing from other parts of Cuba or the West Indies, maintain a stronghold. Where the swamp meets the sea, the young of economically valuable marine animals find shelter. In addition to an outstanding flora and fauna, sheer size contributes to Zapata's significance among the world's wetlands. At more than 4,500 km², it is in a class with the Florida Everglades (USA) and the Pantanal of southern South America.

Less celebrated than Zapata Swamp proper, but equally rich in life and more vulnerable, are the forests that cover portions of the Zapata Peninsula. Nowhere else in Cuba—perhaps in the Caribbean—have such large tracts of lowland forest escaped destruction. Substantial populations of more than 80% of Cuba's endemic birds depend on these swamp forests and drier semideciduous forests. In fact, the Zapata Peninsula as a whole is unquestionably the island's greatest haven for birds.

Zapata's geology and hydrology are as complex as its web of living creatures. Sinkholes, flooded caverns, and dissected surface rivers punctuate the limestone bedrock where most of the peninsula's vegetation grows on peaty soils. This mosaic of water and land deserves its international recognition and national protection. Zapata Swamp is a UNESCO Man and the Biosphere Reserve and a Ramsar site, as well as a Cuban national park (Fig. 1). Four other core conservation areas are protected by Cuban law—but much of the peninsula, especially the forests, remains outside formal protection. Logging of large timber trees and harvesting of fuelwood go unchecked throughout much of the region. Even the marshes and swamps are not immune to peril. Invasive species, especially exotic trees and shrubs, have begun their march into Zapata's inner reaches, and agricultural lands surrounding Zapata are potential sources of pollutants.

Our aim in conducting a rapid biological inventory was twofold: to document the presence of animal and plant groups, especially those less well known than birds, and to link the status of these organisms to threats that continue to grow in the Zapata Peninsula. Conservation coverage in the region is admirable, but more intensive management is needed, especially outside the formally protected parts of the peninsula. Information on diversity and danger will support the preservation of this giant gem of the Caribbean, not only by Cuban conservationists, but also by Zapata's human communities.

Overview of Results

LANDSCAPE AND SITES VISITED

We surveyed the biological riches of the Zapata Peninsula from 8 to 15 September 2002. This rapid inventory took place north and east of the Bay of Pigs, in the polygon circumscribed by Bermeja, Playa Girón, the Hatiguanico River, and Peralta (Fig. 1). We made observations, and in some cases collected voucher specimens, at six sites that gave us access to Zapata's four major wild vegetation types: mangrove forest, marsh grassland, swamp forest, and semideciduous forest.

At 4,520 km², Zapata Swamp (Ciénaga de Zapata) is one of the largest marsh systems in the world, rivaled only by the Florida Everglades (USA) and by the Pantanal of Brazil, Bolivia, and Paraguay. Combined with associated upland habitats, it stands out in terms of landscape complexity and biological endemism in Cuba and the Caribbean. In fact, with its 37 landscape types and distinctive plants and animals, Zapata Swamp is a unique faunistic, floristic, and physiographic region in Cuba.

Like the Everglades, the Zapata region is a mosaic of vegetation formations on limestone bedrock. Both freshwater and salt marshes, islands of tall vegetation (*petenes*), underground pools (*cenotes*), and dissected surface rivers are characteristic. Although hydrology and plant cover have been altered in areas accessible to humans, much of the Zapata Peninsula is intact.

In diversity and ecological services, Zapata's richness is not limited to its terrestrial and freshwater habitats. Its coastal zone and marine shelf give refuge to juvenile and larval stages, as well as breeding adults, of species of great ecological and economic importance. Among these species are the land crab *Cardisoma guanhumí*, crabs of the genus *Callinectes*, the queen conch *Strombus gigas*, the West Indian manatee (*Trichechus manatus manatus*), marine turtles (*Caretta caretta*, *Eretmochelys imbricata*, and *Chelonia mydas*), crocodiles (*Crocodylus rhombifer* and *C. acutus*), and fishes (*Calamus*, *Lutjanus*, and *Haemulon*) (ICGC 1993).

For taxonomic diversity of animals found only in Cuba, this wetland-and-forest complex is outstanding. Most of Cuba's endemic birds live in the region, and Zapata is the only place in the country where all eight endemic genera coincide. It is also home to the largest population of the endemic Cuban gar, or *manjuarí* (*Atractosteus tristoechus*, Lepidosteidae), a very primitive freshwater fish

threatened with extinction, as well as several other fishes restricted to Cuba (*Gambusia punctata*, *G. puniculata*, *Cichlasoma tetracantha*, and *Cubanichthys cubensis*). Species or subspecies found only on the peninsula itself include Zapata Wren (*Ferminia cerverai*, Fig. 5A), Zapata Rail (*Cyanolimnas cerverai*), Zapata Sparrow (*Torreornis inexpectata*), the dwarf hutia (a rodent, *Mesocapromys nanus*), the Cuban crocodile (*Crocodylus rhombifer*), and a new species of blind fish (*Lucifuga*) recently discovered in the eastern cenotes.

Archaeological sites contribute to the Zapata Peninsula's cultural significance in the region. Of the 33 sites present on the peninsula, some include remains of the three main aboriginal cultures of Cuba.

At present, the biodiversity of the peninsula is protected formally through four core conservation areas. Two are of national importance: Zapata Swamp National Park (Parque Nacional Ciénaga de Zapata) and the Zapata Cave-Lake System (Sistema Espeleolacustre de Zapata), a Distinguished Natural Element in Cuba's protected-area network. Their combined area is 432,100 ha. The other two—Bermeja and Los Sábalo Wildlife Refuges—protect areas of great local value (combined area 2,446 ha). Zapata Swamp also has been designated a UNESCO Biosphere Reserve (657,100 ha), as well as a Ramsar site (an internationally important wetland) by the International Wetlands Convention (Fig. 1). Most of the land protected by Cuban law or international agreement lies in the swamp itself (for the applicable laws, please see Appendix 8). Upland forests, which harbor many endemic species that do not occur in the wetlands, have received very little protection and are hardest hit by overexploitation of natural resources. Even for the wetlands, long-term health of the ecosystem is at risk because the headwaters are outside the national park and may be threatened by diversion, channelization, and pollution.

Zapata's importance as a center of avian diversity and endemism has been known for many years. Other taxonomic groups have not received as much scientific attention. For example, during the rapid

inventory we found fewer than half of the bird species known from the peninsula and no new records for the region. In contrast, the field team recorded more species of amphibians and reptiles during the week-long inventory than had been registered previously for the peninsula. Nevertheless, for most of the organism groups surveyed, members of the field team had collected information during earlier studies. We present highlights of this ecological context in the Technical Report.

FLORA AND VEGETATION

The broad extent and relatively good condition of Zapata Swamp's vegetation underscore its significance for conservation. The region is probably best known for its marsh grasslands. Although these marshes are low in species richness and endemism, they are crucial habitat for endemic birds, the largest remaining population of Cuban crocodiles, some endemic fishes, and a notable population of West Indian manatees, as well as a host of other species. Vegetation within the marshes ranges from plants floating on open water to dense fields of sawgrass (Fig. 2H), actually a sedge, with tall grasses and scattered palms. Like the sawgrass areas of the Florida Everglades, Zapata's marshes are kept open by fire. Without it, woody vegetation would encroach and the marshes would become shrubland. But much of the marsh may burn too often to maintain dense sawgrass and other characteristic vegetation. Little is yet known about the effects of too-frequent fire on the vegetation and fauna of Zapata Swamp, but we suspect that the ideal burn cycle is intermediate, maintaining structural diversity without allowing significant invasion of woody vegetation. Such a regime probably would be favorable for species, like the endemic Zapata Rail and Zapata Wren, that depend on open marsh grassland.

Mangrove forests hug the coastline and penetrate up Zapata's rivers. Though depauperate in both plant and vertebrate diversity when compared with other forest types, mangrove areas are crucial nurseries for much of the region's marine life. We surveyed these

forests mainly along the Hatiguanico River, where three species of mangroves occur.

Most of Zapata's upland forests occupy a wide swath mainly south and east of the marsh (Figs. 1, 2A). These stands are the most extensive remnant of low-elevation forest in Cuba and harbor most of the region's endemic bird species, as well as most of its reptiles. Here, both species richness and endemism are moderate. The canopy is dominated by relatively few tree species. We surveyed two types of upland forest: seasonally to permanently inundated swamp forest (Fig. 2C), which appears to be resistant to fire; and semideciduous forest (Fig. 2E), primarily on limestone, in which *Lysiloma latisiliquum* dominates.

In our inventory of these four vegetation types, as well as some areas of open, disturbed land, we recorded 305 species of vascular plants of an estimated 1,000 in the region (Appendix 1). Among them were several tree species of ecological or economic significance, including mahogany and sabal palm.

INSECTS

The surveys of invertebrates conducted during the rapid inventory must be considered preliminary because of our limited field time. Among insects, we surveyed ground beetles (in the family Carabidae), ants, and dragonflies.

We recorded 54 species of carabid beetles, of which 4 are endemic to Cuba and 1 is a new species of *Ardistomis* (Appendix 2). We suspect that many more species will be found at Zapata when more habitats and sites have been inventoried.

Zapata's ant fauna is dominated by widespread and introduced species. Cuba's primarily terrestrial ants may not have been able to adapt to the inundation to which almost the entire peninsula is subjected. During the rapid inventory we recorded 17 of the 30 species predicted for the region (Appendix 3). One of these species (*Pseudomyrmex pazozi*) is endemic to Cuba. We noted a range extension for the leafcutting ant *Acromyrmex octospinosus*.

As Cuba's most extensive wetland, Zapata Swamp is a site of great importance for dragonfly conservation. Of the 50 species of dragonflies predicted to occur in the Zapata region, we noted 18 (Appendix 4). No Cuban dragonflies are endemic.

MOLLUSKS

Land snails dominate the mollusk fauna of Cuba. Of approximately 1,300 species found in the country, nearly all are endemic. Zapata has few species for an area of its size. As is true for ants, the periodic flooding of terrestrial habitats may have been a barrier to land snails' invasion of the region.

During the rapid inventory we recorded 5 species of land snails, of which 1 (*Cysticopsis exauberi*) is a new species for the Zapata region (Appendix 5). We also registered 7 species of freshwater mollusks, including 2 new Zapata records (*Helisoma foveale* and the rare *Drepanotrema anatinum*). Two other notable records were *Liguus fasciatus alcaldei*, a subspecies previously thought extirpated in the region, and *Eurycampta supertexta*, a Cuban endemic.

AMPHIBIANS AND REPTILES

The survey of amphibians and reptiles that we conducted added significantly to the knowledge of the herpetofauna of the Zapata Peninsula. Of 16 amphibian species predicted to occur in the region, 10 had been recorded before the rapid inventory; we registered 14 (Appendix 6). Of an estimated 43 reptile species, 36 had been recorded previously; we registered 41 (Appendix 6).

About one-quarter of Cuba's amphibian and reptile species are known from the Zapata Peninsula. In reptiles, species richness is relatively high but endemism is only moderate (15 of the 41 species recorded on the rapid inventory are endemic to Cuba). Two of these endemic species, a lizard (*Sphaerodactylus richardi*) and a snake (*Arrhyton procerum*), are restricted to the

peninsula. In contrast to reptiles, and like Cuba's amphibians in general, Zapata amphibians show an extraordinary degree of endemism (13 of the 14 species recorded during the inventory are found only in Cuba).

One of our amphibian records (the toad *Bufo empusus*, Fig. 4C) was the first for Zapata since the nineteenth century. *Eleutherodactylus auriculatus* (Fig. 4D), *E. varians*, *E. eileenae*, *E. planirostris*, *E. riparius*, *Bufo peltacephalus*, and *Osteopilus septentrionalis* (all frogs and toads) were abundant during the rapid inventory.

First records for reptiles in Zapata were *Anolis equestris juraguensis*, *A. lucius*, *A. pumilus*, *Arrhyton taeniatum*, and *Typhlops biminiensis*. We also noted a range extension for the Zapata endemic *Sphaerodactylus richardi*, which was abundant during our survey. Several other lizard species appeared to have large populations, as did the turtle *Trachemys decussata* (Fig. 4H), even though the latter is heavily harvested for food, religious purposes, souvenirs, and pets.

BIRDS

The Zapata Peninsula is unquestionably the most important area for birds in Cuba. More species of Cuban endemics occur here than anywhere else. The marshes contain the largest populations of waterbirds in the country. Species richness and population sizes of migrant landbirds are the highest in Cuba.

All three of the birds restricted to the Zapata region—Zapata Rail, Zapata Wren (Fig. 5A), and an endemic subspecies of Zapata Sparrow—are inhabitants of its marshes. Zapata Sparrow is known otherwise only from two small populations in eastern and northern Cuba. Zapata's marshes also are home to the endemic Red-shouldered Blackbird, the threatened Sandhill Crane (represented by an endemic subspecies), and the threatened West Indian Whistling-Duck.

As critical as Zapata's marsh habitats are for bird conservation, its forests are at least as significant. Twenty of the 23 bird species endemic to Cuba occur in the Zapata Peninsula; most of them (including 9 species

considered threatened or endangered) are dependent on the remnant and, at present, unprotected forests. Populations of these threatened species are among the largest remaining in Cuba. Given that we saw every Cuban endemic (with the exception of the nearly extinct Zapata Rail) on Zapata's list during this brief survey, populations must be very large for these range-restricted species as well. Full protection of Zapata's forests will secure habitat for nearly all of Cuba's endemic avifauna. Such protection cannot be duplicated elsewhere.

