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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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Centro Oriental de Ecosistemas y Biodiversidad and Museo de Historia Natural "Tomás Romay"

The mission of the Centro Oriental de Ecosistemas y Biodiversidad (BIOECO) is to carry out specialized, interdisciplinary studies in the Eastern Region of Cuba that define and characterize the most important and interesting areas for the conservation of biodiversity. BIOECO also works to establish the means and methods for conservation of these areas and the wise use of their resources, as well as to contribute to the ecological recovery and the sustainable socioeconomic and cultural development of the region.

BIOECO has four Divisions:

- The Tomás Romay Museum of Natural History
- Botanical Gardens
- Natural Sciences
- Protected Areas

These Divisions conduct scientific studies, management of protected areas, ecological planning, in-situ and ex-situ conservation, environmental education, and community projects.

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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 knowledge and cultural appreciation 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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The steep mountains and nearly impassable roads of Pico Mogote Ecological Reserve presented a challenge magnified by truly awful weather during our fieldwork. Nevertheless, the inventory was a success due to the collaboration and generous help of various people and institutions. We warmly thank each and everyone who helped us before, during, and after the inventory.

The Ministerio de Ciencia, Tecnología y Medio Ambiente (CITMA) and the Empresa Forestal Integral Baconao-Turquino authorized us to work in the area and collect specimens for Cuban museums. The Cuban Interests Section in Washington, D.C. kindly granted visas for North American participants.

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EDITORS' NOTE: Jennifer Shopland of Conservation/Information Design (formerly of The Field Museum) was one of the original volume editors for this Rapid Biological Inventories report. She revised or edited large portions of the text and appendices, in both English and Spanish. She also managed the editorial process in 2004. Because she had to leave the project before its conclusion, however, and was not able to oversee final quality, she has asked to have her name withdrawn from the list of editors of record. Errors in form and content remain the responsibility of the other editors. We thank Jennifer for her contributions.

MISSION

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	20–25 September 2002
Region	<p>The Baconao Biosphere Reserve region, in southeastern Cuba, approximately 25 km east of Santiago and 45 km southwest of Guantánamo (Fig. 1). The inventory was carried out in Pico Mogote Ecological Reserve, 14.9 km² in size, which is adjacent to the 30 km² Gran Piedra Protected Natural Landscape (Fig. 2A).</p> <p>The area has been recognized as Pico Mogote Ecological Reserve by Santiago's provincial government after a formal review and reconciliation process. At present, the Consejo de Ministros (Cuban Council of Ministers) is reviewing a proposal for recognition of the Ecological Reserve at the national level. Though expected, the approval has not been granted as of the writing of this report.</p>
Sites surveyed	The inventory team used a single camp, at the site of the long-abandoned French coffee plantation “La Gran Sofía,” from which all major habitat types could be reached by foot (Figs. 2A, 2B).
Organisms studied	Vegetation, seed plants, mollusks, spiders, butterflies, hymenopterans (ants, bees, and wasps), amphibians and reptiles, birds, and human communities. Collaborators provided additional data from previous studies in the area for liverworts, mosses, ferns and fern relatives, other arachnids (scorpions and whip scorpions), and mammals.
Highlights of results	<p>Pico Mogote Ecological Reserve has been altered significantly by human activity, which began more than a century ago when French owners of coffee plantations and their slaves arrived from Haiti. The Reserve retains representative stands of its original habitats, but most of the forests are young and some non-native tree species cover large areas (Fig. 2B). The most altered habitats—plantations of non-native pines and areas invaded by aggressive, non-native species of trees and shrubs—will require active management so that good-quality, indigenous pine forest, gallery forest, broadleaf evergreen forest, and montane rainforest can be restored.</p> <p>Judging from our four to six days in the field (depending on the organismal group), complemented by additional data from collections, literature, and unpublished studies, we report the following significant findings.</p> <p>Birds: We registered 48 bird species during the inventory, and 83 species are known for the area around the Reserve. We saw 9 of the 22 species of birds endemic to Cuba (that is, found nowhere else), including Gundlach's Hawk, Cuban Screech-Owl, Cuban Pygmy-Owl, Cuban Trogon, Cuban Tody, Cuban Green Woodpecker, Cuban Vireo, Oriente Warbler, and Cuban Blackbird (Fig. 6). The majority of the endemics are forest birds, indicating that despite the</p>

