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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.

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	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 km^2 in size, which is adjacent to the 30 km^2 Gran Piedra Protected Natural Landscape (Fig. 2A). 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.
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	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. 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. **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

Highlights of results
(continued)

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, i**n 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 km^2 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

Conservation targets 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.

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.

Vegetation	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
Nonvascular Plants	Five endemic **liverwort** species (*Diplasiolejeunea pocsii*, *Radula cubensis*, *R. longiloba*, *R. pocsii*, and *Riccardia reyesiana*); and three species of the genus *Plagiochila* that are threatened in the Sierra Maestra (*P. binomini*, *P. ekmanii*, and *P. stolonifera*) Three threatened species of **mosses** (*Atrichum angustatum, Schlotheimia jamesonii*, and *Thamnobryum fasciculatum*)
Vascular Plants	Two threatened species of **ferns** that live within the Reserve (*Polystichum viviparum* and *Thelypteris heteroclita*) Five threatened species of **seed plants**, namely *Spirotecoma apiculata* and *Tabebuia hypoleuca* (Bignoniaceae), *Cedrela odorata* (Meliaceae), *Pimenta cainitoides* (Myrtaceae), and *Meriania leucantha*, (Melastomataceae); *Lepanthopsis microlepanthes*, an orchid that in Cuba occurs only in the Reserve and in the adjacent Gran Piedra Protected Natural Landscape; and the other Cuban endemics

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

Conservation Targets (continued)

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

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.

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)

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.

Research (continued)	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.
Further inventory, monitoring (of conservation targets), **and surveillance** (of additional species and ecological processes)	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. 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. 03 **Track populations of *Eleutherodactylus* frogs for signs of declines**, as have been seen in mountain habitats elsewhere in the Caribbean and Latin America. 04 **More thoroughly inventory and track populations of North American migrant birds.** 05 **Continue to record raptor migrations, habitat use, and nesting in the Reserve.** 06 **Locate the nesting sites of White-collared Swift and Black Swift** so that they can be tracked and protected.
Education and training	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. 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. 03 **Provide more materials about local flora and fauna to the environmental education program at Gran Piedra's school.** 04 **Create and install additional, more informative signs about the Reserve, aimed at both local residents and visitors.** 05 **Revise existing educational products aimed at tourists visiting the area, and devise new, improved materials.**

Technical Report

OVERVIEW OF INVENTORY SITE

In 1987, UNESCO designated Baconao Biosphere Reserve (la Reserva de la Biosfera Baconao) in southeastern Cuba. It comprises approximately 92,360 ha, of which 12,810 fall in core areas (*www.unesco.org*), and is bounded on the west by the city of Santiago, to the east by Lake Baconao, to the south by the Caribbean Sea, and to the north by the northern flanks of the Sierra de la Gran Piedra* (roughly 19°52' to 20°08' N by 75°16' to 75°46' W). The habitats vary widely, from coastal mangroves, to rocky or sandy seashores with dry forests and shrublands, to wet montane rainforests and pinelands.

During six days in September 2002, we carried out a rapid biological inventory in Pico Mogote Ecological Reserve (Reserva Ecológica Pico Mogote), a core area in the north-central portion of Baconao Biosphere Reserve (Fig. 1). Pico Mogote Ecological Reserve is 14,900 ha in size and mostly consists of secondary-growth montane rainforests and plantation pine forests (Fig. 2B). However, in areas of the Reserve with difficult access, remnant stands of older, indigenous pine and broadleaf forests persist.

The area has a rich history, including settlement and extensive agriculture since the middle of the nineteenth century. More than 38,000 people now live in the buffer zones and transition zones of the Baconao Reserve (*www.unesco.org*), but few live in and next to Pico Mogote Ecological Reserve and the adjacent, protected scenic area called the Gran Piedra (Fig. 2A). In the following chapters, we describe the wild plants and animals, and the human communities associated with Pico Mogote, using data gathered during our inventory as well as previous inventories carried out by the scientists at the Eastern Center for Ecosystems and Biodiversity (Centro Oriental de Ecosistemas y Biodiversidad, BIOECO).

* To clarify our geographical references, "Sierra de la Gran Piedra" is a mountain range that forms the easternmost part of the Sierra Maestra. (The Sierra Maestra continues westward for another 200 km.) "The Gran Piedra" refers to Gran Piedra Protected Natural Landscape (el Paisaje Natural Protegido Gran Piedra), a conservation area immediately west of the Pico Mogote Ecological Reserve that contains a large rock outcrop, and "Gran Piedra" is a local human community.

SITE VISITED BY THE BIOLOGICAL INVENTORY TEAM

La Gran Sofía Camp

(19°59'54" N, 73°35'05" W, altitude ca. 800 m)

From the small community of Gran Piedra, we continued east for 8 km along a dirt road to La Gran Sofía (Fig. 2A), an abandoned French coffee plantation founded in the nineteenth century (described by J. Jiménez in the Technical Report). This camp perched on the bank of a small stream running through the ruins of the plantation at a site where a small hydroelectric plant was built and later abandoned. The gallery (riparian) forests surrounding the camp were completely dominated by a single, very aggressive, non-native plant species, *Syzygium jambos* (rose apple or "pomarrosa," Fig. 3B), which the French imported for its edible fruits, its fragrant flowers, and the shade it provided to coffee plants. From this base camp, we travelled by foot to montane rainforest at higher altitudes, to cloud scrub (on steep slopes above 1,100 m), pine forest, remnant broadleaf evergreen forest, abandoned pastures, and odd mango-dominated forest within Pico Mogote Ecological Reserve. We passed an abandoned camp on a ridge crest at 19°59'05" N, 75°34'14" W, but saw few other signs of recent human activity in the higher-altitude forests.

PHYSIOGRAPHY, HYDROLOGY, CLIMATE, AND SOILS

Authors: Miguel Abad Salazar and Alberto Beyris Mazar

Pico Mogote Ecological Reserve lies within the upper elevations of the Sierra de la Gran Piedra, about 20 km from the city of Santiago de Cuba, and 2.5 km east of the tourist center at the Gran Piedra (Fig. 2A). Its 14.9 km^2 are divided between north and south slopes, and more than 53% of its area is above 800 m elevation. The highest point is Pico Mogote itself, at 1,130 m.

GEOLOGY

The geology of the area is characterized by the predominance of the undifferentiated El Cobre Group (Méndez et al. 1994), which are Eocene sedimentary rocks of volcanic origin (principally andesites).

RELIEF

Because of constant tectonic uplift of the area, the rivers cut very deeply into the terrain and produce a complex, strongly dissected relief. Steep slopes and strong, denuding, erosive processes predominate. The south face of the Sierra exhibits the most extreme slopes. Within this geomorphology, relatively flat areas are scarce and concentrated in the lower valley of the San Antonio River.

Tectonic processes have forced the mountains into a series of parallel ridges oriented north to south, each bearing a line of peaks of approximately equal height.

HYDROLOGY

With the exception of the San Antonio River, the hydrological network is woven by rivers whose volumes fluctuate seasonally. Flow during the dry season is minimal, and some of these rivers dry out completely, but flow can be considerable during the rainy season.

The north slope includes 69% of the area of the Reserve. Its streams drain to the San Antonio and Indio Rivers, which then flow into the Baconao River. These rivers are less seasonal and have greater flow than those of the south face because of the greater rainfall carried by the trade winds. The south face is drained by the Magdalena and Sigua Rivers, which run directly to the Caribbean. The extreme eastern part of the Reserve drains into Arroyo La Anita, which then joins the Baconao River.

CLIMATE

The climate is very variable. Two zones, with completely different climatic conditions, are present in the Reserve. The first, a horizontal band formed by the

land over 800 m on both the north and south slopes, has only one season with relatively rainy winter conditions. Here, the relative humidity is 87%–90% at 7:00 a.m. and 75%–80% at 1:00 p.m. (Montenegro 1990). Precipitation is considerable, varying annually between 1,400 and 1,600 mm. The wettest period falls from April to October, with more than 100 mm of precipitation each month. Rain typically falls at least 10 days per month from May to November. May, September, and October are the rainiest months. Average evaporation rates are low, and most days are cloudy and cool. An average of 238 days per year have fog and low clouds; 162 of these days have dense fog (Montenegro 1990). Each month from October to May typically has at least 14 days with dense fog, in contrast to the months from June to September, which usually have 9 or fewer (Montenegro 1990).

The second climatic zone has two seasons, winter and summer. It covers areas below 800 m on the north slope of the Reserve, and between 400 and 800 m on the south slope. The average rainfall in this zone is 1,100–1,400 mm, less than that of the upper climatic zone, and the average annual temperature is 4ºC higher.

Northeast trade winds predominate on the north slope, which is the windiest zone, from November to April. During this same period, the trade winds pass up and over the mountains and produce hot, dry, Föhn-effect winds on the south slope. The south slope is also affected during the day by light marine winds from the southeast, which produce whirlwinds (Montenegro 1990).

In valleys or basins with blocked airflow, cold air spilling off the slopes accumulates during night-time hours and produces chilly pre-dawn temperatures. These cold-air pools occur frequently in the intra-mountain valley on the north side of the Gran Piedra. The average annual temperature there varies between 18ºC and 22ºC. At the summit of Pico Mogote, average minimum temperatures are 14ºC–18°C, due to the altitude. Above 800 m, the average yearly maximum ranges from 24ºC to 25ºC, and the minimum from 16ºC to 18ºC. Between 600 and 800 m altitude, the average yearly maximum is 25ºC–27ºC, and the minimum 17ºC–18ºC. In general, minimum temperatures decrease by 0.4°C per each 100-m increase in elevation on the north slope, and by 0.6°C on the south slope.