Compared to other areas of Cuba, the Zapata Peninsula has the largest populations and greatest species richness of migrant passerines from North America. For at least 12 species of these migrants, a significant portion of the population winters in Cuba and uses the forests of the Zapata region. Because the rapid inventory took place outside the peak of their migration, our species count for migrant passerines was low. Migrant shorebirds flock to Zapata's wetlands, but we did not visit parts of the peninsula where shorebird populations are highest. These latter migrants probably were abundant at the time of our survey.

In all, we recorded 117 species of birds (91 breeders, 17 species overwintering, and 9 transients; Appendix 7). In addition to the local endemics noted above, we observed Gundlach's Hawk, Blue-headed Quail-Dove, Gray-fronted Quail-Dove, Cuban Parakeet, Bee Hummingbird (Fig. 5D), and Fernandina's Flicker, all threatened Cuban endemics. Other significant records included the first Bay-breasted Warbler for Zapata Swamp; significant numbers of migrating Common Nighthawks and Eastern Kingbirds, which had been registered only once and twice, respectively, at Zapata before this inventory; and Yellow-throated Vireos, a rare winter resident, in mixed-species flocks.

MAMMALS

Mammalian diversity in the Zapata region, as in Cuba, is low. Including both native and introduced species, Zapata's mammal fauna includes 5 orders, 9 families, 14 genera, and 15 species. Bats are richer in species than

other groups. The declining West Indian manatee (subspecies *Trichechus manatus manatus*) inhabits the La Broa-Hatiguanico River Inlet along Zapata's coast. The peninsula's 3 species of hutias are representatives of a group of large-bodied rodents, containing 13 living species, restricted to the Greater Antilles. One of these hutias, *Mesocapromys nanus*, is known in modern times only from the Zapata region. During the rapid inventory we recorded 4 mammal species: the relatively common and widespread native hutia *Capromys pilorides* and 3 introduced species (black rat, *Rattus rattus*; house mouse, *Mus musculus*; and small Indian mongoose, *Herpestes javanicus*).

HUMAN COMMUNITIES

Human population density in Zapata Swamp is low (2 inhabitants per km²). Access to the region has been limited to the railroad and one paved road entering the heart of the peninsula. Zapata's extensive marshes have discouraged human visitation, let alone settlement. This light footprint is responsible in part for the good condition of many of the peninsula's wild communities.

Nevertheless, Zapata's human communities depend on the natural resources provided by the swamp and surrounding forests. Our work in Zapata Swamp did not include a rapid social inventory, in part because of the short period available for fieldwork. But prior studies indicate that inhabitants of the buffer zone subsist mainly through small-scale agriculture, exploitation of forests (lumber and charcoal; Fig. 6C), and fishing. Other activities include silviculture, livestock production, sport hunting, and apiculture. Recently, tourism has blossomed in the region but has had little economic impact on most residents. Well-planned development of ecotourism in the Zapata Peninsula could provide some economic support to the local population as well as increase their stake in the continued conservation of forests, marshes, and marine resources.

THREATS

The primary threats to the biological diversity and natural resources of the Zapata Peninsula are (1) *human activities that damage the water table, marshes, and swamps*; (2) *human activities that destroy or degrade upland forests*; and (3) *invasive species*.

Agriculture is of concern as a potential threat to Zapata's wetlands. Outside Zapata Swamp itself, fertilizers and livestock may contribute to excessive nutrient loads and chemical contamination that eventually pollute the marshes and swamps. Also, water is diverted and impounded for irrigation, as well as other human uses, with unknown impacts on the ecosystem. Experiments in rice culture are among the agricultural developments that lead to drainage of wetlands. The nonhuman inhabitants of Zapata Swamp also may suffer from fragmentation of their habitats by roads and canals, and from the lingering effects of past peat extraction.

Zapata's forests are threatened both by selective logging and by clearcutting. Local needs for firewood and charcoal lead to clearing of forest patches. Over more extensive areas, loggers target larger trees as sources of lumber for construction. This degradation of the forest goes beyond the loss of individual trees, however. Artificial openings exacerbate hurricane damage and leave the forest more susceptible to devastation by lightning- or human-induced fires. Even if remnant forests survive these forces, their structure may no longer be suitable for some of Zapata's endemic species of birds.

So far, the most destructive invasive species in the Zapata region are nonnative plants. *Melaleuca*, an Australian tree, has invaded the marshes and may prove as severe a problem there as in the Florida Everglades, where it is the target of vigorous control efforts. *Dichrostachys* (known locally as *marabú*, Fig. 6A) and *Casuarina* have similar potential for degradation of native habitats in the upland forests. But plants are not the only invaders that threaten Zapata's ecosystems. The small Indian mongoose, which was among the four mammal species seen during the rapid inventory, is a well-known threat to birds and

other small vertebrates. Several nonnative fish species (*Clarias* [walking catfish], *Oreochormis*, and *Cyprinus*) have been introduced into Zapata's waterways.

Other threats to the conservation of wild species and communities include the following:

- *Fires at unnaturally high frequencies in the marshes:* As noted above in Flora and Vegetation, ecologists still know little about how much fire is too much, but uncontrolled fires set by humans, combined with hurricane damage and alteration of the water table and wild vegetation, present a clear danger.
- *Desiccation and salinization of soils:* Past exploitation of peat and current agricultural practices have rendered some soils unsuitable for wild communities.
- *Free-ranging livestock and feral mammals:* These animals degrade vegetation directly by grazing and trampling. Also, cattle and goats introduce seeds of invasive exotics into the forests. At present, water buffaloes are limited to the region of rice plantations, but if they should spread into wild swamps and marshes, they could become a serious problem.
- *Damage to palms in forests and palm savannas:* The commercial pet trade encourages poachers to cut down palm trees so that they can rob parrot nests. Householders also cut palm fronds for roof thatch. Although quotas for the latter harvest may lie within the carrying capacity of palm populations, existing regulations are not uniformly enforced.
- *Hunting:* Wild populations of some species may be able to support harvest at the subsistence level. But the hunting of Cuban crocodiles, hutias, and West Indian Whistling-Ducks must be eliminated. The *jicotea* (the turtle *Trachemys decussata*) and the *majá de Santa María* (Cuba's largest snake, *Epicrates angulifer*) may need similar protection.
- *Unregulated tourism:* Although ecologically sensitive tourism could be a force supporting conservation on the peninsula, the spread of recreational infrastructure and uses that ignore conservation needs is a potential threat. On beaches, alteration of substrate and vegetation poses a specific threat to carabid beetles and may endanger other animals, as well as plants.
- *Limitations on human resources for conservation:* Local residents lack the knowledge of flora, fauna, and ecosystem sensitivity that would prepare them for more conservation-friendly practices. In addition, Zapata's conservation staff need additional equipment and training to achieve their potential for action.

CONSERVATION TARGETS

The following species, communities, and ecosystems in the Zapata region are of particular conservation concern because they are (1) especially diverse or threatened vegetation types or aquatic habitats; (2) species or subspecies endemic to Cuba or to Zapata; or (3) species or subspecies that are rare, threatened, endangered, vulnerable, or declining (including some economically valuable species). Some of these conservation targets meet more than one of the criteria above.

ORGANISM GROUP	CONSERVATION TARGETS
Biological Communities	Marsh ecosystem with a dynamic mosaic of habitats Semideciduous forests Swamp forests Palm savannas Rivers, creeks and lagoons
Vascular Plants	Local endemics (5 species—see Technical Report) Timber trees (<i>Swietenia</i> , <i>Cedrela</i> , etc.)
Insects	A new species of ground beetle (Carabidae) in the genus <i>Ardistomis</i> (likely to be a Zapata endemic) Four species of carabid beetles endemic to Cuba: <i>Clivina cubae</i> , <i>Ardistomis elongatulus</i> , <i>Coptia effeminata</i> , and <i>Chlaenius cubanus</i>
Mollusks	Two Cuban endemics: <i>Eurycampta supertexta</i> and <i>Cerion magister</i> The Zapata endemic <i>Laevapex pfeifferi</i> <i>Liguus fasciatus alcaldei</i> (ranked Vulnerable by the World Conservation Union [IUCN], and previously thought to be extirpated in Zapata) <i>Drepanotrema anatinum</i> (rare)
Reptiles	Threatened species: Cuban crocodile (<i>Crocodylus rhombifer</i>), <i>jicotea</i> (the turtle <i>Trachemys decussata</i>), <i>majá de Santa María</i> (the boa <i>Epicrates angulifer</i>) Endemic taxa: <i>Sphaerodactylus richardi</i> , <i>Arrhyton procerum</i> , two subspecies of <i>Anolis luteogularis</i> (<i>A. l. calceus</i> and <i>A. l. jaumei</i>)

CONSERVATION TARGETS

Birds

Local endemics of Zapata Swamp (2 threatened species, 1 threatened subspecies)

Other threatened Cuban endemics (6 species, all forest birds)

Other threatened species (7)

Other endemic species (11)

Habitat for terrestrial migratory species

Mammals

Three species of hutias (endemic Cuban rodents): *Mesocapromys nanus*, *Capromys pilorides*, *Mysateles prehensilis*

West Indian manatee (*Trichechus manatus manatus*) (declining)

Human Communities

No specific targets yet identified

BENEFITS FOR CONSERVATION AND FOR THE REGION

Although Zapata Swamp has received national and international recognition as a conservation area, formal protection is limited to four core areas that lie primarily in the wetlands, leaving the biologically rich upland forests open to destruction or degradation. Even in protected areas, limitations on budgets and training cut into the effectiveness of management staff. Outside Zapata proper, unaddressed damage to the aquifer and its watershed may be a long-distance threat to protected areas where direct impact seems light.

We propose a conservation landscape that would extend legal and on-the-ground protection of flora, fauna, and their habitats in the Zapata Peninsula. At the same time, it would secure a future for the local economy through a well-planned system of ecotourism and other economic activities compatible with conservation.

Some of the specific benefits for the region, for Cuba, and for the world include preservation of the following:

- 01 One of the world's largest and most nearly intact marsh ecosystems, and the largest wetland in the Caribbean;
- 02 The largest remaining expanse of lowland forest in Cuba, and possibly in the Caribbean;
- 03 The largest cave-lake system in Cuba, with complex hydrological conditions that include at least three superposed aquifers creating distinct life zones;
- 04 Significant populations of more than 80% of Cuba's endemic birds, as well as two species and a subspecies (all in unique genera) restricted completely to Zapata Swamp;
- 05 Habitat for endemic amphibians, reptiles, mammals, and insects; and
- 06 Natural resources, wood, food (including marine nurseries), and water on which local human communities depend.

Although the Zapata Peninsula is vulnerable to complex threats, both intrinsic and extrinsic, that are exacerbated by pressures on Cuba's economy, it has the conservation advantage of a low human population. Unlike many other lowland areas in Latin America and the Caribbean, Zapata Swamp is likely to remain sparsely populated because of its forbidding terrain. Combining this demographic advantage with formal protected status, conservation professionals will be able to focus first on areas like semideciduous forests, which are more accessible and therefore more immediately and severely imperiled.

RECOMMENDATIONS

The rapid inventory gave us an opportunity to combine an ecological context, generated from previous studies, with an assessment of conservation targets, and threats to their survival, in the Zapata Peninsula. We suggest that regional agencies can strengthen and extend existing conservation efforts through a landscape of both strictly protected areas and parcels managed for use of natural resources. Toward that end, we offer the following recommendations for protection and management, further inventory, research, and monitoring.

Protection and Management

- 01 **Expand the intensity and extent of conservation action to the entire Zapata Peninsula.** The current national park protects a major portion of the marsh ecosystem, but other wild communities, especially the forests, do not receive adequate formal protection. Strengthening protection and management outside the park's limits is a high priority. Appropriate ecological zoning of buffer areas would be another effective form of protection.
- 02 **Manage the extraction of local wood for subsistence use.** Protect forest remnants in the more elevated parts of the peninsula. Especially important is to protect the forest at Bermeja from exploitation. Eliminate the removal of sabal and royal palms, and reduce the use of their leaves for roofing.
- 03 **Implement effective plans for reforestation.** Investigate the potential for managed logging, as well as exploitation of palms.
- 04 **Evaluate and, if necessary, mitigate the effects of contamination, drainage, and channelization on Zapata's wetlands.** Use the results of management research (see Research recommendations 1 through 5, below) to set goals and test approaches.
- 05 **Control invasive species like marabú (*Dichrostachys*) and other plants.** Limit the expansion of *Melaleuca* and, if possible, eliminate it through a management program. Eradicate introduced, nonnative animal species (mongoose, fishes such as *Clarias*, etc.) and feral populations of domestic animals (dogs, pigs, etc.).
- 06 **Experiment with the management of fire frequency in marsh, swamp, and forest habitats.** How much is too much?
- 07 **Reduce, control, or eliminate the hunting of species overharvested for subsistence or commercial trade.** Among these species are the Cuban crocodile, the jicotea turtle, West Indian Whistling-Duck, White-crowned Pigeon, manatee, and hutias. Test approaches to eliminating the robbery of parrot nests for the pet trade.
- 08 **Educate residents about biodiversity, natural resources, and the importance of conserving them.** Zapata Swamp's designation as a Man and the Biosphere

RECOMMENDATIONS

Protection
and Management
(continued)

Reserve recognizes the crucial role that human communities must play in regional conservation action. Engaging local populations will be essential to the protection of the peninsula's wild species and communities.