disturbance in the area, a forest avifauna has been preserved. Populations of two of the endemics, the Cuban Tody (*Todus multicolor*) and Oriente Warblers (*Teretistris fornsi*), are quite dense, and the breeding populations of Gundlach's Hawk (*Accipiter gundlachi*) are significant. Hunting, especially of Gray-headed Quail-Dove (*Geotrygon caniceps*), Gundlach's Hawk, and Stygian Owl (*Asio stygius*) may lead to the extirpation of these species in the area. Many North American migratory species pass through the Reserve.

Amphibians and reptiles: We recorded 12 species of amphibians (all frogs) and 15 species of reptiles (12 lizards and 3 snakes), and we predict the presence of at least 4 other reptiles. The number of amphibians found is 20.7% of the amphibian species in Cuba, and the reptiles constitute 11.0% of all Cuban species, even though the Reserve covers only 0.01% of the surface area of Cuba. These species also represent 42.9% of the amphibians and 21.7% of the reptiles recorded for the Sierra Maestra (the massif that includes the Reserve and is one of the most significant for Cuban amphibians and reptiles). Eleven (91.7%) of the amphibian species are endemic whereas 12 (80.0%) of the reptiles are endemic either to Cuba or to the Eastern Region of Cuba. Three of the lizards present are considered threatened in Cuba, including *Anolis isolepis*, *A. rejectus*, and *Chamaeleolis porcus* (Fig. 5J).

Mammals: The indigenous fauna of the Reserve includes 6 species of bats, and 3 species of rodents (all hutias, in the genus *Capromys*). Six non-native species have established themselves in the Reserve, including 2 rats, a mouse, and feral cats, dogs, and pigs.

Invertebrate animals: Twelve species of **mollusks** were observed during the inventory (Figs. 4A–C). We recorded a subspecies of *Caracolus sagemon* that may be new to science, as well as a subspecies of *Troschelvindex arangiana* that had not been observed since its original description (65 years ago) and which was known previously only from its type locality in the Sierra del Turquino. Species richness of snails is also high: worldwide, the number of species per locality ranges from 5 to 12 species, and this study ties the maximum value recorded.

The Reserve is rich in species, genera, and families of **spiders** (Figs. 4D–E). We inventoried 58 species, including 3 endemic to the Sierra Maestra. Four species of **scorpions and whip scorpions** were captured. One of these, a species of *Rowlandius*, is new to science and was known previously only from the nearly summit of the Gran Piedra. At 1,130 m altitude, we also discovered the highest known population of *Rhopalurus junceus* (Fig. 4F), a scorpion endemic to Cuba, which up to now had never been seen at altitudes above 800 m.

REPORT AT A GLANCE

Highlights of results
(continued)

We observed 24 species of **butterflies** of about 35 species expected for the area. About 60% of the species are also observed in the coastal zone, despite the different altitude and climate of the two areas.

For the study area, 133 species of **ants, bees, and wasps** (hymenoptera) were identified; we have not determined the proportion of species endemic to Cuba. We estimate that at least 200–300 species are present. The abundance of parasitic wasps, which is typical of forested areas, is noteworthy. Formicidae (the ants) was the family with the greatest number of species; opportunistic and well-dispersed species most common and abundant, but we also found some interesting Cuban endemics.

Plants: During the inventory, we recorded 316 species of **seed plants** (pines and flowering plants; Figs. 3A–E). We estimate that there are approximately 400 species in the Reserve, and 600 in the Reserve and the adjacent Gran Piedra Protected Natural Landscape, of which 17% are Cuban endemics, mostly from the Eastern Region of Cuba.