SOILS

Three types of soils (as defined by Hernández et al. 1994) are found in the the Reserve:

Ferralítico Rojo Lixiviado

The most extensive soil in the Reserve, this is usually found over meteorized, iron-rich (ferralitic) deposits. Its depth varies from shallow to deep, and it is poor and rather acidic (pH 4.0–4.5). Assimilable phosphorus (P_2O_5) is 2.75–6.78 mg/100 g of soil, assimilable potassium (K_2O) is 5.0–44.2 mg/100 g of soil, and organic matter 4.7%–7.4%. These values are higher than those found by Renda et al. (1981) in similar soils elsewhere in the Sierra Maestra.

Pardo Sin Carbonato

This soil predominates in premontane areas of the north slope. Formation of this soil is related to the presence of tuffaceous rocks (originally derived from fine volcanic fragments and dust). Depth averages around 45 cm. External drainage is regular, and internal drainage is moderate. Gravel and rock outcrops are frequent.

Esquelético

This "skeletal" soil occurs almost exclusively on steep slopes and knife-edge summits. It is dispersed through the Reserve along the divide between the watersheds, and is generally stony and less than 10 cm deep.

VEGETATION

Participants/Authors: Orlando J. Reyes and Félix Acosta Cantillo

Conservation targets: 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

INTRODUCTION

The vegetation of Pico Mogote Ecological Reserve has been highly disturbed. It is well worth conserving, however, because it has retained its floristic species richness and native vegetation types, which vary according to the altitudinal levels of the Sierra. The potential vegetation corresponds almost entirely with broadleaf evergreen forest (500–800 m) and montane rainforest (800–1,400 m), according to the system of Capote and Berazaín (1984) and Reyes (in press).

This site shows well-defined ecological characteristics. The most noteworthy depend on altitude, which affects temperature, winds, atmospheric humidity, and rainfall. Fog and low clouds are very important, reducing the intensity of solar radiation in areas above 800 m most days of the year. Also significant are the degree of exposure and the soils, which are poor, acidic, and weathered (primarily Ferralíticos Rojo Lixiviados, Hernández et al. 1994).

METHODS

Because our time was very limited, we hand-drew outlines of habitats onto 1:25,000-scale topographic maps in the field. We did this by performing visual surveys and determining points with a hand-held GPS unit. We studied the structure of habitat types and described floristic composition and characteristics for each of the vegetation layers, as well as for the humus layers.

HABITATS

Montane rainforest (*pluvisilva montana*)

Bioclimatically, the study location is categorized as Humid Equatorial ("Thermoxeric," in the sense of Vilamajó 1989). The Gran Piedra weather station, situated near the Reserve, reports the following data (Montenegro 1990): absolute maximal temperature 29ºC, absolute minimal temperature 6ºC, mean temperature 18.4ºC, mean insolation 5 to 7 hours per day, relative humidity 89.6%, mean annual rainfall 1,664 mm, and mean number of days with rainfall 139. Horizontal precipitation (fog and low clouds) above 800 m occurs most often right before noon, which reduces afternoon sunlight. This phenomenon tends to homogenize environmental conditions during a large part of the day, minimizing energetic differences produced by exposure. Horizontal precipitation, according to Boytel (1972), provides moisture to the soil and vegetation; Samek and Travieso (1968) claimed that it can deliver up to 50% of the rainfall. Thus, it has an important role in increasing humidity and limiting its loss in the ecosystem. The predominant winds, which are also the strongest, are trade winds from the northeast and north-northeast.

In the Sierra de la Gran Piedra, this habitat (Figs. 2B, 2C) is found on Ferralíticos Rojo Lixiviados or Pardo Amarillento soils, which are derived from rocks from the El Cobre Group. These soils have good surface and internal drainage. Leaf litter is well distributed on the soil surface. Layer L (according to the system of Herrera and Rodríguez, 1988) reaches 3–5 cm. Layers F and H are mixed, occasionally forming a matrix up to 10 cm thick, which sometimes can constitute a virtual mat of roots.

The height and cover of the upper canopy are fairly uniform. In this habitat, height typically fluctuates from 12 to 15 m, and cover is 80%–100% of the soil surface. The most-abundant species are *Ocotea leucoxylon*, *O. cuneata*, and *Beilschmiedia pendula* (Lauraceae), *Prestoea acuminata* var. *montana* (Arecaceae), *Cupania americana* and *Matayba oppositifolia* (Sapindaceae), *Dendropanax arboreus* (Araliaceae), *Chionanthus domingensis* (Oleaceae), a species of *Ilex* (Aquifoliaceae), *Clusia tetrastigma* (Clusiaceae), and *Syzygium jambos* (Myrtaceae). Less common are *Cyrilla racemiflora* (Cyrillaceae), *Cinnamomum elongatum* (Lauraceae), *Alchornea latifolia* (Euphorbiaceae), and *Prunus occidentalis* (Rosaceae). In the Pico Mogote region, the canopy layer is taller and reaches between 20 and 25 m; the most-abundant species are *Prestoea acuminata* var. *montana*, *Chionanthus domingensis*, *Prunus occidentalis*, and a species of *Ocotea*.

The shrub layer has coverage of 40%–70%. Characteristic species, sometimes present in abundance, are *Gesneria viridiflora* (Gesneriaceae), *Psychotria nervosa* (Rubiaceae), and *Cyathea parvula* (Cyatheaceae). Often present are *Callicarpa floccosa* (Verbenaceae), *Hedyosmum grisebachii* (Chloranthaceae), *Meriania leucantha* (Melastomataceae), *Coccoloba diversifolia* (Polygonaceae), and *Cyathea aspera*. In the Reserve, the most abundant species are *Prestoea acuminata* var. *montana*, *Cyathea parvula*, *Chionanthus domingensis*, and a species of *Ocotea*.

Cover in the herbaceous layer is 50%–80%. Characteristic species are *Ocotea leucoxylon*, *O. cuneata*, *Prestoea acuminata* var. *montana*, *Cupania americana*, *Clusia tetrastigma*, *Chionanthus domingensis*, *Oplismenus setarius* (Poaceae), *Blechnum occidentale* (Blechnaceae), *Gesneria viridiflora*, *Psychotria nervosa*, and *Columnea cubensis* (Gesneriaceae). Often also present are *Callicarpa ferruginea*, *Phaius tankervilliae* (Orchidaceae), *Palicourea alpina* (Rubiaceae), and species of *Hedyosmum* and *Peperomia* (Piperaceae). The most-abundant species in the Reserve are *Casearia sylvestris* var. *sylvestris* (Flacourtiaceae), *Syzygium jambos*, *Prestoea acuminata* var. *montana*, *Cyathea parvula*, *Meriania leucantha* var. *nana*, and a species of *Ocotea*.

Lianas are poorly represented. *Guzmania monostachya* (Bromeliaceae) and *Columnea cubensis* are abundant epiphytes. *Campyloneurum phyllitidis* (Polypodiaceae) and a species of *Bromelia* (Bromeliaceae) are sometimes present.

Secondary forest in montane rainforest ecotopes
(*bosque secundario en ecótopos de pluvisilva montana*)

This habitat is an advanced successional stage of montane rainforests of the Sierra de la Gran Piedra. It is found in the highest elevations of the massif, above 800 m. The soil is Ferralítico Rojo Lixiviado, poor and acidic, and generally deep. The slope varies and is frequently greater than 20°. Microrelief is moderate.

The layer of leaf litter is well developed. Layer L varies from 1.5 to 4.0 cm but is usually 2.0–2.5 cm, whereas layer F fluctuates between 1 and 2 cm, rarely more. Layer H forms a root mat embedded in a matrix of humus, which is greater than 10 cm in the areas with best development, and shallower in others. In this successional stage (Homeostasis I and the beginning of Fiera II), the root mat constitutes a subsystem that receives nutrients released from the decomposition of leaf litter and provides them to plants. Thus, it is the principal element in the recirculation of nutrients in this ecosystem.

Structurally, this could be considered either a shrub-dominated forest or a tree-dominated shrubland. The most developed areas (successional stage Fiera II) have a low arboreal layer, 7–10 m in height, with 70%–100% cover. The characteristic species are *Clusia tetrastigma*, *Matayba oppositifolia*, *Lyonia latifolia* subsp. *calycosa* (Ericaceae), *Cyrilla racemiflora*, *Clethra cubensis* (Clethraceae), and *Coccoloba diversifolia*. Also reaching this layer are *Alchornea latifolia*, *Ocotea leucoxylon*, *Gomidesia lindeniana* (Myrtaceae), *Myrica cerifera* (Myricaceae), and *Ossaea granulata* (Melastomataceae).

The shrub layer has a cover of 40%–100%. Here, *Cyathea parvula*, *Matayba oppositifolia*, *Gomidesia lindeniana*, and *Ossaea granulata* are always present, and *Clusia tetrastigma* and *Myrsine coriacea* (Myrsinaceae) frequently occur. Sometimes found are *Ocotea leucoxylon*, *Casearia sylvestris* var. *sylvestris*, *Alchornea latifolia*, *Coccoloba diversifolia*, *Cyrilla racemiflora*, *Ilex repanda*, *I. macfadyenii*, *Lyonia latifolia* subsp. *calycosa*, *Eugenia scaphophylla* (Myrtaceae), *Cyathea aspera*, *Palicourea alpina*, and *Gesneria viridiflora*, as well as *Clethra cubensis* and *Guettarda monocarpa* (Rubiaceae) in less-developed areas.

The coverage in the herbaceous layer varies from 80% to 100%. Characteristic species include *Gomidesia lindeniana*, *Panicum glutinosum* (Poaceae), *Ocotea leucoxylon*, *Matayba domingensis*, *Gesneria viridiflora*, *Oplismenus setarius*, and *Scleria lithosperma* (Cyperaceae). Frequently present are *Sticherus bifidus* (Gleicheniacee), *Blechnum occidentale*, *Ichnanthus pallens* and *Olyra latifolia* (Poaceae), *Cyathea parvula*, *Clusia tetrastigma*, *Palicourea alpina*, *Prestoea acuminata*

var. *montana*, *Eugenia scaphophylla*, *Phaius tankervilliae*, *Ilex macfadyenii*, and a species of *Callicarpa*.