- 09 **Involve Zapata's human residents in establishing not only local plans for conservation action but also a regional management approach.** Use entry points and capitalize on social assets identified in sociological and ethnobiological studies (see Research, below).
- 10 **Encourage well-planned ecotourism and concentrate plans for new hotels in already developed areas** (Playa Larga and Playa Girón). Ecotourism could be an economic engine in the region. Existing tourist facilities provide an obvious focus for additional development that could occur without harming wild communities.
- 11 **Improve working conditions for personnel responsible for conservation.** Courses, brochures, and other training methods will increase these professionals' capacity for action.
- 12 **Establish decisive guidelines for effective collaboration of the research and management organizations in the region (CITMA, EMA, FLORA Y FAUNA).**

Further inventory

- 01 **Continue biological inventories across different seasons and in the largest possible diversity of habitats.**
- 02 **Verify the status of *Mesocapromys nanus* in the region.** If the species is present, conduct studies of its natural history, especially its current geographic distribution, habitat quality, and population status.
- 03 **Inventory particular species and areas within Zapata**, including the following: (1) Zapata Rail, (2) Zapata Wren, (3) Zapata Sparrow, (4) hutias, (5) Cuban crocodile, (6) forest areas east of Playa Girón, and (7) large swamp areas of the southern and western parts of the Zapata Peninsula.

Research

- 01 **Evaluate the influence of human activities on wild populations**, including (1) the alteration of water chemistry in the watershed by agricultural activity north and east of Zapata; (2) drainage of wetlands and diversion of waterways; (3) selective logging for valuable timber species, and clearcutting for charcoal and firewood; and (4) subsistence, commercial, and sport hunting.
- 02 **Develop sociological and ethnobiological studies of the human communities of the Zapata region** in order to understand the ecology and standards of living of these inhabitants, as well as their uses of wild species. Use the results to develop local and regional management plans.

Research
(continued)

- 03 **Measure the effects of fire frequency and intensity on the flora and fauna of sawgrass and forest habitats.**
- 04 **Develop techniques for control of invasive plants.** Build on the efforts of practitioners and scientists in similar ecosystems—for example, the Florida Everglades. Apply the results immediately to *Melaleuca* and other invasives (see Protection and Management, above).
- 05 **Study the dynamics of marsh grasslands (especially in relation to fire) and of forests (especially in relation to recovery after hurricanes).** Use both satellite images and ground-truthed data as a baseline. Compare the results to those at ecologically similar sites.
- 06 **Conduct long-term studies of the natural history of species of conservation importance** (nutrition, reproduction, structural use of the habitat, climatic requirements, vocalization, behavior). Particular species deserving of focus include mammals (hutias, manatee), reptiles (Cuban crocodile), birds (Zapata Wren, Zapata Sparrow, parrots, Blue-headed Quail-Dove), and carabid beetles.
- 07 **Clarify the taxonomy of Zapata populations of giant *Anolis* lizards and frogs.**

Monitoring

Develop a comprehensive regional monitoring plan based on conservation goals for wild and human-sphere targets and threats to their survival. We recommend particular attention to the following:

- 01 **Monitor changes in the physical and chemical characteristics of Zapata's water and wetlands in relation to goals established through management research (see Research recommendations 1 through 5, above).** Track and, if necessary, control diversions and other hydrological alterations, as well as the inflow of nutrients and contaminants from the agricultural areas to the north.
- 02 **Initiate regular surveillance of all vegetation types to guard against the establishment of invasive plant species.** In particular, need to monitor *Melaleuca* closely, so that eradication efforts can be put into effect if it is spreading rapidly.
- 03 **Track changes in the extent and condition of mangrove forests,** using both satellite images and field observations.
- 04 **Track amphibian populations to detect possible declines.** Worldwide, amphibians are showing population decreases, many for reasons yet unknown. At Zapata, preliminary evidence suggests that some frog species, at least, may be suffering similar declines.

Technical Report

Although the rapid inventory team was in the field only for seven days, several of the Cuban members of the group have years of experience in scientific study of the Zapata Peninsula. Because of the shortage of publication opportunities, little information from their inquiries has been available to scientists and conservationists abroad or even in other parts of Cuba. In this report we include excerpts from this wealth of information for two reasons: to complement and give context for the rapid inventory results, and to put this scientific foundation into the hands of decision makers. Within the sections below, for each organism group we distinguish records from the rapid inventory (Results of the Rapid Inventory) from this complementary information (Ecological Context). Threats and Recommendations are based on both streams of information. In all Appendices except Appendix 6, we call out separately the species known from the Zapata Peninsula but not recorded during the rapid inventory.

OVERVIEW OF INVENTORY SITES

The inventory took place on the Zapata Peninsula, Matanzas Province, Cuba, from 8 to 15 September 2002. We established a base at the office of the Ministry of Science, Technology, and the Environment of Zapata Swamp (Ministerio de Ciencia, Tecnología, y Medio Ambiente de Ciénaga de Zapata [CITMA]) near Pálpite and daily surveyed other parts of the Zapata Peninsula.

GEOLOGY, HYDROLOGY, AND CLIMATE

Geology

The Zapata Basin is the largest and most complex system of karstic (limestone) drainage in Cuba. The calcareous bedrock, which is highly water-soluble, is of marine origin. Combined with distinctive hydrology and variable weather conditions, it has given rise to diverse and unique ecosystems, such as the Marsh-Spring Vegetation Complex (Complejo de Vegetación de Manatíal de Ciénaga), known only from this wetland. The Zapata Basin strongly influences the ecology and climate of the entire southern sector of Matanzas Province,

southwest of Cienfuegos Province and southeast of La Habana Province.

Although elevations on the Zapata Peninsula range from sea level to 10 m, the Zapata Basin itself does not exceed 6 m asl. It consists of two well-defined blocks of land, separated by deep terrestrial faults, on either side of the Bay of Pigs. To the west, the Ciénaga Occidental, bounded by La Habana Province, is lower and has a shallow coast characterized by an accumulation of sediments. To the east lies the higher Ciénaga Oriental, bounded by Cienfuegos Province and distinguished by a steeper, rocky shore. Crossing the center of the peninsula from east to west is a calcareous ridge that penetrates the low, flooded western sector and is known locally as *la parte alta de la Ciénaga* (“the high part of the Swamp”).

Peaty soils predominate in the Zapata Basin. Running in four bands from east to west are the following soil types: (1) red ferralitic (typic and hydrated) and yellowish ferralitic; (2) peaty, peaty gleysols, and marly-peaty; (3) red and black rendzinas; and (4) coastal bog and mangrove swamp solonchaks. The largest concentrations of peat occur in the Ciénaga Occidental, along with marsh soils that include muddy and sandy material. In the Ciénaga Oriental, bare karst predominates, with vegetation growing directly on it. Sand dunes taller than 2 m are found in the same zone.

Hydrology

Intense karstic development, not only in Zapata Swamp itself but also in the upper third of the basin (the southern karstic plain of Colón), has created the largest limestone drainage system in the country. This Southern Matanzas Basin, or Zapata Basin, occupies nearly the entire southern portion of Matanzas Province and the southwestern extreme of Cienfuegos Province (ICGC 1993). The drainage system forms a complex of aquifers at different depths. Its discharge, in large part, creates Zapata Swamp.

The superficial hydrology of the basin is very dissected because of the karst geology, flooding processes, and human activities of channelization, regulation of water levels, and drainage. Carried in rivers, lagoons,

swamps, trenches, and artificial channels of medium to low volume, most surface water is discharged into the Bay of Pigs and La Broa Inlet through two main drainages. The more important of the two routes follows the Hatiguanico, Negro, Gonzalo, and Guareiras Rivers, which drain directly into the sea through La Broa Inlet. Numerous springs in the upper third of the basin give rise to these rivers.

The extent of subterranean drainage in the basin has not been evaluated yet, but its considerable contribution appears as numerous submarine springs clearly visible in satellite images (ICGC 1993). Zapata Swamp is a buffer rather than a barrier to marine intrusions. Maximum water depth in the salt marshes is 2 m; in the coastal zone, 600 m; and in the Bay of Pigs, 1,000 m.

Climate

Like the rest of Cuba, the Zapata Peninsula has two clearly differentiated seasons: a warm, wet season from May to October and a dry, cooler season from November to April. Rainfall varies from 1,200 to 1,300 mm during the wet season (80-85% of the annual total) and from 250 to 300 mm during the dry. The annual average is 1,500 mm. Most rain falls in the afternoon. The northeastern part of Zapata Swamp is one of the wettest places in Cuba—1,700 mm of annual precipitation is the maximum. Electrical storms are frequent and intense during the wet season. The prevailing winds come from the east.

The mean annual temperature on the peninsula is 24.5°C, with an average minimum of 18°C and an average maximum of 38°C. Winters in the region are among the coolest in Cuba. Temperature range is more extreme in the interior of the peninsula, which also is wetter than the coast. Shallow waters are very warm throughout the year, the mean temperature ranging from 24 to 30°C.

Relative humidity is particularly high in Zapata Swamp, with average values ranging from 76% (March-April) to 83% (September-November). Annual averages in the region are exceeded in Cuba only by values in

some mountainous areas. In spite of this high average humidity, dry continental air masses, high temperatures, solar exposure, and wind patterns combine during drought periods to create favorable conditions for wildfires. Whether of human origin or from lightning strikes, these fires cause considerable ecological and economic damage on the peninsula.

The most dangerous and dramatic atmospheric phenomena on the Zapata Peninsula, as throughout Cuba, are tropical storms and hurricanes. Hurricane season lasts from June to November, but the most active months are September, October, and November. Sustained wind speeds exceeding 210 km/h have been recorded for some hurricanes that have hit Zapata. Flooding is common in May and June or September and November, not only from hurricanes but also from large rainfalls that occur within a 24-h period.

SITES VISITED

Here we describe sites surveyed during the rapid inventory conducted in September 2002. We selected these sites to sample a broad range of habitats from accessible entry points. In the sections on individual taxonomic groups, below, we characterize sites surveyed by team scientists working on inventories or research at other times.

Bermeja (22°9'33" N, 80°57'52" W)

At this site, 12 km north of Playa Girón, are swamp forests that are periodically or permanently inundated, with soils rich in organic matter. The forests have a canopy layer 8-15 m tall, with emergents to 20 m, and show deciduous and epiphytic elements. The area has been disturbed by logging and by domestic livestock, especially cattle. We reached the area from the south and walked old trails and dirt roads. Surveys took place on 9, 10, and 14 September 2002.

Peralta (between 22°35'27" N, 81°18'21" W, and 22°33'57" N, 81°19'15" W)

This site is situated along the highway between La Habana and Santa Clara at Km 122, approximately 20 km from the entrance road to Zapata. The trail

at Peralta is 2.5 km long. Peralta's swamp forests are similar to those at Bermeja. The southern section of this site also contains marsh grasslands (Fig. 2D). We surveyed this site on 10 September 2002.

Pálpite (between 22°19'45" N, 81°11'5" W, and 22°19'28" N, 81°12'38" W)

This site lies approximately 5 km south of Guamá on the road to Playa Girón. The swamp forests to the southwest of the village are similar to those in other parts of the peninsula. We surveyed the area informally each day throughout the inventory, as our base was at Pálpite. On the afternoon of 9 September 2002 we surveyed a trail running west from the village.

Hatiguanico River (between 22°35'49" N, 81°26'16" W, and 22°35'49" N, 81°38'54" W)

More than 30 km long, the Hatiguanico is the largest river draining the Zapata Peninsula. It reaches the heart of Zapata Swamp. Our Hatiguanico site (Fig. 2C,F) lies 8 km south of the highway between La Habana and Santa Clara at Km 101. It includes the guard post at Hato de Jicarita. The Hatiguanico River empties into La Broa Inlet and is navigable for small boats along most of its course. Its banks are low and mostly covered with mangroves that have a canopy 5-15 m high, with herbaceous plants and vines present. Elsewhere along the river are marsh grasslands that are periodically or permanently flooded, with an accumulation of peat. The dominant plants in this marshland include the sedge *Cladium jamaicense* (sawgrass, *cortadera de ciénaga*), *Typha angustifolia* (cattails, *macío*), rushes, and *Sagittaria lancifolia*. We surveyed this site by small boat on 11 and 12 September 2002.

Punta Perdíz (between 22°7'3" N, 81°6'58" W, and 22°8'7" N, 81°5'38" W)

This site is situated within the Cave-Lake System of Zapata (Sistema Espeleolacustre de Zapata). It is characterized by semideciduous forest with a canopy at 15-20 m growing on well-drained, bare karst. It contains elements from dry evergreen forests and coastal

forests, including *Metopium toxiferum* (poisonwood, *gual de costa*), *Swietenia mahagoni* (mahogany, *caoba*) and *Bursera simaruba* (gumbo-limbo, *almácigo*). We surveyed a trail leading inland from the highway to Playa Girón on the morning of 13 September 2002.