The pteridoflora (**ferns and relatives**) comprises about 180 species, of which 173 have been recorded from the Reserve (Fig. 3F). Regional endemism is low and consists of 3 species, none of which is exclusive to the Reserve. The Reserve also shelters 61 species, subspecies, and varieties of **mosses** (15% of the total for Cuba); no Cuban endemics have been recorded for the Reserve but 3 species are threatened. Sixteen families, 45 genera, and 139 species of **liverworts** have been found in the Reserve (about 30% of the Cuban hepatics). Five of these species of liverworts are endemic to Cuba (of which 2 are found only in Eastern Cuba, and the other 3 are considered threatened).

Human communities: The Pico Mogote area has been populated for only about 130 years, even though the foothills of the Sierra de la Gran Piedra had an indigenous presence from very early times. Christopher Columbus described the area as he sailed by in 1494, but areas in and adjacent to the Reserve were not settled until the late 1800s, when French fleeing the revolution in Haiti established slave-based coffee plantations. Today fewer than 25 inhabitants live or use land within the Reserve, and an additional 84 individuals live nearby, primarily in the small village of Gran Piedra, which is accessible by road from the city of Santiago de Cuba. Some of their activities are not compatible with the protection of native species in the Reserve, but the small number of people in the area, combined with environmental education, provides an opportunity for wise long-term management of the Reserve that will benefit local residents as well as wild biodiversity.

Main threats

The greatest threat to native biodiversity in the Reserve comes from the presence of non-native plant and animal species that have been introduced, intentionally and unintentionally, to the area. Importation of rose apple (*Syzygium jambos*) by the French, who ate the fruits and used these trees to shade coffee, was one of the earliest and most noxious introductions because this species aggressively crowds out native vegetation. More recent introductions of exotics for forestry include a pine (*Pinus caribaea*) and *Eucalyptus*. Rats and feral animals, including cats, dogs, and pigs, also appear to have a significant negative effect on the Reserve.

Some furtive agriculture and wood harvest now take place in the Reserve. We have little information on how extensive they are or on how to provide good alternatives for local residents.

Catastrophic loss of habitat is a danger to the Reserve. Its small size increases the probability that large-scale forces like hurricanes or fires will destroy a significant proportion of vegetation types and associated wildlife.

Finally, the ruins of the French coffee plantation La Gran Sofía are slowly being degraded by vegetation growing on them and by the erosive effects of water drainage.

Principal recommendations for protection and management

- 01 **Initiate programs to control and eradicate exotic species of plants and animals**, including rose apple (pomarrosa, *Syzygium jambos*), aroma (marabú, *Dichrostachys cinerea*), lead tree (lipi lipi, *Leucaena leucocephala*), *Eucalyptus*, rats, and feral pigs, dogs, and cats.
- 02 **Continue to protect and restore high-quality representatives of all native forest types of the Reserve by passive and active means.**
- 03 **Reduce or eliminate hunting of birds in the area (such as Gray-headed Quail Dove, Gundlach's Hawk, and Stygian Owl), and prevent furtive agriculture and wood harvest within the Reserve.** Develop programs with incentives for local residents that encourage them to protect the Reserve. Evaluate negative impacts on the Reserve that derive from activities by local individuals and businesses, and develop priorities for and methods to eliminate the most threatening of these.
- 04 **Provide more education and materials to the park guards about the flora and fauna, the local and national significance of the Reserve, its boundaries, and allowable activities.**

REPORT AT A GLANCE

Principal recommendations for protection and management (continued)

- 05 **Develop and distribute more materials about the flora and fauna of the Reserve to environmental education programs, and to local adult residents and visitors,** to improve their appreciation of the value of the Reserve and the rules for its use.
- 06 **In collaboration with local residents, carry out further inventory, research, and monitoring** of the distribution of native forest stands, forest succession, threatened and endangered species, raptors (e.g., Gundlach's Hawk), North American migrant birds, and species thought to be at high risk (e.g., populations of *Eleutherodactylus* frogs at higher elevations in the mountains).
- 07 **If possible, expand the size of the Reserve, or the geographic scope of the area covered by the same management techniques used in the Reserve.** To do this, work through the normal legal processes governing protected areas, together with all parties interested in the Reserve and its natural resources.
- 08 **Develop and implement programs to manage and protect the ruins of the French coffee plantations in the Reserve,** in coordination with the Provincial Agency for Cultural Heritage (Dirección Provincial del Patrimonio Cultural de Santiago de Cuba) and the City Conservator, the parties responsible for their conservation.