Of lianas, only *Smilax havanensis* (Smilacaceae) is always present. *Smilax lanceolata* occurs frequently, and *Philodendron consanguineum* (Araceae), *Odontosoria scandens* (Lindsaeaceae), *Chiococca alba* (Rubiaceae), and *Arthrostylidium multispicatum* (Poaceae) occur occasionally. Of the epiphytes, *Dichaea hystricina* and *Isochilus linearis* (Orchidaceae), and *Aechmea nudicaulis*, *Guzmania monostachya*, and *Tillandsia fasciculata* (all Bromeliaceae) are frequently seen, and less often *Dendrophthora* (Viscaceae) and *Hillia parasitica* (Rubiaceae).

Successional stages of broadleaf evergreen forest
(*bosque secundario en ecótopos de bosque siempreverde mesófilo*)

No areas of primary broadleaf evergreen forest remain, but secondary broadleaf evergreen forest is one of the most extensive communities in the Reserve (Fig. 2B).

The humus has a layer L of about 1.5 cm and a layer F of 4 cm. It lacks layer H.

The variable arboreal layer is frequently around 12 m tall. Important species are *Cinnamomum elongatum* and *Allophyllus cominia* (Sapindaceae). We frequently found *Clusia rosea* and, on recently abandoned coffee plantations, *Erythrina poeppigiana* (Fabaceae, to 30 m in height). *Cupania americana*, *Ocotea cuneata*, and *Roystonea regia* (Arecaceae) also occur.

In the shrub layer, *Ocotea leucoxylon*, *Trophis racemosa* (Moraceae), *Cinnamomum elongatum*, and a species of *Psychotria* are important. Also present are *Prunus occidentalis*, *Urera baccifera*, *Mangifera indica* (Anacardiaceae), *Guarea guidonia* (Meliaceae), *Syzygium jambos*, *Clusia rosea*, *Eugenia* (cf. *E. floribunda*), and *Wallenia laurifolia* (Myrsinaceae).

The herbaceous layer is rich in species. *Pharus lappulaceus* (Poaceae), *Faramea occidentalis* (Rubiaceae), *Picramnia pentandra* (Picramniaceae), *Guarea guidonia*, *Pavonia spinifex* (Malvaceae), and *Blechnum occidentale* are important. *Trophis racemosa*, *Chrysophyllum oliviforme* (Sapotaceae), *Cupania americana*, *Dendropanax arboreus*, and *Prunus occidentalis* are occasional.

Among lianas, we observed *Trichostigma octandrum* (Phytolaccaceae), *Tournefortia hirsutissima* (Boraginaceae), *Cissampelos pareira* (Menispermaceae), *Pisonia aculeata* (Nyctaginaceae), and *Vitis tiliaefolia* (Vitaceae).

Secondary forest of *Syzygium jambos*
(*bosque secundario de Syzygium jambos*)

This type of forest replaced montane rainforests and broadleaf evergreen forests in areas that were heavily disturbed by coffee cultivation. French plantation owners planted *Syzygium jambos* (rose apple or "pomarrosa," Fig. 3B) to provide shade for the coffee and for production of edible fruits.

Mean annual precipitation ranges from 1,400 to 1,600 mm. The soil is Ferralítico Pardo Amarillento, derived from rocks of the El Cobre Group. Its texture varies from very friable to slightly pliable, and its depth from shallow to very shallow. The accumulation rate of humus is low. Layer L is about 2 cm thick, whereas F and H are mixed and can reach about 1 cm.

The arboreal layer is uniform, its height varying from 12 to 15 m. The only characteristic species is *Syzygium jambos*, but isolated individuals of *Chrysophyllum oliviforme*, *Cinnamomum elongatum*, and *Clusia rosea* sometimes appear.

The cover of shrub layer is 20%–80%, and of the herbaceous layer 80%–100%. Species frequently encountered are *Blechnum occidentale*, *Gesneria viridiflora*, and *Phaius tankervilliae*.

Lianas are poorly represented. Among the epiphytes, only *Guzmania monostachya* is always present and abundant. *Tillandsia fasciculata*, *Epidendrum nocturnum* (Orchidaceae), and *Philodendron lacerum* are scattered.

Gallery forest of *Syzygium jambos*
(*bosque de galería de Syzygium jambos*)

This disturbed forest type replaces native habitats, destroyed by human activities, along streams and rivers.

The layer of leaf litter is shallow: layer L is about 1 cm thick, and only traces of F can be seen. The arboreal layer, essentially composed of *Syzygium jambos*, is 10–14 m high, with 100% cover. Sometimes *Calophyllum antillanum* (Clusiaceae), *Pouteria domingensis* (Sapotaceae), and *Chionanthus domingensis* are present.

The shrub layer has about 40% coverage, and the most-abundant species is *Gesneria viridiflora*. Also present are *Calophyllum antillanum*, *Syzygium jambos*, *Viburnum villosum* (Caprifoliaceae), *Mangifera indica*, *Myrsine coriacea*, *Casearia sylvestris* var. *sylvestris*, *Roystonea regia*, *Cinnamomum elongatum*, *Ilex macfadyenii*, *Cestrum laurifolium* (Solanaceae), *Piper aduncum* (Piperaceae), and species of *Coccoloba* and *Guettarda*.

In the herbaceous layer, the most-abundant species are *Blechnum occidentale* and seedlings of *Syzygium jambos*. *Pavonia spinifex* and a species of *Asplenium* (Aspleniaceae) are abundant, also. We observed *Palicourea alpina*, *Myrsine coriacea*, *Chionanthus domingensis*, *Cupania americana*, *Polygala oblongata* (Polygalaceae), *Clusia rosea*, *Dendropanax arboreus*, *Phaius tankervilliae*, *Scleria secans*, and *Casearia sylvestris* var. *sylvestris*.

Gallery forest (*bosque de galería*)

This native community develops along streams and rivers, under the constant influence of their humidity.

Below 800 m (in the zone of broadleaf evergreen forest), leaf litter covers about 70% of the soil surface; layers L and F are mixed and are about 1 cm thick. The soil has many superficial roots. The arboreal layer is 12–20 m in height, with emergents of up to 30 m. The most important species is *Clusia rosea*. Also important are *Chionanthus domingensis*, *Cojoba arborea* (Fabaceae), *Coccoloba diversifolia*, and *Matayba oppositifolia*. Other species we encountered include *Pithecellobium obovale* (= *Abarema obovalis*, Fabaceae), *Dendropanax arboreus*, *Cupania americana*, *Beilschmiedia pendula*, *Syzygium jambos*, *Guarea guidonia*, *Trophis racemosa*, and *Cecropia schreberiana* (Cecropiaceae). In the shrub layer, the most important species is *Gesneria viridiflora*. Most important in the herbaceous layer are *Blechnum occidentale* and *Syzygium jambos*; also important are *Cupania americana* and *Pharus lappulaceus*. *Chionanthus domingensis*, *Cinnamomum elongatum*, *Beilschmiedia pendula*, *Gesneria viridiflora*, *Palicourea alpina*, *Guarea guidonia*, *Wallenia laurifolia*, *Casearia sylvestris* var. *sylvestris*, *Scleria lithosperma*, and *Clusia rosea* are also present.

Above 800 m (in the zone of montane rainforest), humus layer L is around 2 cm thick, and traces of a mixture of F and H occur among the rocks. The most abundant species in the arboreal and shrub layers of the gallery forest is *Prestoea acuminata* var. *montana*, although also noteworthy in the arboreal layer are *Cecropia schreberiana* and *Cinnamomum elongatum*, and in the shrub layer, *Psychotria grandis*. In the herbaceous layer, the most important are *Pharus latifolius* and *Syzygium jambos*; others of importance are *Blechnum occidentale*, *Cinnamomum elongatum*, and *Psychotria grandis*.

Cloud scrub (*matorral nublado*)

Cloud scrub, which occurs in the southern part of Pico Mogote (Figs. 2B, 2E), could not be thoroughly studied because of its steep slope of around 90°. Species observed in the shrub layer were *Lyonia latifolia* subsp. *calycosa*, *Ilex macfadyenii*, a species of *Celtis* (Ulmaceae), *Clusia grisebachiana*, *Myrsine coriacea*, *Clethra cubensis*, and *Vaccinium cubense* (Ericaceae). Patches of *Dicranopteris pectinata* occur in the herbaceous layer.

Successional stages of cloud scrub in montane rainforest ecotopes (*matorrales secundarios*)

These are initial successional stages that will mature unless subjected to further natural (or human) disturbance. The soil is Ferralítico Rojo Lixiviado, with a flat microrelief. Humus layer L is about 2 cm thick, and

F is 1.5 cm thick with some very fine rootlets. Layer H was not observed.

The shrub-canopy layer is from 3 to 5 m in height, with about 70% coverage. *Myrica cerifera* and *Cyrilla racemiflora* are the most abundant species; less abundant are *Ilex macfadyenii*, *Cyathea parvula*, and *Myrsine coriacea*.

The herbaceous layer covers the entire ground, and the most abundant species are *Blechnum occidentale*, *Ilex macfadyenii*, *Hypericum nitidum* (Hypericaceae), and *Sticherus bifidus*. Other species are more dispersed and less abundant.

In the Pico Mogote region, the shrub layer reaches 2–3 m, with coverage of 60%. The species with the greatest cover are *Myrsine coriacea* and *Ilex macfadyenii*. Also present are *Syzygium jambos*, *Brunellia comocladifolia* (Brunelliaceae), *Cyathea arborea*, *C. parvula*, *Viburnum villosum*, *Miconia elata* (Melastomataceae), *Chionanthus domingensis*, *Alchornea latifolia*, and a species of *Citharexylum* (Verbenaceae). Isolated individuals of *Clusia rosea* and *Ocotea leucoxylon* occur.