Caleta Sábalo (22°13'31" N, 81°8'34" W)

Two vegetation types stand out at this site, 4-6 km northeast of Los Hondones: swamp forests dominated by *Bucida* spp., and semideciduous forests. Palms are a notable element here. The mollusk team surveyed this site on 10 September. The beetle team surveyed this site before the rapid inventory.

FLORA AND VEGETATION

Participants/Authors: Robin Foster, Tania Chateloín

Conservation targets: Marsh ecosystem with dynamic mosaic of habitats; semideciduous forests; swamp forests; palm savannas; local endemics (five species); timber trees (*Swietenia*, *Cedrela*, etc.)

INTRODUCTION

The vegetation of Zapata Swamp bears a striking resemblance to that of the Florida Everglades, USA, even though many or most of the dominant plant species are different. Both regions have limestone foundations, as well as high frequencies of hurricanes and fire. Ecological equivalents are evident in the two ecosystems. For example, the common tree of inundated forest in the Everglades, bald cypress (*Taxodium*), is similar in growth form to the *júcaros* (*Bucida palustris* and *Bucida buceras*) in Zapata Swamp. As in the Everglades, deductions about plant communities can be confusing as a result of human intervention. Not only have drainages shifted from their original locations, but also most of the access in the area follows either elevated roads and causeways or canals with levees. Each has its own narrow band of invasive vegetation penetrating the native habitats.

METHODS

Because our time for the rapid inventory was so limited, we used informal survey methods to cover as much ground and to visit as many habitats as possible. We complemented descriptions of vegetation types and lists of species with photographs of species taken during our surveys. A subset of these photographs appears in Rapid Color Guides (<http://fm2.fieldmuseum.org/plantguides/guideimages.asp?ID=176> and <http://fm2.fieldmuseum.org/plantguides/guideimages.asp?ID=177>). Analysis of satellite images allowed us to describe the distribution of and temporal changes in vegetation types. Also, we incorporated information from previous studies by biologists and naturalists from the National Center for Protected Areas (Centro Nacional de Áreas Protegidas [CNAP]), CITMA, the Institute of Ecology and Systematics (Instituto de Ecología y Sistemática [IES]), and the National Museum of Natural History of Cuba (Museo Nacional de Historia Natural de Cuba).

ECOLOGICAL CONTEXT

Floristic richness and endemism

Scientists and naturalists who have explored the Zapata wetland complex have recorded approximately 1,000 species of vascular plants in 110 families. Within this flora, endemism is relatively low. As many as 130 species found in Zapata may be endemic to Cuba. Most of these endemics are found in the drier forests, not in the swampland. Endemic to the Zapata Peninsula itself are 5 species of plants: 2 species of palms (*Copernicia brittonorum*, *Coccothrinax cupularis*) with known localities, and 3 additional species (*Acacia zapatensis*, *Behaimia roigii*, *Calypttranthes peninsularis*), which have not been collected for more than 80 years.

Vegetation

The Zapata Peninsula is remarkable in having extensive areas of natural vegetation in good condition, as well as a degree of forest cover considered outstanding at the level of the Caribbean as a whole. Seventeen vegetation formations occur on the peninsula (see Appendix 1).

RESULTS OF THE RAPID INVENTORY

Floristic richness and endemism

During the survey we registered 305 species (Appendix 1) of an estimated 1,000 in the region. Of the species recorded, at least 3 had not been observed previously by T. Chateloín in her many years as a botanist in the region. Compared with other parts of Cuba, the Zapata Peninsula has few local endemics. Species richness is moderately high, mainly because of high habitat diversity. Zapata's forests are the vegetation types richest in species, but in general their species counts are lower than those of similar forests in other parts of the country. Although Zapata's wetlands are far less speciose than its forests, they are richer in species than wetlands elsewhere in Cuba and the Caribbean.

Vegetation

Of the species we observed, 99 were herbaceous (32%), 85 shrubs (28%), 58 trees (19%), 47 vines (15%), and 16 epiphytes (5%). The main vegetation types that we observed during the survey were mangrove forest (10 species), marsh grassland (31 species), swamp forest (90 species), semideciduous forest (101 species) and open, disturbed land (99 species). We briefly examined, but did not thoroughly survey, a shrub formation on limestone (*costa caliza*, Fig. 2B) (29 species) at the edge of the Bay of Pigs.

Mangrove forest (Manglar)

The mangrove forests in Zapata Swamp are like mangroves everywhere: very low in plant diversity but extremely important for the marine life they support, especially as breeding grounds. Red mangrove (*Rhizophora mangle*, Fig. 3B) is the species most tolerant of salt water and most capable of establishing itself in the deepest water closest to the ocean. But this species also grows well in freshwater and comes farther than other species up freshwater streams, where it is mixed with button mangrove (*Conocarpus erectus*), a predominantly freshwater species. Along the same stream edges, *Rhizophora* occurs with many other species of the swamp forest, such as the trees *Calophyllum antillanum* (Fig. 3C)

and *Tabebuia leptoneura*. Although *Bucida* is a dominant plant in swamp forest, it does not occur with *Rhizophora* here as do these other tree species. Where these streams meet the estuary, *Rhizophora* is mixed with white mangrove (*Laguncularia racemosa*). Here the influence of salt water is strong enough to eliminate all but a very few of the swamp forest species (e.g., the vines *Dalbergia ecastaphyllum* and *Rhabdadenia biflora*, and the two mangrove ferns *Acrostichum aureum* and *A. danaeifolium*). The bark of these mangrove species seems to be too smooth to support establishment of many epiphyte species.

Marsh grassland (Herbazal de ciénaga)

At the sites we surveyed, marsh grasslands (Fig. 2D) range from open, shallow water with aquatic plants that are either floating (e.g., *Nymphaea ampla* [Fig. 3A], *Nymphoides grayana*) or emergent (e.g., *Thalia geniculata*, *Oxypolis filiformis*), to dense fields of sawgrass (*Cladium jamaicense*, Fig. 2H) often mixed with tall grasses (e.g., *Saccharum giganteum*) and the cattail, *Typha domingensis*. These areas often are dotted with clumps of the short palm *Acoelorrhapha wrightii* and scattered individuals of the tall palm *Sabal maritima*, both of which are fire tolerant.

Our initial impression was that areas with more extensive open water had deeper water as well. But comparison of satellite images suggests that these areas are merely at an earlier stage of vegetation development following a major fire in the sedge fields. Apparently, some large sedge fields have become open-water marshes in just two months (January to March 2001), and some large open-water marshes have become dense sedge fields in two years (1999 to 2001). If fire were suppressed in Zapata Swamp, the marsh grasslands—as is the case in the Everglades of the United States and in the pampas of Venezuela and Bolivia—would disappear and would be taken over by woody vegetation, first as shrubland, then as low forest. Although fire maintains the integrity of Zapata's marsh grasslands, it is a destructive force in other vegetation types (see Threats and Recommendations, below).

Swamp forest (Bosque de ciénaga)

The fire resistance of this inundated forest is probably attributable to its being in a depression that holds water and maintains high soil and plant moisture in the dry season. In some parts of the Tropics, islands of forest remain in fire-dominated savannas in part because a ring of fire-tolerant woody species along the island's margins slows the fire and prevents it from penetrating farther.

The swamp forest (Fig. 2C) is relatively species-rich but usually dominated by two species of *Bucida* (*palustris* and *buceras*), *Tabebuia leptoneura*, *Calophyllum antillanum*, and the palm *Roystonea regia* in the canopy. In the understory, the small trees/shrubs of *Chrysobalanus icaco*, *Annona glabra*, *Coccoloba diversifolia*, *Ouratea nitida*, and *Cephalanthus occidentalis* predominate, with a high frequency of *Blechnum serrulatum* ferns close to the ground. Around the springs we visited, *Amphitecna* trees are abundant in the understory.

Semideciduous forest (Bosque semideciduo)

Much of Cuba originally was covered with semideciduous forest (Fig. 2E). At least in the areas with limestone substrata, many of the same species, such as the trees *Bursera simaruba* (Fig. 3E) and *Guazuma tomentosa*, predominate throughout these forests. Prior to European colonization, the most valuable economic species, such as *Swietenia mahagoni* (Fig. 3F) and *Cedrela odorata*, may have been much more abundant. In Zapata, by far the dominant species of tree is *Lysiloma latisiliquum* (Fig. 3C), but species richness of small trees is high throughout.

Species of ecological, economic, or cultural significance

Several species of trees stand out as ecologically or economically important in the forests of the region. The sabal palm *Sabal maritima* (Fig. 2G) provides nest sites for bird species including two threatened parrots, Cuban Parrot (*Amazona leucocephala*) and Cuban Parakeet (*Aratinga euops*), and the threatened endemic Fernandina's Flicker (*Colaptes fernandinae*). Populations of *S. maritima* are clumped, with an uneven age distribution. *Lysiloma latisiliquum* is the dominant tree

species in semideciduous forest. It spreads clonally and resprouts readily following disturbances, such as hurricanes, and thereafter dominates by shading out other species. Like other species of its genus, *Swietenia mahagoni* (Fig. 3F) is greatly prized for its wood. The wood of this species may be the finest among the mahoganies (Mathew 1994). It originally was a common element of woodlands and forests of the Greater Antilles. Its abundance has declined throughout this range, and it is considered endangered (WCMC 1998).

Local human populations use approximately 125 plant species for their medicinal properties.

THREATS AND RECOMMENDATIONS

Threats

Among the serious threats to the vegetation and flora of Zapata Swamp is the invasion of several plant species: *Melaleuca* (an Australian tree that is invading swamp forest and marsh grassland), *Dichrostachys* (a shrub native to Africa that was in all upland forests and disturbed areas visited, Fig. 6A), *Casuarina* (an Australian tree that invades disturbed upland areas), *Delonix* (an ornamental from Madagascar, found in disturbed swamp forest), and *Myriophyllum* (the cosmopolitan water milfoil, which displaces native aquatic pondweeds). *Delonix* probably poses the least significant threat to the region's vegetation. *Melaleuca* has caused severe problems as an invasive in the Florida Everglades and is the target of vigorous control efforts there.

Wildfires are a vital ecological process in seasonally dry swamps—without fire, marsh grasslands become shrublands. But fires that are too frequent or too severe can be destructive rather than restorative. Invasive plants may follow fire into the ecosystem, as in the Florida Everglades. After hurricanes, forest fires often are much more severe than those that normally maintain the diversity and condition of plant communities. Climate change, especially warming, and deliberate burning by humans can aggravate these threats.

Evidence of hurricanes was strong in the vegetation of the Zapata Peninsula (Fig. 6B). For example,

we observed trees that had been blown down north to south by Hurricane Georges in September 1998. Like fires, hurricanes are a force to which many Zapata plants are adapted—for example, many species regenerate by resprouting from stem bases. But large areas may be required as refuges for species that do not resprout. Also, as noted above, hurricane damage may prepare the way for invasive plants and may produce large accumulations of deadwood that fuel the severity of fires. Forest fragmentation severely exacerbates the destruction caused by hurricanes.

Although human density in the Zapata Peninsula is low, pressure on plant communities is significant. Human activities with the most severe impacts for the vegetation and flora are the selective removal of trees, which renders the forest more vulnerable to hurricane and fire damage, and the wholesale clearing of land to raise livestock, especially cattle.

Local people use trees (Figs. 6C, D) for three main purposes: (1) lumber (e.g., *Swietenia mahagoni* and *Calophyllum antillanum* for building materials); (2) charcoal (e.g., *Lysiloma latisiliquum* and *Tabebuia leptoneura*); and (3) curing tobacco (e.g., *Lysiloma latisiliquum* and *Rhizophora mangle*). To some extent, the resprouting of many species after hurricanes is a preadaptation for managed forestry (coppiced forests). Taking advantage of this characteristic, local people might be able to extract wood without harming the biodiversity of wild forest communities.

In contrast, raising livestock in the Zapata region typically involves repeated cutting and burning of forests to eliminate resprouting. As a result, vegetation cover is reduced to palms and inedible shrubs and herbs. Cattle ranching is the strongest of all threats to plant communities in Zapata forests.

Recommendations

- Limit additional clearing of forest for livestock pastures, and restrict access of livestock to forest from existing pastures.
- Control the spread of *Melaleuca*. Build on the efforts of land managers in Florida to eradicate this species.
- Study forest recovery after hurricanes. The effects of hurricanes on forest structure have been examined in other parts of the Caribbean Basin. The effects in Zapata should be compared to those in other areas, including Puerto Rico (e.g., China 1999; Weaver 2002), Nicaragua (Vandermeer 1997), and elsewhere. Studies in the Florida Everglades following Hurricane Andrew (Horvitz and Koop 2001; Horvitz et al. 1998; Pascarella and Horvitz 1998) may be most relevant because of the ecological similarities of the Everglades and Zapata. Use the results to protect refuges for the hardest-hit plant species.
- Initiate regular surveillance of all vegetation types to guard against the establishment of invasive plant species. Develop plans for control or eradication of any invasives detected.
- Experiment with the management of fire frequency in marsh, swamp, and forest habitats. Use the results to establish prescribed fire cycles that sustain biodiversity.
- Investigate the potential for managed logging.
- Track changes in the extent and condition of mangrove forests, using both satellite images and field observations. Use the data to detect potentially harmful changes in marshland hydrology (flow characteristics, sediment deposition, salinity), to which mangroves are very sensitive.
- Study the dynamics of marsh grasslands, especially in relation to fire. Obtain baseline data through satellite images and sampling of the biota, and compare before and after fires. Use the data to manage fire frequency by maintaining the proper balance of vegetation structure.
- Compare relative water depths in swamp forest and marsh grasslands to determine whether deeper water reduces the severity of fires in the forest. Use this information to evaluate whether channels within the peninsula, or water use upstream, is interfering with the water levels crucial for biodiversity maintenance.
- Use the results of all of the above research to develop a regional management plan.