Long-term conservation benefits

- 01 **Maintenance of a natural area rich in Cuba's biodiversity and cultural heritage.** Pico Mogote Ecological Reserve retains nearly all original native species and all native forest types, and is home for many endemic, rare, and threatened Cuban plant and animal species, as well as many migratory birds.
- 02 **A source for the recolonization of healthy populations of birds, trees, and myriad other organisms,** in restoration efforts elsewhere in the Baconao Biosphere Reserve and eastern Cuba.
- 03 **A thriving center for environmental education and ecotourism.** The Reserve's proximity to Gran Piedra Protected Natural Landscape, the biological station of BIOECO, the Motel Gran Piedra, and the city of Santiago provides a foundation for these efforts. Lessons learned from the community-based studies of raptor migration now underway at Gran Piedra should guide the next steps in the development of this opportunity.

Why Pico Mogote?

Every winter, Ospreys hatched in the northeastern United States and Canada fly south, searching for warmer regions. They cross the Straits of Florida and then traverse Cuba from west to east. In the Oriente—the Eastern Region of Cuba—they soar on strong updraft currents generated by the Sierra Maestra mountain range until a set of rocky peaks and one huge, bare rock along the summit signal their arrival at the far east end of the Cordillera: here, they pass directly over Pico Mogote and the Gran Piedra. These peaks are the highlands above 1,000 m that are closest to the Sagua-Baracoa massif to the north. Thus, they serve as an important bridge for the interchange of biotas between these mountain ranges.

The easternmost spine of the Sierra Maestra runs parallel to and just 10 km from the southern coastline of Cuba. It generates altitudinal gradients in climatic conditions, as well as differences between the south- and north-facing slopes of the range. This diversity of altitude and exposure, combined with a complex geology and varied soils, has given rise to the area's biological richness.

Human activity also has shaped the region's ecosystems. Until the start of the nineteenth century, the area was almost completely unaltered by humans. French settlers, who fled the Haitian Revolution, then began to transform the landscape, which was a paradise for coffee cultivation. Only the highest peaks and steepest slopes escaped conversion to plantations. These areas remain a testament to the native richness of the Cuban biota, and as a potential source for the dispersal of native plants and animals in the restoration of surrounding lands.

The indisputable natural and cultural values of the region were the basis of its declaration as Baconao Biosphere Reserve. Our objective is to generate knowledge and recommendations that will strengthen and increase the protection and proper management of biodiversity in a remarkable core area, Pico Mogote Ecological Reserve.

Conservation of Pico Mogote

CURRENT STATUS

The 14.9 km² area has been recognized as Pico Mogote Ecological Reserve by Santiago's provincial government after a formal review and reconciliation process. At present, the Consejo de Ministros (Cuban Council of Ministers) is reviewing a proposal for recognition of the Reserve at the national level. Though expected, the approval has not been granted as of the writing of this report.