The herbaceous layer has 100% coverage and is dominated by *Dicranopteris pectinata* (Gleicheniaceae), which extends over 80% of the surface. *Panicum glutinosum*, *Hypericum nitidum*, and *Scleria secans* are also important. Other species found include *Clidemia hirta* (Melastomataceae), *Lisianthius glandulosus* (Gentianaceae; Fig. 3D) *Odontosoria aculeata*, *Heterotrichum umbellatum* (Melastomataceae), *Syzygium jambos*, and a species of *Elephantopus* (Asteraceae).

Gallery grassland (*herbazal de galería*)

This community is very limited in the Reserve. Its only vegetation layer is herbaceous, has a height of about 1.2 m, and is composed almost entirely of *Cyperus alternifolius* (Cyperaceae). Also present are *Mikania micrantha* and *Piper aduncum*. In canopy openings, *Bidens pilosa* (Asteraceae), *Syzygium jambos*, *Pavonia spinifex*, *Sida rhombifolia* (Malvaceae), and species of *Asclepias* (Asclepiadaceae) and *Ludwigia* (Onagraceae) occur.

Old pastures (*pastizales secundarios)*

A few areas retain the features of old pastures within the Reserve. The shrub layer is 5–6 m high. Dominant species belong to the genera *Ossaea* and *Eugenia*. Also found are *Lantana camara* (Verbenaceae), *Chrysophyllum oliviforme*, *Allophyllus cominia*, *Viburnum villosum*, *Cinnamomum elongatum*, *Ilex macfadyenii*, *Trema micrantha* (Ulmaceae), and species of *Cytharexylum*, *Miconia*, and *Vernonia* (Asteraceae).

In the herbaceous layer, *Panicum maximum* (Poaceae) predominates, accompanied by *Scleria secans*, *Polygala oblongata*, *Picramnia pentandra*, *Lantana camara*, *Chromolaena odorata* (Asteraceae), *Spermacoce laevis* (Rubiaceae), *Turnera ulmifolia* (Turneraceae), *Clusia rosea*, and *Desmodium incanum* (Fabaceae). We observed the lianas *Pisonia aculeata* and *Vitis tiliaefolia*.

Pine plantations with relicts of native pine groves (*plantaciones de pino y relictos de pinares naturales*)

The extensive plantations of *Pinus caribaea* and *P. maestrensis* in the Reserve are about 40 years old (Fig. 2B, 2D). Isolated relicts of native pine groves also remain. Generally the soils are Ferralíticos Rojos Lixiviados, shallow to very shallow, derived from rocks (mostly andesites) of the El Cobre Group. The humus layers are relatively well-developed. Layer L varies between 2.5 and 4.0 cm in thickness, composed mainly of pine needles; F is about 2 cm thick; and H at times reaches 9 cm and is full of roots and rootlets.

The canopy layer is *Pinus maestrensis* in some areas and *P. caribaea* in others, with rare occurrences of other species. This layer reaches a height of 25–30 m, sometimes higher. Its coverage varies from 60% to 90%.

The shrub layer has variable coverage of 30%–80%. The most abundant species are *Clusia rosea*, *Casearia sylvestris* var. *sylvestris*, *Viburnum villosum*, *Pithecellobium obovale*, and *Myrsine coriacea*, accompanied by a large number of other species.

The herbaceous layer is very dense, generally covering 100% of the soil surface. The most abundant species are *Nephrolepis multiflora* and *N. biserrata*

(Nephrolepidaceae). Also important are a species of *Cestrum*, *Ichnanthus pallens*, *Clusia rosea*, and *Blechnum occidentale*. Many other species are present, with less coverage.

We observed the lianas *Hippocratea volubilis* (Hippocrateaceae) *Passiflora sexflora* (Passifloraceae), *Mikania micrantha* (Asteraceae), *Canavalia nitida* (Fabaceae), and *Stigmaphyllon sagreanum* (Malpighiaceae). Epiphytes are relatively rare. The most common is *Tillandsia fasciculata*.

Naturalized mango grove (*mangal naturalizado*)

This is a dispersed community, especially in the southeastern part of the Reserve. It is found primarily mixed with areas of *Syzygium jambos*.

The arboreal layer has 100% coverage of *Mangifera indica* (mango, Anacardiaceae) and reaches a height of 15 m. Occasionally present are *Syzygium jambos*, *Clusia rosea*, a species of *Lonchocarpus*, and *Bucida buceras* (Combretaceae).

In the shrub layer, which has very minimal coverage, one finds *Mangifera indica*, *Gesneria viridiflora*, and *Guarea guidonia*.

The herbaceous layer has about 30% coverage. The most important species is *Syzygium jambos* (as seedlings), which is accompanied by *Faramea occidentalis*, *Chionanthus domingensis*, *Cupania americana*, *Adiantum tenerum* (Pteridiaceae), *Exothea paniculata* (Sapindaceae), *Blechnum occidentale*, and a species of *Cestrum*.

THREATS AND RECOMMENDATIONS

Primary among the threats to native vegetation is the establishment of introduced plant species. *Syzygium jambos*, introduced by French planters for fruit and shade, and present in most of the vegetation types that we observed, aggressively crowds out native species. More recent introductions, in this case for forestry, include *Pinus caribaea* and *Eucalyptus*. We lack information on the specific effects of these exotic tree species on native vegetation and wildlife habitats.

Within the Reserve, illicit agricultural clearing and tree harvest, especially for precious woods, still exist, although on a small scale. As with the impact of invasive species, we have insufficient knowledge about the alterations to the ecosystem caused by local deforestation and forest degradation.

We recommend research on the following: (1) the effects of non-native tree species on native vegetation types, and the potential consequences of eradicating these invasives, (2) the ability of ecosystems to recover from past disturbances through natural succession, (3) the potential for replacement of forest stands of *Syzygium jambos* with native tree species, and (4) the impact of small-scale agriculture and wood harvest on wild vegetation.

We advocate the use of these research results (1) to begin the control of invasive species, (2) to reduce or eliminate clearing and degradation of forests, (3) to encourage the establishment and spread of populations of the native *Pinus maestrensis*, and (4) to protect or restore areas of native vegetation. Mapping and characterization of remaining old forest stands in the Reserve, using our rapid inventory's maps as a starting point, will be central to these strategies for protection and management of Pico Mogote's wild vegetation.

LIVERWORTS

Author: Kesia Mustelier Martínez

Conservation targets: Five endemic species, *Diplasiolejeunea pocsii* and *Radula pocsii* (exclusively in the Eastern Region of Cuba), and *Radula cubensis, R. longiloba,* and *Riccardia reyesiana* (pan-Cuban endemics); and three species of the genus *Plagiochila* (*P. binomini, P. ekmanii,* and *P. stolonifera*), which are threatened in the Sierra Maestra

INTRODUCTION

Liverworts belong to the division Hepatophyta of the nonvascular plants (Margulis and Schwartz 1998), and may take two forms: foliose or thallose. These plants are dependent on water for the development of their life cycle and are generally very small, some microscopic. Thus, microclimatic conditions are very important for their growth, as are availability and

variety of microhabitats within the ecosystem. Consequently, liverworts are more abundant in humid forests (and, in Cuba, montane forests especially), although some species can tolerate extreme environmental conditions and are distributed widely.

Liverworts constitute an important nutrient bank, impeding the loss of essential elements that otherwise would be washed away by precipitation. In addition, liverworts retain a large percentage of rainwater because of their great absorbency. In this way they regulate water flow, reduce evaporative loss, preserve moisture in the soil, and prevent erosion. They also contribute to soil formation and fertilization by rapidly transforming into humus.

METHODS

I conducted a bibliographic review and examined specimens in the Bryological Section in the Herbario del Centro Oriental de Ecosistemas y Biodiversidad (BSC). The herbarium contains 462 specimens of liverworts that were collected in the study area and identified following the traditional criteria for this group of plants (Gradstein et al. 2001). To determine the conservation status of these plants, I used the classification of Hallingbäck et al. (1996).

RESULTS

In Pico Mogote Ecological Reserve are found 16 families, 45 genera, and 139 species of liverworts (Appendix 1). These represent 52% of the species reported for the Sierra de la Gran Piedra (Mustelier 1999), 38% of those reported for the entire Sierra Maestra, and about 30% of the Cuban hepaticological flora. Throughout the Sierra de la Gran Piedra, scientists have recorded about 245 species of liverworts, and 5 species of hornworts (none of which are recorded for the Reserve, despite appropriate ecological conditions). This gap in the collection record suggests that the number of species reported here for the Reserve may increase.

These plants grow on the ground and on rocks, trunks, branches, and leaves in the various vegetative formations. Epiphytes are very abundant in the most humid forests, the most dominant species being *Lejeunea cerina*, *L. flava*, *Metzgeria elliottii*, *M. furcata*, and *Radula pallens*. Among the epiphylls, *Diplasiolejeunea brunnea*, *Drepanolejeunea mosenii*, and *Leptolejeunea elliptica* are noteworthy. In addition, species of the genera *Asterella* and *Marchantia* are abundant and cover the ruins of the coffee plantations in the Reserve. On rocks in gulleys and streamcourses, species of *Riccardia* are dominant.

The family with the most species in the Reserve is Lejeuneaceae, which contains 36% of all species present. This is also the most abundant family in Cuba, as well as throughout the Neotropics, and is noted for its diversity and ecological plasticity.

THREATS AND RECOMMENDATIONS

The presence and species richness of liverworts are affected by any alteration in the forests where they live. Their recovery is difficult and slow, in contrast with other plant groups, and thus their greatest threat is the rapid destruction of forests from natural or human causes.

For the conservation of the hepaticological flora, I recommend the protection of all forest habitats in the Reserve.