INSECTS

GROUND BEETLES

Participant/Author: Pavel Valdés

Conservation targets: A new species of the genus *Ardistomis*; four endemic species: *Clivina cubae*, *Ardistomis elongatulus*, *Coptia effeminata*, and *Chlaenius cubanus*

INTRODUCTION

The ground beetles of the family Carabidae (Coleoptera) are predators and live mostly in the soil. They are associated with many habitats from the coastline to the highest elevations in Cuba. These insects constitute excellent assessment indicators of the condition of natural ecosystems and are particularly sensitive to the damage caused by human activity.

Zapata Swamp protects appropriate habitat for populations of several species of ground beetles that are not frequently encountered in the rest of Cuba.

This wetland constitutes a genuine refuge for the majority of species of carabid beetles that live in the lowlands. Here are found the oldest and the most generalist members of most lineages that colonized Cuba. This pattern of colonization is reflected in the low endemism and high species richness in Zapata.

METHODS

This report summarizes the carabid beetles found on sporadic visits to Zapata Swamp from 1997 through the rapid inventory of September 2002. Because we visited only localities in the eastern part of the Swamp, just a small portion of the region has been surveyed.

The main methods used during the inventory were the direct collection of beetles in the field and the nocturnal attraction of beetles through the use of lights installed in human-altered locations.

We surveyed the following sites for carabid beetles:

- *Playa Larga*: Coastal segment of the Bay of Pigs that includes Buena Ventura and Playa Larga up to Girón, where we collected many species that inhabit saline

areas, and other species that are attracted by the lights of the numerous tourist installations of this area.

- *Canal Soplillar*: Areas far from the origin of the artificial channel of Soplillar, consisting of a gravel bed with many herbaceous species. This region is flooded very frequently.
- *Los Sábalos*: A wooded area 4-6 km northeast of Los Hondones. This site was not visited during the rapid inventory. Along the edges of numerous bodies of water, many species live in the humid peat.
- *Pálpite*: See description in Overview of Inventory Sites, above.
- *Canal de los Patos*: The beetles live in the peat that forms the flood-prone soils.

ECOLOGICAL CONTEXT

Zapata Swamp has been poorly studied in terms of its carabid fauna. None of the previous researchers with large collections of Carabidae (for example, P. J. Darlington Jr.) worked in this area. J. C. Gundlach collected some representatives of the family and indicated that they came from Zapata, but he did not provide specific localities or publish a list of species for the area. The inventory of carabid beetles listed in this report thus constitutes the first published for Zapata Swamp but should be considered preliminary.

RESULTS OF THE RAPID INVENTORY

I recorded 54 species, 4 of them endemic to Cuba (see Appendix 2). Among them, I discovered a new species in the genus *Ardistomis* during this survey. Some taxa could not be identified to the level of species, because a detailed review of the material deposited in scientific collections is required for identification. In the future, I expect that many more species will be found as more sites are covered, especially in the western part of the region.

THREATS AND RECOMMENDATIONS

Threats

Like the vertebrate groups mentioned earlier, ground beetles are threatened by habitat loss and deterioration caused by wood extraction and forest clearing, intense fires, and damage to the wetlands. Specific dangers to these insects include the following: (1) desiccation and salinization of soils as a result of peat exploitation and agricultural activity, (2) use of insecticides against bloodsucking insects, and (3) overuse of beaches for tourism (with strong impacts on littoral species).

Recommendations

- Manage the local extraction of wood for subsistence use.
- Implement effective reforestation plans.
- Improve working conditions for conservation staff.
- Regulate the development and impact of tourist installations.
- Describe the new species of *Ardistomis*.
- Review specimens for which specific status must be confirmed through detailed comparisons.
- Continue to document the natural history of ground beetle species.
- Evaluate present and future anthropogenic influences on the carabid fauna.
- Undertake new inventories in the rest of the peninsula during the rainy season.

OTHER INSECTS

Participant/Author: Jorge Luis Fontenla

Conservation targets: No specific targets yet identified

INTRODUCTION

During the September 2002 rapid inventory, the field team surveyed two other insect groups: ants and dragonflies. We were able to collect less information

about these two groups than about other organisms, but we record both the ecological context and the inventory results here.

Ants

In general, the ant fauna of the Zapata Peninsula is poor in comparison to that of other parts of Cuba. The species that predominate are either introduced, or adaptable and opportunistic. Examples of these include the fire ant (*Solenopsis geminata*) and the Santa Anilla (*Wasmannia auropunctata*). The low species richness of ants in the Zapata region may be attributable to the periodic inundation of forests—the majority of Cuban ants are terrestrial, as opposed to arboreal.

The rapid inventory of the ants in the Zapata region recorded 17 species of an estimated regional fauna of 30 (Appendix 3). We found 1 species endemic to Cuba: *Pseudomyrmex pazozi*, an arboreal ant. Our record of the leafcutting ant *Acromyrmex octospinosus* is noteworthy because the species was previously known only from the northwestern and north-central parts of Cuba.

Dragonflies

Cuba is home to 81 species of dragonflies; none of these is endemic. As the largest wetland in the Antilles, Zapata is an area of great importance for the conservation of dragonflies. Fifty species probably occur in the region.

During the rapid inventory we recorded 18 species of dragonflies (Appendix 4). The low species count was largely the result of the short period of the survey combined with its emphasis on areas of terrestrial vegetation. The most abundant species varied among the sites surveyed: at Bermeja it was *Erythrodiplax umbrata*; at the Hatiguanico River site it was *Tramea insularis*. Nevertheless, both species were very common at all the sites visited.

Future surveys should include the dry months, because some dragonfly species migrate during the winter months. Canals with abundant aquatic vegetation should be surveyed with greater intensity.

MOLLUSKS

Participant/Author: Alina Lomba

Conservation targets: Two Cuban endemics: *Eurycampta supertexta* and *Cerion magister*; the Zapata endemic *Laevapex pfeifferi*; *Liguus fasciatus alcaldei* (IUCN category Vulnerable); *Drepanotrema anatinum* (rare)

INTRODUCTION

The terrestrial malacological fauna of Cuba is almost entirely endemic—totally different from those of the neighboring Antillean islands (for example, Hispaniola and Jamaica). Among its main characteristics are the high diversity of taxonomic forms, the abundance of many populations, the marked endemism, and the limited range of many species and subspecies (Espinosa and Ortea 1999). In Cuba, scientists have registered nearly 1,300 species of land snails, of which 96% are endemic.

METHODS

Between 8 and 15 September 2002 we visited the following sites in the Zapata Swamp region: Bermeja, Peralta, Pálpite, Hato de Jicarita (Hatiguanico River), Caleta Sábalo, and Punta Perdíz. We recorded species both by direct observation and by collecting specimens.

ECOLOGICAL CONTEXT

The malacofauna of Cuban rivers consists of very few species, and most of them have dull coloration. This group of species is of biomedical interest because they are potential intermediate hosts of dangerous nematodes and platyhelminths that parasitize both humans and economically important nonhuman animals.

Five species of land snails and 14 freshwater mollusk species had been reported for the Zapata region prior to the rapid inventory, from collections and from the literature (Espinosa and Ortea 1999; Alayo and Espinosa in press).

RESULTS OF THE RAPID INVENTORY

During the rapid inventory we found five species of land snails. One of them, *Cysticopsis exauberi*, is a new record for the area.

We collected seven species of freshwater mollusks (Appendix 5). The most abundant in the region is *Pomacea palludosa*. The presence of *Helisoma foveale* and *Drepanotrema anatinum* constitute new records for the area. *Drepanotrema anatinum* was also an important find because, although this species is widely distributed throughout Cuba, it is considered rare. Because the majority of the sites visited are flooded for most of the year, the freshwater malacofauna is particularly abundant.

We made the following observations at individual sites:

- **Bermeja** (semideciduous forest and marsh grassland): No species was notably abundant at Bermeja, which was flooded during the rapid inventory. Here we recorded *Eurycampta supertexta*, *Zachrysia auricoma auricoma*, and *Cysticopsis exauberi*.
- **Peralta** (marsh shrubland): We found both *Helisoma caribeum* and *Pomacea palludosa*. The latter species not only is very abundant here but also reaches incredible sizes. We also recorded *Helisoma foveale* and *Drepanotrema anatinum*, both new records for Zapata.
- **Pálpite** (semideciduous forest): We found *Zachrysia auricoma auricoma* and *Eurycampta supertexta*, both typical inhabitants of this vegetation type. Close to this area, we found shells of *Liguus fasciatus alcaldei*. This subspecies had been reported for the region, but scientists had thought that the logging of semideciduous forests (its preferred habitat) and severe hurricane damage had eliminated its populations.
- **Hato de Jicarita** (marsh grassland): We found *Pomacea palludosa* (especially abundant), *Helisoma foveale*, *Drepanotrema anatinum*, *Laevapex pfeifferi*, and *Eupera cubensis*.

- *Caleta Sábalo* (semideciduous forest): We found specimens of *Eurycampta supertexta* and *Zachrysia auricoma auricoma*. According to a personal communication from one of the specialists for this region, live individuals of *Liguus fasciatus alcaldei* have been found in the forests of Caleta Sábalo. We did not encounter this species in our survey of this site. However, we are optimistic that in future inventories, live specimens of *L. f. alcaldei* could be found.
- *Punta Perdíz* (coastal thickets [*manigua*] along the shore, as well as the littoral zone): We found *Cerion* sp. (terrestrial), *Nerita peloronta*, *N. versicolor*, *Fissurella barbadensis*, *Cenchritis muricatus*, and *Acanthopleura granulata*. The species seen, in particular *Acanthopleura granulata*, indicate that the condition of the ecosystem in this area is good. Particularly abundant were *Fissurella barbadensis*, *Nerita versicolor*, and *N. peloronta*.

THREATS AND RECOMMENDATIONS

Threats

Threats to terrestrial mollusks include the forest clearing, logging, and fragmentation that have been so devastating for the rest of Zapata's fauna. Fires that are not part of the regenerative cycle of forest habitats also take their toll. Hurricanes can aggravate the effects of these threats. For *Liguus*, shell collecting may cause damage to local populations.

Contamination of marshes, swamps, and rivers may be a threat for Zapata's freshwater mollusks. Elimination or degradation of wetlands through drainage for agriculture may limit the habitat available for these species.

Recommendations

- Eliminate or mitigate the large-scale threats (clearing, logging, fragmentation, and excessive burning) of the forests that support Zapata's land snails.
- Evaluate, and if necessary reduce, the impact of waterborne pollution and wetland drainage on freshwater mollusks.

- Investigate the effects of local shell collecting on *Liguus* populations.

AMPHIBIANS AND REPTILES

Participants/Authors: Luis M. Diaz and Eduardo Abreu Guerra

Conservation targets: Threatened species: *Crocodylus rhombifer*, *Trachemys decussata*, *Epicrates angulifer*; endemic taxa: *Sphaerodactylus richardi*, *Arrhyton procerum*, two subspecies of *Anolis luteogularis* (*A. l. calceus* and *A. l. jaumei*)

INTRODUCTION

Endemism in Cuba's herpetofauna is high. Of 58 described species of amphibians, approximately 95% are found only in Cuba. Of 137 described species of reptiles, 81% are endemic. At least 2 additional species of amphibians and several species of reptiles are now being described. We estimate the herpetofaunal richness of the Zapata Peninsula at 16+ species of amphibians and 43 of reptiles.

METHODS

We based the rapid inventory of September 2002 on information from visits to Zapata Swamp that began in 1994.

To inventory amphibians, we listened for frogs' calls at night, taped their voices, and collected specimens for identification. We used a small net to detect the presence of tadpoles in bodies of water.

For reptiles, we used a rake to search the leaf litter and looked under stones and fallen logs for hidden snakes and lizards. We searched other vegetation layers as well, making observations in wooded and sunny areas, in addition to building interiors. With these methods we found most of the anoles, geckos, teiids, and other lizards recorded, as well as snakes and rare species with fossorial habits. To make visual observations of turtles and crocodiles, we surveyed the Hatiguanico River in a motorboat, all the way to its outlet, channels, and tributaries.

Some of our inventory records are based on specimens found dead. At night we observed some species of amphibians and snakes on the highway and detected some sleeping geckos, snakes, and anoles by using a headlamp.

We complemented our field observations with analysis of voucher specimens in other collections. We were able to work with specimens for most of the species collected previously in Zapata Swamp localities.

ECOLOGICAL CONTEXT

Before the rapid inventory, 10 species of amphibians and 36 species of reptiles had been recorded for the Zapata Peninsula. None of the amphibian species is endemic to Zapata. Although Zapata populations of *Eleutherodactylus riparius* are differentiated from other populations of the species, they are not yet recognized as a different taxon (Estrada and Hedges 1998).