CONSERVATION TARGETS

<p><i>Conservation targets</i> are the elements of physiographic, biological, or cultural diversity that we want to persist in the landscape. The targets for Pico Mogote Ecological Reserve were chosen because they are (1) vegetation types that are especially species-rich, diverse, or threatened, (2) species, subspecies, or communities/assemblages that are endemic to the country, the region, or the locality, (3) species, subspecies, or communities/assemblages that are rare, threatened, endangered, vulnerable, or declining (including economically valuable species), (4) migrant species possibly made vulnerable by their dependence on the local landscape, (5) institutions, social assets, or human-built structures that are both significant for the landscape's diversity and threatened, and (6) human land uses and social/ecological practices that appear to support biodiversity conservation.</p>	<p>We identified the following conservation targets for the Reserve during the rapid inventory. Site managers and planners should continue research on these targets to refine our selections. Detailed lists of conservation targets are provided at the beginning of each group's chapter in the Technical Report.</p>	
	<p>Vegetation</p>	<p>Cloud scrub, relictual pine groves, montane rainforest, and successional stages of montane rainforest, gallery forest, and broadleaf evergreen forest with good potential for recovery from past disturbances</p>
	<p>Nonvascular Plants</p>	<p>Five endemic liverwort species (<i>Diplasiolejeunea pocsii</i>, <i>Radula cubensis</i>, <i>R. longiloba</i>, <i>R. pocsii</i>, and <i>Riccardia reyesiana</i>); and three species of the genus <i>Plagiochila</i> that are threatened in the Sierra Maestra (<i>P. binomini</i>, <i>P. ekmanii</i>, and <i>P. stolonifera</i>)</p> <p>Three threatened species of mosses (<i>Atrichum angustatum</i>, <i>Schlotheimia jamesonii</i>, and <i>Thamnobryum fasciculatum</i>)</p>
	<p>Vascular Plants</p>	<p>Two threatened species of ferns that live within the Reserve (<i>Polystichum viviparum</i> and <i>Thelypteris heteroclita</i>)</p> <p>Five threatened species of seed plants, namely <i>Spirotecoma apiculata</i> and <i>Tabebuia hypoleuca</i> (Bignoniaceae), <i>Cedrela odorata</i> (Meliaceae), <i>Pimenta cainitoides</i> (Myrtaceae), and <i>Meriania leucantha</i>, (Melastomataceae); <i>Lepanthopsis microlepanthes</i>, an orchid that in Cuba occurs only in the Reserve and in the adjacent Gran Piedra Protected Natural Landscape; and the other Cuban endemics</p>

	<p>Mollusks</p>	<p>Endemic species of the Eastern Region of Cuba (<i>Obeliscus latus</i> and <i>Coryda alauda</i>), and endemic species with restricted distributional ranges (<i>Cysticopsis lessavillei</i>, <i>Zachrysia bayamensis</i>, <i>Troschelvindex arangiana magistra</i>, <i>Obeliscus clavus flavus</i>, and a new subspecies of <i>Caracolus sagemon</i>)</p>
	<p>Spiders and Relatives</p>	<p>Populations of 12 species of spiders endemic to Cuba and living in the Reserve, particularly 3 species known only from a few localities within the Sierra Maestra (<i>Citharacanthus alayoni</i>, <i>C. cyaneus</i>, and <i>Drymusa armasi</i>) and 1 species known only from the Eastern Region of Cuba (<i>Ischnothele longicauda</i>)</p> <p>Populations of a scorpion, <i>Rhopalurus junceus</i>, and of a whip scorpion, <i>Rowlandius</i> sp. nov., found in cloud scrub, in montane rainforest, and in pine plantations with relicts of native pine grove</p>
	<p>Insects</p>	<p>Rare and charismatic species of butterflies (<i>Calisto sibylla</i>, <i>Anaea cubana</i>, <i>Hamadryas februa</i>, <i>Hypna clytemnestra</i>, and <i>Astrartes habana</i>)</p> <p>Species of hymenopterans (wasps, bees, and ants) endemic to Cuba</p>
	<p>Amphibians and Reptiles</p>	<p>Species with restricted geographic distributions (<i>Eleutherodactylus gundlachi</i>, <i>E. intermedius</i>, <i>Sphaerodactylus ramsdeni</i>, <i>Anolis rejectus</i>),</p> <p>Amphibian species that have experienced population declines elsewhere in Latin America (e.g., those in the genus <i>Eleutherodactylus</i>)</p>

Conservation Targets (continued)