MOSSES

Authors: María E. Potrony and Ángel Motito Marín

Conservation targets: Three threatened species (*Atrichum angustatum, Schlotheimia jamesonii,* and *Thamnobryum fasciculatum*)

INTRODUCTION

According to the regional classification of Núñez et al. (1989), the Sierra de la the Gran Piedra is one of the eight geographic areas of the Sierra Maestra Subregion. From a phytogeographic point of view, the study region has been considered an independent district by Samek (1973) as well as by Borhidi and Muñiz (1986), although the two studies use slightly different geographic boundaries.

The area, recognized for its scenic value, presents a mosaic of abiotic elements that favor the development of a rich flora, in which the bryophytes stand out for their high species richness. For the Sierra de la Gran Piedra, scientists have inventoried 212 infrageneric moss taxa belonging to 102 genera and 42 families (Potrony and Motito 1999).

The 1,147 specimens we examined indicated that this area has been very interesting to foreign bryologists, beginning with the collection efforts of A. Schafer in 1911. Pico Mogote Ecological Reserve has not been explored as intensively as the rest of the Sierra.

METHODS

We obtained data for the analysis of mosses of the Reserve from an examination of specimens collected in the study region and deposited in the Herbario del Centro Oriental de Ecosistemas y Biodiversidad (BSC). We analyzed data from these specimens and from specimens cited in the literature using the "HERBARIO. MUS" database. The taxonomic criteria are those of Gradstein et al. (2001).

We made a preliminary assessment of threatened taxa using guidelines for threat categories established by the Conservation Assessment and Management Plan for Selected Cuban Plant Species (CAMP 1998), taking into account the methods proposed by Hallingbäck et al. (1996, 1998) for the bryophytes.

RESULTS

In Pico Mogote Ecological Reserve, 61 infrageneric moss taxa were inventoried. These represent 15.0% of the total for Cuba, 18.5% of the total for the Sierra Maestra, and 29.0% of the total for the Sierra de la Gran Piedra (Appendix 2). The infrageneric taxa inventoried belong to 42 genera and 22 families. The genera are 25.4% of the total for Cuba, 28.9% of the total for the Sierra Maestra, and 29.2% of the total for the Sierra de la Gran Piedra. The families represent 45.0% of Cuban families, 46.0% of the families in the Sierra Maestra, and 52.0% of the families in the Sierra de la Gran Piedra.

We estimate that approximately 110 infrageneric moss taxa exist in the region. No endemics have been recorded for the Reserve. Among the most-abundant taxa are *Phyllogonium fulgens*, *Cyrto-hypnum involvens*, *Leucobryum giganteum*, and *Neckeropsis undulata*. Three taxa are considered threatened: *Schlotheimia jamesonii* is considered Critically Endangered; *Thamnobryum fasciculatum,* Endangered; and *Atrichum angustatum,* Vulnerable.

THREATS AND RECOMMENDATIONS

All three threatened species occur in the Reserve as epiphytes on larger plants. We recommend the conservation of representative forest types pending a more extensive study of the distribution of these species and the threats to them.

FERNS AND FERN RELATIVES (Pteridophyta)

Author: Manuel G. Caluff

Conservation targets: The two threatened species that live within the Reserve (*Polystichum viviparum* and *Thelypteris heteroclita*)

INTRODUCTION

Pico Mogote Ecological Reserve forms part of the Piedraense Phytogeographic District (Cordillera de la Gran Piedra), which in turn is the eastern part of the Maestrense Phytogeographic Sector (Sierra Maestra), situated in the southeastern part of Cuba (Borhidi and Muñiz 1986).

For the Piedraense District, 335 infrageneric taxa, 66 genera, and 25 families have been reported. These taxa constitute 51%, 68%, and 81%, respectively, of those reported for all of Cuba (Caluff and Shelton, unpublished). Eighteen endemic species endemic to Cuba are present in the region. Most of these plants are terrestrial and occur at altitudes above 900 m. Fifteen threatened species are found in the district.

With respect to the pteridophytes, the Piedraense District is the most studied in Cuba (Caluff 1985) and

has the second richest pteridoflora in the country. This flora is characterized by its numerous ecological and taxonomic types and by low endemism, due primarily to the absence of extreme edaphic and climatic conditions and to the large number of coexisting microhabitats.

METHODS

The information that follows is based on collections and inventories of pteridophytes made outside the period of the rapid inventory. Numerous specimens collected in the region are deposited in the Sección Pteridophyta of the Herbario del Centro Oriental de Ecosistemas y Biodiversidad (BSC).

I carried out inventories using transects, selecting representative habitats, or, in some cases, using survey plots. In all cases, I made a field list of easily recognizable species and collected species in doubt for later identification. Individuals of some interesting species were cultivated in the Jardín de Helechos, in Santiago de Cuba, for additional study of their phenology and autecology.

For the list of taxa, I followed the classification system of Crabbe et al. (1975), with minor modifications. I also used their classification of vegetation types for the analysis of the pteridoflora by habitat, below. Some taxa studied have been identified only to the generic level.

RESULTS

I estimate the pteridoflora of Pico Mogote Ecological Reserve at about 180 species, of which 173 were found during my study (Appendix 3). Regional endemism is low and consists of three species, none of which is exclusive to the Reserve:

- *Polystichum viviparum*—endemic to the Sierra Maestra and to the locality of La Perla, Yateras, Meseta del Guaso, Guantánamo Province, where a collection was made at the beginning of the twentieth century. Only one individual is known to occur in the study area.
- *Lygodium cubense* var. *cubense*—pan-Cuban endemic, very common in western and central Cuba, less common in the east. I observed and collected this species in the study area a few times in secondary vegetation and in gallery forest.
- *Alsophila cubensis*—pan-Cuban endemic common in the three large mountain systems of Cuba. It usually appears as part of the understory in gallery forest, and rarely in montane rainforest and broadleaf evergreen forest. Occasionally it is found in secondary vegetation.

Two threatened species are found in the region, the endemic *Polystichum viviparum*, and *Thelypteris heteroclita*, known in Cuba from a single collection in the study region and from only two other collections made in the western Sierra Maestra.

The dominant species in the Reserve, which are also the most common, are *Nephrolepis multiflora* (presently the country's most abundant fern), *Thelypteris dentata* (common in the majority of Cuban ecosystems), *Cyathea parvula* (one of the most common species in the study area, as well as in the other mountain systems of eastern Cuba), *Blechnum occidentale* (a Neotropical species), and *Lycopodiella cernua*.

A few interesting records obtained in the region during the study are *Dicranoglossum furcatum*, the only collection in southeastern Cuba; *Elaphoglossum spatulatum*, the only collection in the Sierra de la Gran Piedra (it is very rare throughout the western Sierra Maestra); *Adiantum capillus-veneris*, the only collection in the Gran Piedra; *Thelypteris heteroclita*, the only collection in the Gran Piedra, and only the third collection for Cuba; and a species of *Arachniodes* that is possibly a new species or nothospecies (a hybrid between different species in the same genus) to science.

Analysis of the pteridoflora by habitat

Gallery forest

The bulk of the local pteridoflora is concentrated in gallery forests. Epiphytes are abundant, both low and high in the vegetation. Epiphytes in the lower levels of the vegetation, mostly belonging to the family Hymenophyllaceae, concentrate on tree trunks and settle on populations of algae and bryophytes that tend to grow

on the side of trees exposed to flowing water. Epiphytes in the upper levels of the vegetation, mostly belonging to the family Polypodiaceae, grow on horizontal branches and forks and generally live on the bases of large bromeliads or the roots of *Anthurium* species (Araceae). Many species grow on large rocks and outcrops covered with previously established algae and bryophytes. The lateral surfaces are colonized by numerous species of *Blechnum*, *Asplenium*, *Adiantum*, and *Thelypteris*, as well as by several species of *Selaginella* that on occasion form extensive matrices. Open areas are ideal for species of successional vegetation.

Montane rainforest

The pteridoflora of the montane rainforest is exuberant, and within it elements of cloud forest as well as evergreen forest at times converge. Some species, which at lower altitudes are exclusively gallery forest species, here may occur on the banks of either permanent or ephemeral waterways, or may be found at some distance from them. In this vegetation type, species of *Asplenium*, *Diplazium*, *Elaphoglossum*, *Grammitis*, *Hymenophyllum*, and *Trichomanes* are abundant, whereas other genera, such as *Adiantum* and *Pteris*, are absent or poorly represented.

Clearings are common within montane rainforest areas because of landslides and individual fallen trees. These clearings are usually occupied by transitional, secondary vegetation, where pteridophytes of the genera *Pteridium*, *Dicranopteris*, *Sticherus*, and *Odontosoria* proliferate, as well as some sun-loving, arborescent ferns, such as *Cyathea arborea* and *C. parvula*.

Pine plantations with relicts of native pine groves

Ecological conditions of this type of vegetation are not favorable for more than a few pteridophyte species, which are represented by extensive populations. The very reduced species richness of pteridophytes may be due as much to the acidic soils and tree surfaces as to production of allelopathic substances by these trees.

These species are exclusively terrestrial, and epiphytic pteridophytes are totally absent. A few facultative epiphytes like *Phlebodium aureum* and *Polypodium triseriale* occasionally appear, living in the humus layer of the soil.

Species that are very abundant here include *Pteridium aquilinum*, *Lycopodiella cernua*, *Cyathea parvula*, and *Odontosoria aculeata*. Occasionally, a few calcium-loving species are seen, which are atypical for this type of vegetation, e.g., *Pteris longifolia*, *Adiantum melanoleucum*, and *Nephrolepis exaltata*.

Secondary forests

Pteridophytes in secondary vegetation are basically terrestrial. Approximately 10% of pteridophytes in this vegetation type seem to be mostly unrestricted as to their preferred microhabitats, but only on very rare occasions do these plants appear on trees.