Among reptiles, a lizard (*Sphaerodactylus richardi*, Gekkonidae) and a snake (*Arrhyton procerum*, Colubridae) are local endemics. The type locality for both species is Caleta Buena (40 km east of Playa Larga). *Arrhyton* is known from just two specimens and may be very rare. Zapata Swamp is unusual in harboring 4 species of giant anoles. Two subspecies of the giant anole *Anolis luteogularis* (*A. l. calceus* and *A. l. jaumei*) are restricted to the peninsula and have narrow ranges there. *A. l. jaumei* is known only from the vicinity of Playa Larga.

RESULTS OF THE RAPID INVENTORY

During the rapid inventory we recorded 14 species of amphibians (Appendix 6)—one-quarter of Cuba's amphibian fauna, with representatives of all amphibian families known in the country. Thirteen of these species are endemic to Cuba.

Our record of *Bufo empusus* (Fig. 4C) in Zapata Swamp was the first since the late nineteenth century (Gundlach 1880). We heard several choruses of this toad during rainy nights at the Bermeja site and in all the grassy areas south of the highway near Peralta. We heard and collected *Bufo gundlachi*,

Eleutherodactylus atkinsi (Fig. 4G), and *E. eileenae*, previously unknown in the Zapata region. *Bufo gundlachi* and *B. empusus* are explosive breeders and are seldom encountered outside their giant choruses during rainy nights. This behavior may account for the long absence of Zapata records. *Eleutherodactylus auriculatus* (Fig. 4D), *E. varians*, *E. eileenae*, *E. planirostris*, and *E. riparius* are abundant but much easier to hear than to see. *Bufo peltacephalus* and *Osteopilus septentrionalis* are two other very common anurans.

We found frogs with a color pattern like that described for *Bufo fustiger* (Fig. 4F), as well as others with the characteristics of *Bufo peltacephalus*. Schwartz (1960) initially described *Bufo fustiger* as a geographic race of *B. peltacephalus*. Schwartz and Henderson (1991) recognized it as a distinct species. In a preliminary acoustic analysis of the recordings that we made in Los Hondones, where the color pattern is of the *fustiger* type, and Bermeja, where color is of the *peltacephalus* type, we did not detect significant vocal differences between these populations. Also, we found individuals with both color patterns in the Bermeja population. Typically, *Bufo fustiger* has dark brown vermiculations over a light background; *Bufo peltacephalus* displays small, elongated spots over a dark background. We recommend more extensive taxonomic studies of these populations to clarify their status and relationships to other populations. Currently we consider *Bufo peltacephalus* the large toad species present in Zapata Swamp.

During the rapid inventory we registered 41 species of reptiles (Appendix 6), constituting more than 30% of Cuba's species. Fifteen (36%) of the species recorded are endemic to Cuba.

With respect to taxa endemic to Zapata, our observations extended the known distribution of *Sphaerodactylus richardi* to Playa La Máquina, approximately 40 km west of the type locality. Also, judging from material collected on the rapid inventory, we confirmed that *Anolis luteogularis calceus*, restricted to the peninsula, should be considered a geographic race of *A. equestris* rather than of *A. luteogularis*. A future taxonomic revision would be useful in clarifying its status.

We obtained the first records for the Zapata region of the reptiles *Anolis equestris juraguensis*, *A. lucius*, *A. pumilus* (referred to by Estrada [unpubl. ms.] as *Anolis centralis*), *Arrhyton taeniatum*, and *Typhlops biminensis*.

We found several species of lizards easy to detect: *Anolis allisoni*, *A. homolechis*, *A. sagrei*, *Leiocephalus carinatus*, *L. stictigaster*, and *Ameiva auberi*. Several geckos (*Hemidactylus haitianus*, *Sphaerodactylus argus*, and *S. elegans*) were common inside houses. The turtle *Trachemys decussata* (Fig. 4H) was abundant and we frequently saw individuals basking in rivers and channels.

By searching carefully in its microhabitats, we discovered that the endemic *Sphaerodactylus richardi* is abundant among the rocks along the coastline and in semideciduous forest on limestone. During the day *Tropidophis melanurus* (Fig. 4K) takes refuge under palm fronds, logs, and stones, but at night it is easy to spot as it forages on the ground, even close to houses. Some cryptic species, such as *Anolis alutaceus*, *A. angusticeps*, *A. loysianus*, *A. pumilus*, *A. luteogularis*, and *A. ophiolepis*, may not be scarce, even though they are seldom encountered.

Further sampling in the Zapata region should add additional species. One area worthy of exploration would be the limestone formations near Cienfuegos Province, where we would expect to find *Tarentola americana* (Gekkonidae). Among the ground-dwelling *Eleutherodactylus* species, *E. dimidiatus* probably lives in the leaf litter of forests that never flood.

THREATS AND RECOMMENDATIONS

Threats

Like other animal groups in Zapata Swamp, amphibians and reptiles are vulnerable to habitat conversion and degradation from logging, charcoal production, and agriculture, including livestock ranching. Human-set fires also may pose a significant threat to these vertebrates, which are for the most part less mobile than birds or mammals. Chemical and organic contamination of the aquifer and the wetlands it feeds may have more serious

consequences for amphibians than for other terrestrial vertebrates. Both agricultural fertilizers and insecticides, used to control crop pests and mosquitoes, are potential sources of this contamination.

In addition to these widespread threats that harm most or all amphibians and reptiles, heavy pressure on three reptile species puts them at particular risk:

- *Crocodylus rhombifer*: The only remaining wild population of the Cuban crocodile is found in Zapata Swamp. In Lanier Swamp (Isla de la Juventud) and other parts of Cuba, this species has been extirpated completely, although reintroduction efforts are under way. Of the breeding grounds in Zapata Swamp, the most important is in La Boca, Laguna del Tesoro. Major threats to this species include illegal hunting for food; illegal sale of mounted specimens, and of live juveniles as pets; and hybridization with *Crocodylus acutus* on the breeding farms.
- *Trachemys decussata* (Fig. 4H): Although populations of this turtle (*jicotea*) seem to be substantial, it is overharvested for food and religious use, and to be sold as souvenirs or kept as pets.
- *Epicrates angulifer* (Fig. 4J): This boa is the largest snake in Cuba. It is threatened mainly by popular prejudices, as it is considered a serious menace to poultry. Its bad reputation has extended to other snakes (especially *Tropidophis*). In addition, the local population uses its fat for its presumed healing powers.

Recommendations

- Manage local logging for subsistence use and protect remaining forests, especially those at Bermeja, as habitat for amphibians and reptiles.
- Track and, if necessary, control the influx of nutrients through waterways from the highway to Playa Larga.
- Investigate the feasibility of controlling the frequency and intensity of fires.
- Evaluate and, if necessary, reduce the chemical and organic contamination of the aquifer and the wetlands it feeds.

- Reduce, control, or eliminate the harvest of threatened species.
- Increase the number of long-term studies of the natural history of individual species (nutrition, reproduction, structural use of the habitat, climatic requirements, vocalizations, general behavior).
- Continue biological inventories across different seasons and in the largest possible diversity of habitats. Vegetation types on the limestone formations near Cienfuegos Province should be the targets of one such inventory.
- Research the taxonomy of the populations of giant anoles, frogs, and other amphibian species.
- Track amphibian populations to detect possible declines. For example, in 1998 we heard large choruses of *Eleutherodactylus eileenae* on the Bosque Sonoro Trail near Pálpite but heard none during the rapid inventory. Does this difference indicate some unknown force affecting local amphibian populations?

BIRDS

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Conservation targets: Local endemics of Zapata Swamp (3 threatened species or subspecies); other threatened Cuban endemics (6 species, all forest birds); other threatened species (7); other endemic species (11); habitat for terrestrial migrants

INTRODUCTION

By island standards, Cuba is remarkable both for species richness and for endemism (Garrido and Kirkconnell 2000). It has more bird species (360 species: 285 regular in the Cuban archipelago, 75 accidental) and more single-island endemics (23) than any other island in the Antilles. The West Indies themselves stand out in terms of endemism. A high proportion of the land birds are endemic to the region, and many are endemic to single islands. These small ranges put many species at risk.

The Zapata Peninsula is not only the richest site for bird species in Cuba (258 species, i.e., 70% of the Cuban avifauna), but also the richest in the Caribbean for endemic species. Of Cuba's 23 endemics, 20 occur in the Zapata region. Two of these, Zapata Rail (*Cyanolimnas cerverai*) and Zapata Wren (*Ferminia cerverai*, Fig. 5A), are found only in Zapata Swamp. In addition, Zapata is crucially important for birds that are currently considered threatened with extinction. Of the 30 threatened species in Cuba, 16 currently have populations on the Zapata Peninsula (Garrido and Kirkconnell 2000). Historically, Hook-billed Kite (*Chondrohierax uncinatus wilsonii*), Ivory-billed Woodpecker (*Campephilus principalis*), Cuban Macaw (*Ara tricolor*), and Bachman's Warbler (*Vermivora bachmanii*) were known from the area. The importance of the Zapata Peninsula to the conservation of Cuba's avifauna cannot be exaggerated.

METHODS

Between 1987 and the rapid inventory of September 2002, A. Kirkconnell (AK) spent approximately 450 days surveying birds in the Zapata area. The field team's methods and results were built on these efforts.

During the rapid inventory, we walked trails, typically in two to three groups of observers. We began our observations about 30 min before sunrise and returned from the field around noon. In the afternoon, we returned to the field for 2-3 h in the late afternoon when activity levels picked up. On a few occasions, we went out at night to search for owls and nightjars. Occasionally, we used recordings to attract some species. The recorded voice of Cuban Pygmy-Owl (*Glaucidium siju*) attracted small birds.

We sampled the avifauna of the following sites:

- Bermeja (20 h: 9 September [morning], 10 September [afternoon], 14 September [morning])
- Peralta (6 h: 10 September [morning])
- Pálpite (7 h: 9 September [afternoon]; 5 h: 8-15 September [casual observations])

- Hatiguanico River (25 h: 11-12 September)
- Punta Perdíz (8 h: 13 September [morning])

ECOLOGICAL CONTEXT

Of the 258 bird species known from the Zapata Peninsula, 126 breed in the area, 65 are regular winter residents, 35 are regular passage migrants, and the remaining 32 are vagrants (see Appendix 7). Zapata is one of the best-known areas in Cuba in terms of its avifauna. As far back as Gundlach's work in the early 1800s, its importance as a site for birds was recognized. Recently, with improved access to the region and its designation as a Biosphere Reserve, study by ornithologists has increased dramatically. Complementing AK's observations since 1987, personnel at Zapata Swamp National Park and the local CITMA office have contributed numerous sightings and studies. The avifaunal list for the Zapata region presented in Appendix 7 is based primarily on this recent work but includes records from the ornithological literature. Here we draw on work prior to the rapid inventory to note the status of species at risk, as well as some additional endemics. In Results of the Rapid Inventory we call out sightings of several of these species and give new records or extensions of previous knowledge of Zapata's birds.

ENDANGERED SPECIES ENDEMIC TO THE ZAPATA PENINSULA

Zapata Rail (*Cyanolimnas cerverai*)

This species and Zapata Wren have the narrowest distributions of all endemic bird species in Cuba, and the two appear to share precisely the same habitat. Still definitively known only from two localities (Santo Tomás and Peralta), Zapata Rail has been reliably reported only three times since 1970, no doubt because of its secretive behavior and the difficulty of surveying its habitat. Adding to the difficulty of documenting the presence of this species is the lack of definitive recordings of its vocalizations (the single sound specimen originally attributed to this species recently was identified as Spotted Rail [*Pardirallus maculatus*]). This rail

apparently occurs in extremely low densities, in permanently inundated sawgrass marshes of the Zapata region. As determined from interpretations of satellite imagery, suitable habitat may occur as far east as the Playa Larga highway and west to the tip of the Zapata Peninsula. Survival of Zapata Rail depends on complete protection of the sawgrass marshes of Zapata.

Zapata Wren (*Ferminia cerverai*, Fig. 5A)

Along with Zapata Rail, this species has the most restricted range of any Cuban endemic. Recent surveys by AK and colleagues have documented local populations west of La Turba (1 km west of the Playa Larga highway), northwest of Sabana Grande, and south of Arroyones. The species also occurs in marshes on both banks of the Hatiguanico River. To the west, it is known to occur only as far as the mouth of the Guareira River. Nevertheless, expanses of suitable habitat appear to occur well westward into the middle of the Zapata Peninsula. Zapata Wrens occupy year-round territories (except immediately after fires), although they are not distributed uniformly through the inundated marsh habitats of western Zapata. They occur only where dense sawgrass is interspersed with small islands of shrubs and trees, which the birds use as singing perches. They nest in sawgrass.

Zapata Sparrow (*Torreornis inexpectata*)

One of three subspecies of this Cuban endemic is restricted to the Zapata region, where its documented distribution is very similar to that of Zapata Wren. Elsewhere, the species is known only from Cayo Coco, Ciego de Ávila, and coastal Guantánamo Province. Zapata Sparrow occurs primarily in marshes, but its habitat requirements are slightly broader than those of the two preceding species. In addition to using pure sawgrass, sparrows (either individually or in groups of up to 5-7 birds) can be found perching or moving through brushy edges of the marsh, and even in mangroves bordering sawgrass. This subspecies is not found in forests of any kind, in agricultural areas, or in any other habitat lacking sawgrass. Its total population size is probably somewhat higher than that of Zapata Wren.