	<p>Birds</p> <p>Threatened species (<i>Accipiter gundlachi</i>, <i>Asio stygius</i>, <i>Geotrygon caniceps</i>)</p> <p>Birds endemic to Cuba (<i>Accipiter gundlachi</i>, <i>Gymnoglaux lawrencii</i>, <i>Glaucidium siju</i>, <i>Priotelus temnurus</i>, <i>Todus multicolor</i>, <i>Xiphidiopicus percussus</i>, <i>Vireo gundlachii</i>, <i>Teretistris fornsi</i>, <i>Dives atrovioleaceus</i>)</p> <p>North American winter migratory species (<i>Dendroica caerulescens</i>, <i>D. discolor</i>, <i>D. dominica</i>, <i>D. tigrina</i>, <i>Limnothlypis swainsoni</i>), including migratory raptors (<i>Pandion haliaetus</i>, <i>Elanoides forficatus</i>, <i>Buteo platypterus</i>, <i>Falco columbarius</i>, <i>F. peregrinus</i>, <i>Accipiter striatus</i>)</p> <p>Two rare permanent residents (<i>Streptoprocne zonaris</i> and <i>Cypseloides niger</i>)</p>
	<p>Mammals</p> <p>Endemic species (three species of hutia in the genus <i>Capromys</i> and one bat, <i>Phyllonycteris poeyi</i>)</p> <p>Bat communities</p>
	<p>Human Communities</p> <p>Local residents interested in issues of biodiversity and education</p> <p>An educational system that can readily accommodate environmental education activities</p> <p>An ecological station near Gran Piedra (the community) and the Gran Piedra (the protected national landscape and tourist attraction) that can serve as a base for conservation operations in the area</p> <p>Archeological remains of the French coffee plantations La Gran Sofía and Kentucky, and the aqueduct system of the old La Africana coffee plantation</p>

THREATS

Exotic (non-native) plants and animals

Populations of exotic species have persisted in the area ever since they were introduced by immigrant French during their establishment of coffee plantations. Some of these exotics have adapted to local environmental conditions and have become widespread, especially the rose apple, or pomarrosa (*Syzygium jambos*). Beginning in the 1960s, reforestation with the goal of timber production accelerated the introduction of species not native to the Reserve, including *Pinus caribaea* and *Eucalyptus*, with markedly negative impacts on local ecological systems. Similarly, the presence of exotic animals, such as rats and feral pigs, dogs, and cats, has altered native habitats. Though the presence, and often the specific localities, of populations of non-native species are known, we lack information on their specific impacts on native species and the potential effect on the ecosystems if these invasive species were removed.

Hunting

Although limited in extent and frequency, hunting for food or medicine, or for spiritual or magical purposes, threatens populations of some species of animals. Hunting by local residents may be especially harmful to populations of Gundlach's Hawk, which is targeted because it includes domestic poultry in its diet. Gray-headed Quail Dove (*Geotrygon caniceps*) is hunted for food, and Stygian Owl (*Asio stygius*) is killed because it is considered an omen of bad luck and death. The pet trade may be responsible, in part, for the disappearance of Cuban Parakeet (*Aratinga euops*) from the area.

Furtive agriculture and wood harvest

With the exception of hunting, human residents in the area use local natural resources in a way that typically does not constitute an immediate threat to biodiversity conservation. Within the Reserve, however, a few cultivated parcels produce food crops for local consumption and damage soils and vegetation. The production of crafts in the region supports individuals who seek out and harvest prime wood where they can find it, including the Reserve. The furtive extraction of precious woods remains a problem.

Threats (continued)

Catastrophic loss of habitat

The Reserve includes the majority of the best-conserved habitats in the area and is embedded within a much more extensive protected zone, Baconao Biosphere Reserve. Nevertheless, the area encompassed by the Reserve is relatively small, increasing the probability that catastrophic events, such as hurricanes, will destroy a significant proportion of the protected habitats.

Erosion of an important historical site

Some of the cultural heritage of the area, primarily the ruins of the French coffee plantations declared as Cultural Heritage for Humanity (Patrimonio Cultural de la Humanidad), lack effective protection from slow destruction by the relentless, erosive forces of water and vegetative growth, as well as from vandalism by occasional, unscrupulous visitors.