The pteridological composition of secondary vegetation varies according to climatic conditions and altitude, but as a general rule, in a secondary forest in transition to the original vegetation, the large majority of its species are not part of the original vegetation.

Some groups of species, such as those in the Hymenophyllaceae and in the genus *Elaphoglossum*, are completely absent from this secondary forest, despite being common in the native rainforest only a few meters away. These pteridophytes are in fact excellent bioindicators of whether vegetation is native.

Secondary forests in broadleaf evergreen forest ecotopes

This type of vegetation has been significantly disturbed. For that reason relatively few species of pteridophytes are present. The majority of species in these forests are basically terrestrial, but 10% of them are unrestricted with respect to microhabitat. The latter include many common species, some of which are naturalized, such as *Nephrolepis multiflora, Macrothelypteris torresiana,* and *Thelypteris dentata*.

French ruins

Despite their not being a proper vegetation type, the ruins of the old French coffee plantations, which are abundant in the region, have been converted into

a peculiar ecosystem that gives space to the rock-dwelling, calcium-loving species that otherwise would not havean appropriate ecological niche, since calcareous outcrops are very rare in the region. Some species occupying this habitat are *Anemia adiantifolia*, *Cheilanthes microphylla*, *Thelypteris reptans*, *T. retroflexa*, and *Trichomanes punctatum sphenoides*.

THREATS AND RECOMMENDATIONS

The principal threats to the pteridoflora of the Reserve are furtive logging and the opening of roads and trails (which seem inconsequential at first, but later are exacerbated by erosion into wide areas stripped of vegetation). I recommend monitoring of the populations of the threatened species and careful, integrated management of the ecosystems present.

SEED PLANTS
(Spermatophyta)

Participants/Authors: Eddy Martínez Quesada and William S. Alverson

Conservation targets: Five threatened species, Cuban endemics, and *Lepanthopsis microlepanthes*, an orchid that in Cuba occurs only in the Reserve and in the adjacent Gran Piedra Protected Natural Landscape

METHODS

We carried out inventories in the study area in the form of linear and random-walk (meander) transects in all habitats. Wherever possible, these transects were at least 2 m wide. At each point in the survey, we collected botanical material was collected that was of interest, was in doubt, or was unknown. The remaining species were identified and recorded in a field notebook. We defined the degree of threat following the IUCN (2004). Photographs were also taken, which will be available on the Web (*www.fmnh.org/rbi*).

RESULTS

We found 316 species of spermatophytes (in 220 genera and 80 families), of which 260 are identified to the species level, 44 to genus, and 7 to family, with 5 remaining unknown (Appendix 4). Species identified in the Reserve represent 73.3% of those found in the adjacent Gran Piedra Protected Natural Landscape (Figueredo et al. 2001). We estimate that approximately 400 species occur in the Reserve, and 600 in the Reserve and the Gran Piedra, taken together.

Of all taxa registered in the Reserve and in the Gran Piedra, 102 (17.2%) are Cuban endemics, of which 70 are restricted to the Eastern Region of Cuba and 8 to the Sierra Maestra. One additional taxon is endemic to the Sierra de la Gran Piedra: *Rondeletia intermixta* subsp. *intermixta* (Rubiaceae; Fig. 3A).

Throughout the Reserve, species have been introduced as ornamentals or to produce fruit or timber. Some of these have become naturalized in the area (Appendix 4). In one case, *Pinus caribaea*, a native species whose natural area of distribution is western Cuba, has been introduced into the Reserve as a tree cultivated in plantations.

The key species are *Syzygium jambos* (rose apple or "pomarrosa," Fig. 3B) and *Pinus caribaea*. Both were introduced into the Reserve, where they are extensive and common. They play important roles in the ecosystem primarily because (1) they contribute to averting soil erosion and (2) they have strong negative effects on populations of many indigenous plant species.

One notable record is *Lepanthopsis microlepanthes* (Orchidaceae), which is a species in danger of extinction in Cuba, the Dominican Republic, and Jamaica. Its present distribution in Cuba is limited to a montane rainforest at the summit of Pico Mogote and the nearby Gran Piedra, a rock outcrop in the Gran Piedra Protected Natural Landscape. Another important record is *Rondeletia intermixta* subsp. *intermixta* (Fig. 3A), which is also found in the Gran Piedra Protected Natural Landscape. Four species are new records for the Reserve: *Senecio almironcillo* (Asteraceae), *Callicarpa resinosa* (Verbenaceae), *Trema cubensis* (Ulmaceae;

Fig. 3C), and *Aeschynomene viscidula* (Fabaceae). This species of *Aeschynomene* is also new for the Eastern Region of Cuba.

Five threatened, conservation-target species are present in the Reserve (IUCN 2004), of which four are considered Vulnerable—*Spirotecoma apiculata* and *Tabebuia hypoleuca* (Bignoniaceae), *Cedrela odorata* (Meliaceae), and *Pimenta cainitoides* (Myrtaceae)—and one is considered Lower Risk (*Meriania leucantha*, Melastomataceae). Also of concern is *Lepanthopsis microlepanthes* (Orchidaceae), which is considered in danger of extinction in Cuba, the Dominican Republic, and Jamaica (Berazaín et al. 2005).

THREATS AND RECOMMENDATIONS

The primary threat to the seed plants of Pico Mogote Reserve is the aggressive invasion of non-native trees, especially *Syzygium jambos* and *Pinus caribaea*. Small-scale clearing for agriculture and local wood harvest may also damage spermatophyte populations. We recommend the protection of the relatively intact montane rainforest near the summit of Pico Mogote, within which *Lepanthopsis microlepanthes* occurs, as well as the other habitats of the Reserve that shelter the endemic, rare, or vulnerable plant species listed in Appendix 4.

TERRESTRIAL MOLLUSKS

Participant/Author: David Maceira F.

Conservation targets: Endemic species of the Eastern Region of Cuba (*Obeliscus latus* and *Coryda alauda*), and endemic species with restricted distributional ranges (*Cysticopsis lessavillei, Zachrysia bayamensis, Troschelvindex arangiana magistra, Obeliscus clavus flavus,* and a new subspecies of *Caracolus sagemon*)

METHODS

I made field observations during the inventories of the cloud scrub, montane rainforest, pine forest, gallery forest, and secondary vegetation. I recorded data on localities, dates, habitats, and microhabitats while examining all possible biotopes for each habitat. I used a relative-abundance classification that designates species as uncommon, common, or abundant.

RESULTS

I registered 12 species during the rapid biological inventory, which belong to 8 families and 11 genera (Appendix 5). The report for *Cysticopsis lessavillei* comes from the literature. Judging from its available habitats elsewhere, at Pico Bayamesa and in the Sierra del Turquino, I classified it as uncommon and present only in the broadleaf forest.

The previously known geographic distribution of the subspecies of *Caracolus sagemon* does not coincide with the record for Pico Mogote Ecological Reserve. We thus may have a subspecies of *Caracolus sagemon* new to science. Other noteworthy records include the second locality reports for *Obeliscus clavus flavus* and *Troschelvindex arangiana magistra* (Fig. 4A). In 1907, H. Pilsbry described the subspecies *O. clavus flavus* from Santiago de Cuba without mentioning the type locality, and Maceira (2000) recorded it at El Olimpo, also in the Sierra de la Gran Piedra (as is Pico Mogote Ecological Reserve). *Troschelvindex arangiana magistra* has not been observed since its original description (65 years ago) and was known only from its type locality in the Sierra del Turquino. The discovery during the rapid inventory places it in the Sierra de la Gran Piedra as well.

The Reserve lies within the Sierra Maestra, which has the highest elevations in Cuba and high malacological values (75.1% species endemism, 24 families, 60 genera, 155 species, and 84 subspecies, Maceira 2000). Species endemism is 95.6% for the Eastern Region of Cuba and 96.1% for Cuba in general (Maceira 2001).

For the Reserve, 75.0% of mollusks recorded were from the Subclass Pulmonata, 16.6% from Prosobranchisa, and 8.3% from Gymnomorpha. The percentage of species endemism is high (83.3%) and of introduced mollusks, low (16.6%). These data are similar to those recorded for two nearby localities:

El Olimpo, with 10 species and 90% endemism, and Gran Piedra Protected Natural Landscape, with 9 species and 88.9% endemism (Maceira 2000).

Species richness is also high. Worldwide, malacological richness by locality varies between 5 and 12 species (Solem and Climo 1985). This study recorded the maximal value of 12.

An analysis of altitudinal variation shows that *Cysticopsis lessavillei*, *Zachrysia bayamensis* (Fig. 4C), *Obeliscus clavus flavus*, *Caracolus sagemon* subsp. nov., and *Troschelvindex arangiana magistra* are species that occur above 500 m.

In general, the species observed can be divided into ground-dwelling malacofauna (six species) and arboreal malacofauna (six species). Of the ground-dwellers, *Obeliscus* (*Pseudobalea*) *latus* (whose shell aperature faces left) stands out, as do the two introduced mollusks, *Subulina octona* and *Hawaiia minuscula*. Also noteworthy is *Oleacina solidula*, a mollusk predator of other mollusks, whose presence is evidence of the great diversity of ground-dwelling malacofauna.

Among the arboreal malacofauna, *Caracolus sagemon* subsp. nov. and *Zachrysia bayamensis* (Fig. 4C) are abundant and *Troschelvindex arangiana magistra* (Fig. 4A) is common. Some species occupy both habitats: *Emoda pulcherrima pulcherrima* (Fig. 4B), *Zachrysia bayamensis*, *Caracolus sagemon* subsp. nov., *Coryda alauda*, *Cysticopsis lessavillei*, and *Obeliscus clavus flavus*.