THREATENED CUBAN ENDEMIC

Gundlach's Hawk (*Accipiter gundlachi*)

Forests of the Zapata region support one of the five most important populations of this hawk in Cuba. The species occurs in extremely low densities and is persecuted by local farmers throughout Cuba because it occasionally kills their chickens. For successful breeding this species requires large areas of dense forest well away from human settlements.

Gray-fronted Quail-Dove (*Geotrygon caniceps*)

The Zapata population of this species is by far the most important in Cuba. It occurs throughout Zapata in the understory of swamp forests and in marsh borders. Its numbers appear to be stable, but long-term persistence of the species in Cuba depends on continued existence of significant tracts of swamp forest in the Zapata region.

Blue-headed Quail-Dove (*Starnoenas cyanocephala*)

The Zapata region is one of the three most important population centers for this species in Cuba (the other two being Guanahacabibes Peninsula and Sierra del Rosario). In Zapata this dove occurs principally in the narrow band of dry semideciduous forest bordering the coast from Playa Larga to 20 km west of Playa Girón. In addition, it is found regularly in swamp forest east of Playa Larga as far as Bermeja.

Cuban Parakeet (*Aratinga euops*)

The Zapata region supports the fourth most important population of this endangered parakeet (the others occurring in Sierra de Guamuha, Sierra de Najasa, and the Nipe-Sagua-Baracoa Mountains). In Zapata the parakeet's numbers have been declining since 1990, mainly because of nest robbing and destruction of palm trees by humans. This species is highly mobile, moving seasonally in response to local fruit and seed abundance. It requires intact forest with good numbers of mature sabal or royal palms.

Bee Hummingbird (*Mellisuga helenae*, Fig. 5D)

The Zapata population of this species (the world's smallest bird) is the most important remaining in the world. In Zapata this species is restricted to the band of swamp forest from Santo Tomás to the east, as far as Playa Girón and Bermeja. Outside the breeding season the species is difficult to find; it may move locally in response to flowering.

Fernandina's Flicker (*Colaptes fernandinae*)

The Zapata population of this woodpecker is the most important in Cuba. The species occurs very locally within Zapata, reaching its highest numbers in the region of Bermeja. Like the two parrots, this flicker occupies forested areas with high densities of sabal or royal palms.

OTHER THREATENED SPECIES

West Indian Whistling-Duck (*Dendrocygna arborea*)

This globally vulnerable species occurs on many Caribbean islands but is declining everywhere. Cuba supports the largest population, but its numbers are declining steadily as a result of hunting (local hunters indicate that this bird's meat has an excellent flavor). The Zapata region supports one of Cuba's most important breeding populations of this species.

Masked Duck (*Nomonyx dominicus*)

This secretive duck occurs in freshwater marshes from the southern USA patchily south to northern Argentina. It occurs on all of the Greater Antilles, in addition to scattered islands in the Lesser Antilles, but has declined throughout the West Indies (Raffaële et al 1998). It is seldom encountered anywhere in its range, including in Cuba. Although it is rare in Zapata, it is regularly recorded at some sites, especially San Tomás. The Zapata population is likely the most important for this species anywhere in the West Indies. Besides loss of habitat, nest predation by introduced mammals is a major threat.

Sharp-shinned Hawk (*Accipiter striatus*)

This species is rare in the Zapata peninsula. Zapata is home to both the resident Cuban subspecies (*A. s. fringilloides*) and, in winter, migrants from North America (*A. s. velox*). The resident subspecies is considered threatened and usually is associated with pine forests. Because pine stands are rare in Zapata, populations here are not particularly large. Zapata is probably not crucial to the long-term conservation of this species in Cuba.

Sandhill Crane (*Grus canadensis*)

Cuba hosts an endemic subspecies of this widespread crane, and the only population that breeds in Latin America. In Zapata, the third most important Cuban population occurs and numbers about 80 individuals. Their principal breeding occurs in the savannas of the San Lázaro region.

Plain Pigeon (*Patagioenas inornata*)

This species occurs throughout the Greater Antilles but is rare and extremely localized on every island. In Cuba, the principal population occurs in the Sierra de Najasa. In Zapata, the species has been reported recently only in Maniadero, west of Santo Tomás, where it occupies open country with scattered palms.

Cuban Parrot (*Amazona leucocephala*, Fig. 5E)

Forests of the Zapata region support one of the five most important populations of this parrot in Cuba (the others occurring in the Guanahacabibes Peninsula, Sierra de Guamuhaya, Sierra de Najasa, and the Nipe-Sagua-Baracoa Mountains). In Zapata Swamp the parrot populations declined substantially through the 1980s but have begun to recover since about 1996. This recovery may be a consequence of a shift in the principal nesting areas farther away from human settlement. Although both species require intact forest with mature and dead palms, the parrot occurs in a wider variety of forests than does the parakeet. The ecologies of both the parrot and the parakeet should be

studied further, but clearly both require greater protection of forests in order to persist in Zapata.

Stygian Owl (*Asio stygius*)

Stygian Owl occurs patchily through much of the Neotropics. In the West Indies, it is found in Cuba and Hispaniola. The status of this owl in Zapata is poorly known, primarily because it is nocturnal. A few individuals have been found at scattered locations through much of the peninsula. Its preference for dense pine forests suggests that populations in Zapata are probably not as high as those in some other parts of Cuba.

Other Cuban endemics

In addition to the species discussed above, 15 other bird species are endemic to Cuba. Eleven of these 15 endemics (74%) occur in the Zapata region. All of these 11 except the Cuban Grassquit have large populations in the Zapata region.

- Bare-legged Owl (*Gymnoglaux lawrencii*)
- Cuban Pygmy-Owl (*Glaucidium siju*)
- Cuban Trogon (*Priotelus temnurus*)
- Cuban Tody (*Todus multicolor*)
- Cuban Green Woodpecker (*Xiphidiopicus percussus*)
- Cuban Martin (*Progne cryptoleuca*)
(endemic as breeder)
- Cuban Vireo (*Vireo gundlachi*)
- Yellow-headed Warbler (*Teretistris fernandinae*)
- Cuban Grassquit (*Tiaris canorus*)
- Red-shouldered Blackbird (*Agelaius assimilis*)
- Cuban Blackbird (*Dives atrovioleacea*)

North American migrants

Zapata is the most important site in Cuba for endemic birds, with the largest number of species of endemics, and 2 species plus a subspecies restricted to the peninsula. It is also arguably the most important area in Cuba for migrant birds from North America. One hundred species

regularly winter in or migrate through Zapata. The forests of Zapata and coastal mudflats are the most important habitats for migrants. Migrant landbirds (Figs. 5B,C) are abundant throughout the nonbreeding season in Zapata's forests. The abundance and species richness of wintering landbirds is higher at Zapata than anywhere else in Cuba. At least 12 species of migrant landbirds have large portions of their wintering populations in Cuba and use Zapata's forests.

The mudflats along the southern coast of the Zapata peninsula are used heavily by migrant shorebirds both during migration and in winter. Species richness and abundance of individual shorebirds, though not particularly high by global standards, are probably greater here than at any other site in the Caribbean.

RESULTS OF THE RAPID INVENTORY

We observed 117 species of birds during the rapid inventory. Ninety-one of them breed in the Zapata region, 17 winter there, and 9 occur only as transients. Because of the timing of our inventory, most wintering migrants had not yet arrived or, if present, occurred only in small numbers. We observed the following numbers of species at the study sites (note that we observed 3 species—Eastern Meadowlark, Shiny Cowbird, and House Sparrow—only in transit between the major sites sampled):

Bermeja (61)
Peralta (58)
Pálpite (68)
Hatiguanico River (86)
Punta Perdíz (46)

Noteworthy sightings (or absences)

Endangered Zapata endemics

Zapata Rail: We did not encounter this species during our brief inventory.

Zapata Wren: Judging from field surveys by AK and colleagues, satellite imagery, and ground-truthing during and after the rapid inventory, we estimate the total population of Zapata Wrens at 120 to 150 pairs.

Conservation of Zapata Wren depends on protecting and managing its marsh habitat, including controlling the frequency of fires and stopping the spread of *Melaleuca* trees. During our inventory we saw or heard Zapata Wrens along the Hatiguanico River, and on both sides of the road to the guard station at Hato de Jicarita.

Zapata Sparrow: Conservation strategies for Zapata Sparrow are the same as those for the previous two species. During our inventory we saw Zapata Sparrows along the Hatiguanico River and along the road to Hato de Jicarita.

Threatened Cuban endemics

Gundlach's Hawk: During our inventory we encountered Gundlach's Hawk in Bermeja and soaring over the mangroves of the Guareira River (where they nest in the forest islands called *petenes*). We recorded them also in marsh grasslands and in the semideciduous forest near Punta Perdíz.

Gray-fronted Quail-Dove: We heard Gray-fronted Quail-Doves in moderate numbers in the swamp forests at Bermeja, Peralta, and Pálpite. We saw a few individuals, including a cooperative pair on the trail at Peralta. The species is moderately common in Zapata in the appropriate habitat.

Blue-headed Quail-Dove: We heard Blue-headed Quail-Dove at dawn at Bermeja.

Cuban Parakeet: At Pálpite we saw small flocks, ranging from 3 to 8 individuals, on three dates, in disturbed forest along the road. The forest around Pálpite appears marginal as breeding habitat for this species.

Bee Hummingbird: Hurricane Michelle (5 Nov 2001) caused substantial damage to the forest containing the highest number of Bee Hummingbirds in Zapata. The population was extremely low during the period of our inventory. We found only 4 individuals.

Fernandina's Flicker: At Bermeja, where the largest population in Zapata occurs, we observed several individuals in open palm savanna on each of our three visits.

Other new or significant records

On 12 September, AK and J. W. Fitzpatrick observed a Bay-breasted Warbler (*Dendroica castanea*) in the mangroves along the lower course of the Hatiguanico River. This is the first record for the Zapata Swamp, and the earliest fall record for Cuba by two weeks.

Two species, Common Nighthawk (*Chordeiles minor*) and Eastern Kingbird (*Tyrannus tyrannus*), known from one and two previous records at Zapata, were migrating through the area in significant numbers during our inventory. The nighthawk was observed in moderate numbers at Bermeja and Pálpite on the days between 8 and 10 September. Eastern Kingbirds were migrating overhead in significant numbers on 9 September, with more than 200 birds seen in several flocks ranging in size from 15 to 75 birds. Throughout the rest of the inventory, we observed flocks with fewer than 10 individuals daily.

Yellow-throated Vireo (*Vireo flavifrons*), typically a rare winter resident on mainland Cuba, was observed regularly at Zapata in small numbers in mixed-species flocks dominated by warblers, gnatcatchers and other species of vireos.

THREATS AND RECOMMENDATIONS

Threats

In spite of the mobility of many species, the Zapata Peninsula's birds suffer from all the large-scale threats noted earlier: (1) alteration and contamination of the water table and resulting impacts on inundated habitats especially; (2) uncontrolled logging, which alters the vegetation structure on which some endemic species depend; (3) smaller-scale use of trees—for example, cutting leaves for roofing during avian breeding season; (4) degradation of habitat by invasive plants and introduced vertebrate species; and (5) fires that are too frequent or too severe for the resilience of the ecosystem. These threats can cause different kinds of damage during nonbreeding and breeding seasons.

In addition to these sweeping menaces to most of Zapata's birds, particular species are at risk from

more specific threats. The three Zapata endemics, with their ranges narrowly restricted to the marshes, are especially vulnerable to long-term or episodic destruction or degradation of this habitat. Cutting of sabal and royal palms is particularly devastating to populations of both parrot species and Fernandina's Flicker. The parrots also suffer from direct human interference with their breeding efforts, especially when nests are robbed for chicks to be sold as pets. Humans target Gundlach's Hawk because they perceive it as a threat to poultry. Uncontrolled hunting of gamebirds, both terrestrial (e.g., White-crowned Pigeon) and aquatic (e.g., West Indian Whistling-Duck) may already be putting Zapata's populations at risk.

Recommendations

- Consolidate and extend protection for Zapata's birds and their habitats by expanding the intensity and extent of conservation action to the entire peninsula.
- Track and, if necessary, control diversions and other hydrological alterations, as well as runoff and other sources of contamination of the water table and surface water.
- Regulate the extraction of wood, in volume, structure, and seasonality.
- Control the spread of *Melaleuca* in the marsh, as it presents particular dangers for the three marsh endemics.
- Investigate the feasibility of controlling the frequency and intensity of fires.
- Reduce hunting of bird species of particular conservation concern.
- Raise awareness, in farming communities, of the ecological value of Gundlach's Hawk.
- Devise and test strategies for protecting the nest sites of parrots, parakeets, and flickers.
- Study the habitat requirements of breeding Zapata Wren and Zapata Sparrow.

- Fill particular information gaps in the ecologies of Cuban Parrot and Cuban Parakeet: food, breeding behavior, use of frontier habitats.
- Conduct inventories, in more depth, of the following: (1) Zapata Rail, (2) Zapata Wren, (3) Zapata Sparrow, (4) forested areas east of Playa Girón, and (5) the large expanse of swamp to the south and west of the Zapata Peninsula.