OPPORTUNITIES

- 01 **Continued and improved protection of Pico Mogote Ecological Reserve, which is situated between primary centers of Cuban biodiversity, can preserve many species that are endemic to eastern Cuba, or threatened, or both.** Few plant or animal species (mostly birds) have been lost from the area, and the Reserve maintains representatives of all original forest habitats, though sometimes in a young successional stage.
- 02 **The area can be designated an ecological reserve at the national level.** At present, the Council of Ministers of Cuba (Consejo de Ministros de Cuba) is considering this proposal at the national level.
- 03 **Because the Reserve is embedded within the much larger, internationally recognized Baconao Biosphere Reserve, a framework exists for including it in a regional biodiversity plan,** which can cover all of the Sierra de la Gran Piedra.
- 04 **The presence of a biological station can facilitate studies useful for management of the Reserve** (e.g., methods to control or eliminate exotic species, and the effects of active management on the avifauna, herpetofauna, and malacofauna). Situated in Gran Piedra Protected Natural Landscape, just west of the Reserve, the biological station provides basic lodging and serves as a base from which to carry out research and monitoring in the Reserve. The presence of BIOECO in nearby Santiago can provide scientific expertise and guidance for these studies.
- 05 **BIOECO's monitoring program for migrating raptors can be the basis for developing conservation and environmental education programs.** Such programs can strengthen relationships already in place with local residents around the Reserve. The most important local community is Gran Piedra, where active relationships were developed during projects aimed at involving the community in management of the Reserve. Subsequent studies of this community's focus on local biodiversity led to new information on raptor migration in the zone and to potential monitoring projects.

Opportunities (continued)

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- 06 **The local educational system is open to the implementation of environmental education within its curricula.**
 - 07 **The Cuban and international visitors to Gran Piedra Protected Natural Landscape** provide an opportunity for environmental education and improved awareness of the biological richness and importance of the Reserve.
 - 08 **The Gran Piedra is a tourist attraction, and the presence of lodging facilities near the Reserve can facilitate eco-tourism that can generate funds for the Reserve and the community.**

RECOMMENDATIONS

The rapid inventory gave us an opportunity to combine an ecological context (generated both from our field work and from previous studies) with an identification of conservation targets, and threats to their survival, in Pico Mogote Ecological Reserve. We suggest that national and regional agencies can strengthen and extend existing conservation efforts through protection and management, research, further inventory, ecological surveillance, education and training, and collaboration with local communities as follows:

Protection and management

- 01 **Implement programs for the control and eradication of introduced plant species**, especially rose apple (pomarrosa, *Syzygium jambos*), aroma (marabú, *Dicrostachys cinerea*), lead tree (lipi lipi, *Leucaena leucocephala*), and species of *Eucalyptus*. Document the consequences of these eradications.
- 02 **Implement programs for the control and eradication of feral and exotic animals in the Reserve**, including rats, pigs, dogs, and cats. Document the consequences of active management.
- 03 **Protect and restore high-quality representatives of all native forest types**, including montane rainforest, broadleaf evergreen forest, gallery forest, and cloud scrub.
- 04 **Create conditions favorable for the establishment and spread of populations of the native pine, *Pinus maestrensis***. This work may include soil preparation in the season of seed production. Much of this effort should be directed at areas currently planted with *Pinus caribaea*, not native to the area, which should be converted to *P. maestrensis* or other native forest types.
- 05 **Prevent furtive agriculture and wood harvest within the Reserve, as well as methods of road construction that lead to excessive erosion.**
- 06 **Reduce or eliminate hunting of Gray-headed Quail-Dove (*Geotrygon caniceps*), Gundlach's Hawk (*Accipiter gundlachi*), and Stygian Owl (*Asio stygius*)** in the area through environmental education programs, incentives, and close collaboration with park guards and the local community.
- 07 **Develop and implement programs for protection and management of the ruins of the French coffee plantations**, in coordination with the Provincial Agency for Cultural Heritage of Santiago de Cuba (Dirección Provincial del Patrimonio Cultural de Santiago de Cuba) and the Office of the City Conservator (Oficina del Conservador de la Ciudad), which are the institutions responsible for the conservation of these historic buildings. Avoid local forest management practices detrimental to the ruins.