Habitats vary in species richness, and broadleaf forests and the gallery forests have the greatest numbers (nine and eight, respectively). These two habitats hold eight species in common, all endemic to Cuba or more restricted areas within Cuba, of which five are common, two abundant, and one uncommon. Pine forest has the lowest species richness, with only two species, both uncommon. This depauperate mollusk fauna appears to be characteristic of pine forests, since similar data were obtained for corresponding habitat at El Olimpo, close to the Reserve, by Maceira (2000).

THREATS AND RECOMMENDATIONS

Specific threats to terrestrial mollusks in the Reserve have not been identified. Considering that (1) the malacofauna recorded for the Reserve has a high degree of endemism, (2) for some species present the area is their second locality record, and (3) one subspecies recorded during the inventory may be new to science, I recommend management for conservation of broadleaf and gallery forests, where the majority of these species occur. Also, I recommend that plantation pine forests be managed so that their replacement by broadleaf forests by ecological succession is accelerated, since the former impoverish the soils and do not support the malacofauna of the Reserve.

SPIDERS

Participant/Author: Alexander Sánchez-Ruiz

Conservation targets: Populations of 12 species endemic to Cuba and living in Pico Mogote Ecological Reserve, particularly 3 species known only from a few localities within the Sierra Maestra (*Citharacanthus alayoni, C. cyaneus*, and *Drymusa armasi*) and one 1 species known only from the Eastern Region of Cuba (*Ischnothele longicauda*).

METHODS

During the five days of fieldwork in Pico Mogote Ecological Reserve, I conducted several three-hour surveys, actively searching for adult spiders, which are primarily found on vegetation, on the ground, under rocks, in the leaf litter, on fallen tree trunks, or in epiphytic bromeliads. I searched the entire length of the road in the gallery forest, along the San Antonio River, and in the pine groves and broadleaf forest in the western part of the Reserve. In general, I carried out two surveys per day. All surveys were conducted during the day. Specimens were collected at night only in the area around the campsite.

To compile the species list, I took into account collections made during the rapid inventory as well as previous records for the study area. I reviewed the following studies: Alayo (1957), Alayón (1972,

1985, 1992, 2000), Alayón and Platnick (1993), Bryant (1936, 1940), Franganillo (1936), Gruia (1983), Levi (1959, 1985, 1992), Rudloff (1994, 1995), and Sánchez-Ruiz (2000).

The spider fauna of the Reserve has not been studied systematically. Previous publications have been based solely on a few collections in the area and have lacked studies of ecology, behavior, characterization, or populations.

RESULTS

During the rapid inventory of the Reserve, I examined 212 specimens, of which 159 (75%) were identified to the species level. Ten species records were taken from the literature consulted, of which seven were confirmed to be present in the area. Remaining species are new records for the area.

I was able to identify 58 species of spiders, grouped in 22 families and 45 genera. Table 1 shows the percentages of spider species represented with respect to Cuba and the Sierra Maestra. Despite its very small area, as compared with that of the Sierra Maestra or Cuba, and the limited time available for conducting the inventory, the Reserve is rich in species, genera, and families of spiders.

The families with the most species present in the Reserve were Araneidae, Theridiidae, and Salticidae. Of the 247 species endemic to Cuba listed by Alayón (2000), 12 species (4.9%) occur in the Reserve, as do 13.2% of all endemics of the Sierra Maestra. Of these Cuban endemics present in the Reserve, three are known only from the Sierra Maestra (see below) and one one (*Ischnothele longicauda*) is found only in a few localities in the Eastern Region of Cuba.

Several species found during the inventory are characteristic of disturbed environments (Figs. 4D, 4E). Eleven such species were collected only on roadsides; none was ever seen within forests. Apparently these species were transferred by humans or used the road as a path of population dispersal but have not colonized forest habitats. Such is the case with species such as *Latrodectus mactans*, which in general is more abundant in arid and disturbed environments. *Cyclosa caroli* and *C. walckenaeri* are also typical of open areas and dry environments. *Peucetia viridans* generally lives among low vegetation in disturbed areas. *Menemerus bivittatus* is one of the species most common in houses.

THREATS AND RECOMMENDATIONS

Given the fragility of species populations with small distributional ranges, these undoubtedly will be the first to disappear as the loss of their habitats intensifies. In the specific case of the spider fauna of the Reserve, we should focus attention on populations of the three species endemic to the Sierra Maestra that were found during the rapid inventory.

Citharacanthus alayoni is known from only three localities in the Sierra Maestra, and one of these (the Gran Piedra) is adjacent to the west boundary of the Reserve. During the inventory, I collected two adult

Table 1. Spider taxa in Cuba, the Sierra Maestra, and Pico Mogote Ecological Reserve.

Category of spiders	Number of taxa in Cuba Alayón (2000)	% of Cuban taxa in the Reserve	Number of taxa in the Sierra Maestra Sánchez-Ruiz (2000)	% of Sierra Maestra taxa in the Reserve
Species	568	10.2	230	25.2
Genera	243	18.5	130	34.6
Families	53	41.5	38	57.9
Araneomorphae	48	39.5	35	54.3
Mygalomorphae	5	60.0	3	100.0
Endemics	247	4.9	91	13.2

specimens under rocks in the gallery forest. *Citharacanthus cyaneus* is also known from only three localities in the Sierra Maestra and was found in the Reserve under rocks in broadleaf forests. *Drymusa armasi* is the other Sierra Maestra endemic. However, its populations are found only in the Sierra de la Gran Piedra, where they are very abundant.

OTHER ARACHNIDS
(Scorpiones, Amblypygi, and Schizomida)

Author: Rolando Teruel

Conservation targets: Populations of *Rhopalurus junceus* and *Rowlandius* sp. nov., found in cloud scrub, in montane rainforest, and in pine plantations with relicts of native pine grove

METHODS

I conducted all arachnid surveys prior to the rapid inventory. I detected individuals visually by turning over rocks and fallen tree trunks, stripping bark from tree trunks and dead branches, and examining the inside of epiphytic bromeliads. I captured specimens less than 5 mm long using a brush soaked in 80% ethanol and larger specimens with entomological tweezers appropriate for their size and exoskeletal hardness. All material was preserved in 80% ethanol and deposited in BIOECO's collections, properly tagged.

RESULTS

I captured four species, belonging to three orders, three families, and four genera (Appendix 7). This degree of diversity may appear low, but, unlike the pattern in other regions of the Americas and the rest of the world, diversity of these groups in the mountains of the Cuban archipelago decreases markedly with altitude. Above 1,000 m, finding more than one species of each of these orders in any one locality is rare (Armas 1984, 1988; Teruel 1997, 2000a, 2000b, 2001). Therefore, the number of species recorded here, while low, is expected.

Table 2 shows a comparison of the arachnofauna (excluding spiders) of the Reserve (as identified in this study) with all those of the Sierra Maestra (Teruel 2000b, 2001).

Of the species of each order present in the Sierra Maestra, 9% of the Scorpionida, 14% of the Amblypigi, and 8% of the Schizomida are present in the Reserve. Because this reserve encompasses only 0.01% of the national territory of Cuba, the size of its nonspider arachnofauna in these groups is significant.

Four species present in the Reserve are Cuban endemics of diverse types: two endemic to Cuba (the scorpions), one endemic to the Eastern Region of Cuba (the whip scorpion, or amblypigid), and one local to the Sierra Maestra (a schizomid whip-scorpion). One possible cause for the apparent absence of nonendemic species in the Reserve may be that, at least in the Sierra Maestra, they are generally distributed in highly disturbed localities or at very low altitude (Armas 1988; Teruel 1997, 2000b, 2001).

Two records are notable. First, the discovery of a species of *Rowlandius* (Schizomida) that is new to science, currently being described, known previously only from the summit of the Gran Piedra (Armas 2002).

Table 2. Arachnid taxa (except spiders) in the Sierra Maestra and Pico Mogote Ecological Reserve, Cuba.

	Number in the Sierra Maestra				Number in the Reserve			
Order	Families	Genera	Species	Cuban endemics	Families	Genera	Species	Cuban endemics
Scorpionida	2	5	22	20	1	2	2	2
Amblypygi	2	3	7	4	1	1	1	1
Schizomida	1	5	12	11	1	1	1	1
TOTALS	**5**	**13**	**41**	**35**	**3**	**4**	**4**	**4**

Second, the discovery at 1,130 m of a population of *Rhopalurus junceus* (Scorpionida; Fig. 4F), a species endemic to Cuba, which previously was not recorded at altitudes above 800 m (Teruel 1997).

THREATS AND RECOMMENDATIONS

Habitat destruction is the greatest threat to these arachnids. The current vegetative cover of the Reserve shelters significant populations of the two conservation-target species and should be protected. The new species of *Rowlandius* is known only from the Reserve and the summit of the Gran Piedra, where available habitat has been drastically reduced by human activity. Such destruction could lead to the extirpation of the species. In contrast, *Rhopalurus junceus* (Fig. 4F) is widespread in the Cuban archipelago but the population at 1,130 m is very unusual for this genus and deserves protection.

BUTTERFLIES

Participant/Author: Jorge Luis Fontenla R.

Conservation targets: The rare and charismatic species *Calisto sibylla, Anaea cubana, Hamadryas februa, Hypna clytemnestra*, and *Astraptes habana*

METHODS

I made observations around the base of Pico Mogote, along the road leading to the summit, and at the summit itself. The summit is characterized by some intact, as well as secondary, vegetation, in which are found the ruins of some abandoned buildings. I worked from 21 to 25 September 2002, during the mornings and part of the afternoons, except when rainfall prevented the insects from flying.

RESULTS

I observed 24 species (Appendix 8). About 60% of these also are present in the coastal zone, despite the differences between the areas, perhaps because the disturbed habitats of Pico Mogote are open and sunny. Species typical of montane forests, such as *Calisto sibylla*, were present, also. Although an accurate assessment of butterfly species composition in a particular locality requires survey efforts over several months, I estimate the number of species in the area at approximately 35.