MAMMALS

Participant/Author: Stephen Díaz

Conservation targets: Three species of hutias: *Mesocapromys nanus*, *Capromys pilorides*, *Mysateles prehensilis*; West Indian manatee (*Trichechus manatus manatus*)

INTRODUCTION

In the Cuban archipelago, scientists have recorded 38 extant native species of terrestrial and freshwater mammals: 27 bats (with 3 endemic species); an endemic insectivore, the almiquí (*Solenodon cubanus*); 9 endemic species of hutias (Rodentia, Capromyidae); and the West Indian manatee (Sirenia: *Trichechus manatus*).

METHODS

We inventoried mammals mainly through direct observation in the field, as well as through indirect means such as searching for scat and bite damage on branches. The team also relied on the support and the experience of station personnel for information on mammals.

We visited the following sites: Peralta, Hatiguanico River, Bermeja, Pálpite, and Punta Perdíz.

ECOLOGICAL CONTEXT

Mammals are less diverse than other animal groups in the Zapata region. Including both native and introduced species, Zapata's mammal fauna includes 5 orders, 9 families, 14 genera, and 15 species.

Scientists and conservation authorities are concerned by a progressive decline of populations of the

West Indian manatee in Cuba. Estrada and Ferrer (1987) consider its current situation very precarious, mainly a result of indiscriminate exploitation, for meat and skins, that the species has faced for hundreds of years. Its geographic distribution includes, among other areas of western Cuba, part of the Zapata Peninsula, along the coastal region in the La Broa-Hatiguanico River Inlet.

Bats (Chiroptera) are the mammal group with the greatest species richness in Zapata. The taxa recorded are *Noctilio leporinus mastivus*, *Pteronotus parnelli parnelli*, *Artibeus jamaicensis parvipes*, *Phyllops falcatus*, *Brachyphylla nana*, and *Lasiurus borealis*. Six rodents are known from Zapata: *Rattus rattus*, *Mus musculus*, *Mesocapromys nanus*, *Capromys pilorides*, *Mysateles prehensilis*, and *Agouti paca*. Other mammals known from Zapata are the West Indian manatee (the subspecies *Trichechus manatus manatus*), white-tailed deer (Artiodactyla: *Odocoileus virginianus*), and the small Indian mongoose (Carnivora: *Herpestes javanicus*) (Garrido 1980). Of these species, only the bats, *Mesocapromys*, *Capromys*, *Mysateles*, and the manatee are native.

Zapata is home to 3 species of hutias. These rodents belong to the family Capromyidae, which is restricted to the West Indies. Some 26 species pertaining to 8 genera survived into historic times, but only 13 species in 6 genera still exist (Nowak 1999), and most are threatened with extinction. Human exploitation for food has been the primary cause of their demise, although loss of forest in recent times may have contributed to the endangerment of the remaining species.

Of the 3 hutias known from Zapata, *Mesocapromys nanus* (dwarf hutia, *jutía enana*) is a relict species, with a geographic distribution restricted to the Zapata region. Fossil remains of this species have been found elsewhere in the Cuban archipelago (Varona and Arredondo 1979), indicating that at one time it had a larger geographic distribution. The current status (distribution and abundance) of *Mesocapromys nanus* in the peninsula is unknown. According to the personal communications gathered by Garrido (1980), at one time this animal was common near Santo Tomás and Soplillar.

But a notable reduction in its distribution has occurred, and it has not been seen or collected since 1937.

Capromys pilorides (*jutía conga*) and *Mysateles prehensilis* (*jutía carabali*) are more common in the archipelago, and their distributions are much more extensive. Both hutias are found in forested areas and islets of vegetation (including mangroves) that are not flooded during rainy periods. Populations of *Capromys pilorides* are distributed throughout Cuba and show substantial ecological plasticity. Nonetheless, the species has declined with increasing human populations and extension of the agricultural lands in Cuba. *Capromys pilorides* is the largest species of hutia. Apparently it is the species most heavily subjected to illicit hunting, but it is also frequently kept in captivity by villagers and bred as food.

Little information about Zapata's other mammal species exists.

RESULTS OF THE RAPID INVENTORY

During the inventory we recorded only four species: the native hutia *Capromys pilorides* and three introduced species (*Rattus rattus*, *Mus musculus*, and *Herpestes javanicus*). We observed *C. pilorides* at the Pálpite and Hatiguanico River sites. Many areas visited had enough evidence of human activity to suggest pressure on local populations of this species.

THREATS AND RECOMMENDATIONS

Threats

Destruction or degradation of habitat is probably the greatest threat to the mammals of Zapata Swamp. Some of the most sweeping losses may result from unmanaged cutting of forests and drainage of marsh and swamp for conversion to agricultural fields (for example, the rice agroecosystem in the south). The latter threat may be the main culprit in the reduction of populations of the dwarf hutia in central Zapata Swamp. Severe fires following hurricanes or deliberately set by humans make further inroads into the quality of mammal habitat, as does the fragmentation of forest and wetlands by roads and

canals. The disappearance of aquatic vegetation is likely to be a threat to manatee populations. Adding to the damage caused by habitat loss is the impact of illicit hunting on some mammal species.

Recommendations

- Address the sources of large-scale loss and deterioration of mammal habitat. Manage logging, wetland drainage, fire cycles, road building, and channelization so that they are compatible with known conservation needs of mammal species.
- Control illicit hunting.
- Verify the status of *Mesocapromys nanus* in the region. If the species still occurs in Zapata Swamp, conduct studies to define its current geographic distribution, assess habitat quality, and obtain population estimates. Seek support for natural history studies.
- Study the ecology of the other species of hutias in Zapata, with the goal of managing their populations.
- Increase knowledge of the biology of *Trichechus manatus* in Zapata.

HUMAN COMMUNITIES

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Conservation targets: No specific targets yet identified

INTRODUCTION

Our work in Zapata Swamp did not include a rapid social assessment, and without this exploration of the ecology of local communities, we do not feel confident in identifying specific conservation targets in the human sphere. But previous studies of the peninsula's history and human ecology have the potential to put the results of the rapid biological inventory into context. Here we present excerpts of information on demography, history and culture, use of and threats to the region's biological diversity, and the socioeconomic potential for conservation.

DEMOGRAPHY

Zapata Swamp is the largest and least populated *municipio* (comparable to a county) in Cuba. It is home to 9,000 people, with a population density of approximately 2 inhabitants per km². Roughly 40% of the population lives in urban areas and 60% in rural zones, distributed among 19 settlements.

HISTORY AND CULTURE

The Zapata Peninsula owes its name not to its shoelike shape (*zapato*), as some might believe, but to Francisco Zapata, a landholder to whom the municipal government of La Habana granted part of the region in 1635.

On his second voyage to the West Indies, Christopher Columbus encountered native populations, belonging to a late pre-agricultural ceramic culture, around the present-day Bay of Pigs. Later, the distance of the Zapata Peninsula from marine routes, its geographic isolation, and the presence of numerous keys and other potential hiding places made this coast an ideal refuge for pirates. Two of the most notorious were Diego Pérez and Gilberto Girón, who at different periods used Zapata as headquarters for their operations. When piracy and freebooting were eliminated in the nineteenth century, the illegal importation of slaves boomed in the region.

The Ten-Year War for independence in the nineteenth century did not reach Matanzas Province with the force that it had in the eastern part of the country. But because of its proximity to Las Villas Province, where large contingents of *mambises* revolutionaries operated, Zapata Swamp played a far-reaching role in the independence movements of the nineteenth century. The rebel army found safe havens here to regain their strength and heal their wounds.

In the middle of the first decade of the twentieth century, the first and only railroads in the region were built.

The Zapata Peninsula definitively entered the history of the Americas on 17 April 1961 with the Bay of Pigs invasion. This operation of the Central Intelligence

Agency (CIA) involved 1,500 organized men trained, armed, and directed by the government of the United States of America. The Cuban army defeated these troops in battles along the road to Playa Girón from the north.

Zapata Swamp has a distinct cultural identity. It has enormous importance for the conservation of key elements of the Cuban and Caribbean cultures, such as significant archeological sites of aboriginal pre-agricultural communities, as well as the customs, lifeways, and traditional uses of natural resources of the current inhabitants.

USE OF NATURAL RESOURCES

In the past, human pressure on the biological diversity of the Zapata Peninsula was limited. Human populations were and remain relatively low, and much of the terrain is inaccessible because of the presence of extensive mangrove forests, flooded savannas, and marsh grasslands.

Human communities living in and near Zapata Swamp depend on its forests and wetlands for sustenance. Wood extraction and charcoal manufacture are the main source of local income—almost all of Zapata's inhabitants have links to these activities. From the forests comes the wood used to build their homes, tourist installations, and other structures. Ecotourism makes use of some of the forested areas of high quality. Zapata Swamp is the most important source of water for many local communities, even though this water is not always potable. Local communities, as well as neighboring settlements and cities, also depend on the Zapata ecosystem for food.

Core areas

In the protected zones that constitute the core areas of Zapata Swamp, the following uses of natural resources take place:

- *Silviculture*: In the core areas, silviculture is directed toward management for forest conservation rather than wood production. Elimination of exotic plants is one of the goals of this use of the forest.

- *Tourism*: This activity has boomed recently but provides economic benefits to only a small portion of the local population at present. Basic tourist infrastructure has been constructed in portions of Zapata Swamp National Park. Activities include wildlife observation, boat trips, sport fishing, landscape viewing, and hiking.
- *Scientific research*: Because of its inaccessibility, Zapata Swamp has hosted fewer scientific studies than most other areas of the country. Nevertheless, some of the current research includes investigations of fauna and flora, socioeconomic studies of local communities, and historical and cultural research.
- *Livestock production*: Cattle ranching is limited in the Zapata region to the environs of some local communities and is not extensive. It is regulated by two basic plans: the Cattle Plan and the Special Buffalo Plan. Some livestock, especially water buffaloes, have gone feral, causing severe damage to crops and natural vegetation.
- *Sport hunting*: Hunters kill migratory and resident species of birds, primarily in rice fields. Hunting quotas, and therefore impacts on populations, vary from species to species.
- *Fisheries*: A small fishing port is active at Caleta Ávalos.
- *Apiculture*: Artificial beehives are moved from place to place at intervals. Because of the richness of the bee-pollinated flora of the region, apiculture could become stronger than it is now. Also, it is likely to be more compatible with biodiversity conservation than many other uses of natural resources.

Buffer zone

Outside the core areas, the major uses of natural resources are the following:

- *Forestry*: In this zone, forest exploitation is authorized by a forest ordination project and is directed to the production of lumber, firewood, charcoal, and wood for the curing of tobacco and leather. Forestry companies are involved in larger-scale extraction; a small percentage of charcoal producers are self-employed. The guidelines of the ordination project allow extraction of firewood from logging zones as long as specific harvesting schedules are observed. Despite reforestation efforts, a large area of forest on the peninsula has been destroyed or significantly disturbed.
- *Silviculture*: This activity focuses on forest improvement through the development of plantations and other alternatives to the harvest of wild forests. Silviculture generates jobs for the local population and has the potential to guarantee the survival of the forest.
- *Agriculture*: Rice, citrus, and other agroecosystems have been developed in the region. Some of the land users are private smallholders. The most significant damage caused by this use of resources comes from habitat destruction and pollution via chemical fertilizers.

OBSTACLES TO AND POTENTIAL FOR CONSERVATION

In recent years, socioeconomic changes in Cuba and in the Zapata Peninsula have encouraged an increase in human pressure on the biological diversity of the region. Both local populations and migrants from other parts of the country have contributed to the increases in forest destruction and degradation and in illegal hunting and fishing. Two overarching influences that aggravate this pressure have been the strained circumstances of the national economy and an evident decrease in national capacity to preserve crucial natural areas. A major handicap is the lack of infrastructure adequate to sustain protected-area conservation and to promote environmental education.

On a regional scale, unplanned tourism poses a future threat. Even ecotourism has the potential to damage Zapata's ecosystems, as well as its economic fabric, unless activities are managed carefully and unless financial and social benefits flow to local communities.

Times may be changing for the better. Cuba is showing a trend toward economic recovery. Efforts like the World Wildlife Fund-Canadian International Development Agency Conservation and Sustainable Development in Zapata Swamp project provide a nucleus for building conservation capacity in the region. Protection and management of Zapata Swamp could take a great leap forward with the following steps that would address underlying socioeconomic pressures:

- Expand the intensity and extent of conservation action to the entire Zapata Peninsula, with appropriate zoning to accommodate people living in the region.
- Manage the extraction of local wood, especially in the Bermeja area, and implement effective plans for reforestation.
- Track and, if necessary, check the inflow of nutrients and contaminants from agricultural areas to the north.
- Regulate or eliminate the hunting of threatened, endangered, or sensitive species.
- Improve working conditions for conservation staff.
- Coordinate the activities of responsible agencies to strengthen planning and implementation of conservation.
- Conduct sociological and ethnobiological studies with Zapata's human communities to provide the basis for local and successful management plans.
- Increase the extent and level of conservation education for the peninsula's inhabitants, as well as training for conservation staff.
- Encourage environmental tourism and concentrate plans for new hotels in areas already developed.