RECOMMENDATIONS

Protection and
management
(continued)

- 08 **Increase the size of the Reserve, or enlarge the area encompassed by management activities.** Use appropriate legal means and involve all interested parties. Increasing the size of the Reserve will decrease the probability of complete destruction of major habitats and their wildlife by catastrophic events, such as hurricanes.
- 09 **Bring the databases available for the Reserve up to date using data from the Protected Areas (Áreas Protegidas) Program.** These new data also should be included in the documentation (*expediente*) for the Reserve.

Research

- 01 **Research the challenges arising from the eradication of exotic species.** These studies will allow Reserve managers to create effective programs for the elimination of some of these species and to understand the biological consequences of their eradication.
- 02 **Determine means for extracting the non-native pine *Pinus caribaea* without excessive erosion or damage to native plants and animals that now live in the habitats that it dominates** (e.g., the rare, endemic chameleon *Chamaeleolis porcus*). Consider a comprehensive 30-year plan for eradication, dividing the Reserve into sectors and completely removing this species during that time frame.
- 03 **Study the ability of the ecosystem to recuperate by natural succession from past disturbances.** For example, select areas that have seed or seedling banks of native species but are now dominated by rose apple (*Syzygium jambos*), non-native pines, or advanced successional stages of broadleaf evergreen forest. Carefully experiment by removing a few non-native canopy trees to allow more light to reach the understory. Observe and document the effects and incorporate these findings into more experimentation and subsequent active management. In areas where broadleaf evergreen forest once grew, but which are now essentially devoid of native seeds or seedlings, create experimental plots planted with seeds transported from elsewhere in the area.
- 04 **Evaluate damage that natural-resource use by local residents and businesses may cause to the Reserve.** Rank the impact on flora and fauna in the Reserve of activities documented to have a negative effect, and develop programs to eliminate the most important negative impacts.
- 05 **Study habitat use by birds, with particular focus on the use of older, native forests versus younger and more disturbed forest stands,** and use the results to modify and improve management plans for bird species that are conservation targets.

<p>Research (continued)</p>	<p>06 Set priorities for studies of the ecology and population biology of rare and threatened species. The results of these studies can contribute baseline data for monitoring and management decisions.</p>
<p>Further inventory, monitoring (of conservation targets), and surveillance (of additional species and ecological processes)</p>	<p>01 Map, describe, and track populations of endemic, endangered, and threatened species. Improve knowledge of the detailed distribution and ecology of these species with the aim of developing specific goals and guidelines for their conservation in the area. For example, assess the status of Gundlach’s Hawk, and try to determine the causes of previous bird extirpations in the area, which may provide insight on ways to avoid additional local extinctions.</p> <p>02 Map, characterize, and track the remaining old forest stands in the Reserve, using the maps drawn during this inventory as a first approximation. The resulting information can increase our understanding of the natural ecosystems in the area and direct management efforts for the restoration of disturbed forest stands.</p> <p>03 Track populations of <i>Eleutherodactylus</i> frogs for signs of declines, as have been seen in mountain habitats elsewhere in the Caribbean and Latin America.</p> <p>04 More thoroughly inventory and track populations of North American migrant birds.</p> <p>05 Continue to record raptor migrations, habitat use, and nesting in the Reserve.</p> <p>06 Locate the nesting sites of White-collared Swift and Black Swift so that they can be tracked and protected.</p>
<p>Education and training</p>	<p>01 Develop programs with incentives for local residents to support protection of the Reserve. These should contribute to the well-being of the community and fairly divide benefits and management responsibilities.</p> <p>02 Support park guards and local residents interested in the Reserve by providing more information about the local benefits that it provides. Also supply them with guidelines for its use and protection, e.g., permitted activities and boundaries.</p> <p>03 Provide more materials about local flora and fauna to the environmental education program at Gran Piedra’s school.</p> <p>04 Create and install additional, more informative signs about the Reserve, aimed at both local residents and visitors.</p> <p>05 Revise existing educational products aimed at tourists visiting the area, and devise new, improved materials.</p>