THREATS AND RECOMMENDATIONS

The primary threat is deforestation. The first priority for conserving species that are rare or are habitat specialists, such as *Calisto sibylla, Anaea cubana*, and *Hypna clytemnestra*, is to prevent deforestation in the area.

HYMENOPTERANS

Participants/Authors: Eduardo Portuondo F. and Jorge Luis Fontenla R.

Conservation targets: Hymenopterans endemic to Cuba

INTRODUCTION

Hymenopterans are considered one of the most evolved groups of insects, as much for the social level reached by some of their members, such as bees and ants, as for their degree of specialization and dependency with other organisms. Because of this, some hymenopterans are considered key species in ecosystems (LaSalle and Gauld 1994).

Although hymenopterans are better known in Cuba than in some other parts of the Antilles, our understanding of their species assemblages, ecology, and ethology is still far from broad. For Cuba, 1,069 species have been recorded, belonging to 474 genera of 49 families (Genaro and Tejuca 2000). This species count may constitute 35%–50% of the actual total. In the case of the Sierra Maestra, one of our most important mountain ranges because of its size, altitude, and habitat diversity, 242 species and 35 families have been recorded (Portuondo 2000). These are high numbers considering that a large percentage of the parasitic wasps, despite their diversity, have not yet been identified.

The Sierra de la Gran Piedra has the highest elevations of the easternmost end of the Sierra Maestra, an important factor in the spatial distribution of biodiversity. In this mountain range, Pico Mogote Ecological Reserve protects an area that has recovered to a notable degree from past disturbance by humans.

METHODS

Survey methods consisted of the use of a Malaise trap and 50 water-filled, yellow plastic pans (used to trap flying insects that fall into them), which, given climatic conditions created by Hurricane Lily, could be used only for 72 hours and 8 hours, respectively. We also included data from published records and from specimens already in the BIOECO collection.

RESULTS

For the study area, we identified 133 species belonging to 30 families and 116 genera (Appendix 9). Given estimates that only 12% of Cuban hymenopterans are known, we estimate that more than 200–300 species may be present in the Reserve.

A determination of the proportion of endemism is not complete because no review of Cuban hymenopterans exists. Likewise, limited information and the collecting methods did not allow us to be sure of habitat distribution of the captured species.

The abundance of parasitic hymenopterans, typical of forested areas, is notable. Some groups stand out, despite the lack of knowledge of their species composition, namely the scelionid (Scelionidae), diapriid (Diapriidae), and chalcid (Chalcicoidea) wasps.

The family with the greatest number of species was Formicidae (the ants). The most common and abundant species were the opportunists and well-dispersed species (Fontenla 1995), reflecting the degree of disturbance in the area. Nevertheless, we found some endemics, such as species of *Lepthotoras* and *Camponotus*.

THREATS AND RECOMMENDATIONS

The principal threat to the Reserve is deforestation, given its limited area and the logged forests surrounding it. Habitat destruction is likely to be the major threat to hymenopterans, as well. Management plans to protect and restore native species and vegetation would contribute to the survival of these insects in the Reserve.

AMPHIBIANS AND REPTILES

Participant/Author: Ansel Fong G.

Conservation targets: Species with restricted geographic distributions (*Eleutherodactylus gundlachi, E. intermedius, Sphaerodactylus ramsdeni, Anolis rejectus*), and amphibian species that could have experienced population declines elsewhere in Latin America (e.g., those in the genus *Eleutherodactylus*)

METHODS

From 20 to 25 September 2002, I recorded species that were observed or heard in the study area. I actively searched during the day and night and made casual observations, for example, when moving from one site to another. The search included all microhabitats where amphibians and reptiles might be seen, from the ground up to the treetops, including the leaf-litter layer, fallen tree trunks, under rocks, on branches and trunks of trees and bushes, in bromeliads, and under bark. To examine the upper parts of the tallest trees, I used 8x30-power binoculars.

To evaluate abundance in each habitat, I recorded the number of individuals observed of each species, as well as the amount of time spent searching and the number of people participating. With these data, I calculated an index of relative abundance in the form of the number of individuals observed per person-hour of observation.

RESULTS

I recorded 12 species of amphibians (all frogs) and 15 species of reptiles, including 12 lizards and 3 snakes

(Appendix 10). Although no previous records exist for Pico Mogote Ecological Reserve, I predict the presence of at least 4 other reptiles (2 species of the genus *Anolis* and 1 species each from the genera *Diploglossus* and *Typhlops*) on the basis of their existence within Gran Piedra Protected Natural Landscape, which is adjacent to the Reserve and has similar characteristics.

The number of amphibians found is 20.7% of the amphibian species in Cuba, whereas the reptiles constitute 11% of Cuban species. Although these numbers may appear low, they gain importance if one keeps in mind that the Reserve covers only 0.01% of Cuban territory. These species also constitute 42.9% of the amphibians and 21.7% of the reptiles recorded for the Sierra Maestra, the massif that includes the Reserve and that is one of the most important for the herpetofauna of Cuba (Fong 2000).

Eleven (91.7%) of the Reserve's amphibian species and 12 (80%) of its reptiles are endemic (either to Cuba or to the Eastern Region of Cuba). These values are very close to the proportions of endemism for both groups in Cuba (Fong 2000), and correspond to 20% and 18% of the endemic amphibians and reptiles of Cuba, respectively. These numbers highlight the importance of this small area (14.9 km^2) for the conservation of Cuba's herpetofauna, especially the endemic species.

Among the endemics, six amphibians and one reptile are exclusive to the two mountain chains of the Eastern Region of Cuba. Two other reptile species have a more restricted distribution: (1) *Anolis rejectus* is found only in the Sierra de la Gran Piedra, in the Sierra de Boniato, and on the Altiplanicie Santa María del Loreto, Santiago de Cuba Province, in an area of some 300 km^2; and (2) *Sphaerodactylus ramsdeni* (Fig. 5I) is known only from isolated localities in the Sierra de la Gran Piedra and on the Meseta del Guaso, the two separated by about 70 km as the crow flies. These nine species with restricted distributions constitute 39.1% of the endemics in the Reserve; that is, more than one-third of endemic species present in this area are exclusive at least to the Eastern Region of Cuba.

The Reserve is important not only for Cuban endemism but also for the Caribbean. The fact that only 4 species out of 27 are not endemic to Cuba (or restricted areas within Cuba) is striking, but given that 3 of these 4 species live only in the Antilles, the endemism takes on additional significance. For their part, 2 of these species are shared by only two groups of Caribbean islands: Cuba and the Bahamas for *Ameiva auberi*, and Cuba and the Cayman Islands for *Alsophis cantherigerus* (Fig. 5G).

The genera with the greatest number of species were *Eleutherodactylus* (Figs. 5A–F) and *Anolis* (Appendix 10), which is to be expected because these taxa are dominant in the Cuban herpetofauna (Fong 2000). With respect to abundance, four frogs (*Eleutherodactylus auriculatus, E. dimidiatus, E. ionthus,* and *E. limbatus*) and two lizards (*Anolis allogus* and *A. alutaceus*) dominated the amphibian and reptilian fauna of the Reserve. These species are typically the most abundant in the montane forests of eastern Cuba. Other lizards (*Anolis homolechis* and *Leiocephalus cubensis*) were also abundant but in secondary vegetation and especially on roadsides.

I observed the greatest number of species in secondary vegetation (Appendix 10). This habitat includes many different types of vegetation, including secondary forests of rose apple (*Syzygium jambos*, Myrtaceae), those of mango (*Mangifera indica*, Anacardiaceae), and disturbed vegetation. At least five species were found only on roadsides: the lizards *Anolis homolechis, Anolis sagrei, Ameiva auberi*, and *Leiocephalus cubensis*, and the snake *Antillophis andreae* (Fig. 5H).

The broadleaf forests also have a large number of species, three of which were seen only in this habitat type: the frogs *Eleutherodactylus gundlachi* and *E. intermedius* (Figs. 5D, 5E), and the lizard *Sphaerodactylus ramsdeni* (Fig. 5I). Other habitats had equal numbers of species, and, with the exception of the pine forests, the rest share all their species with the other habitats. In pine groves I observed one species, the lizard *Chamaeleolis porcus* (Fig. 5J) that was not seen in other habitats.

THREATS AND RECOMMENDATIONS

Although none of the species found in this survey is included on the Red List of Threatened Species (Hilton-Taylor 2000), three of the reptiles were considered threatened in a national study of biodiversity in Cuba (Vales et al. 1998). These three, the lizards *Anolis isolepis*, *A. rejectus*, and *Chamaeleolis porcus*, were considered "Vulnerable" because of their limited geographic distribution and habitat restriction (they live only in forests), and their primary threat is the destruction of their habitats. Thus, the Reserve is especially important as a refuge for these three species that may be threatened at unprotected sites elsewhere in Cuba.

In recent decades, population reductions and species extinctions have been recorded for amphibians around the world (Barinaga 1990, Wake 1991). In Cuba this phenomenon has not been observed, although a few species have disappeared from areas where their habitats have been altered (Fong 1999). But losses of populations and species on other Caribbean islands, such as Hispaniola and Puerto Rico (Hedges 1993, Joglar and Burrowes 1996) call for vigilance in Cuba as well. These declines have occurred mainly in species of *Eleutherodactylus* in mountainous areas, especially above 800 m, and suggest that surveillance of population fluctuations of these frogs within the Reserve will be critical. We also need research on the causes of any declines—including human disturbance—noted in the area. Monitoring programs, such as that initiated recently in the area adjacent to the Gran Piedra, could help us to understand these phenomena.

BIRDS

Participants/Authors: Luis O. Melián Hernández, Douglas F. Stotz, Debra K. Moskovits, and Freddy Rodríguez Santana

Conservation targets: Threatened species (*Accipiter gundlachi, Asio stygius, Geotrygon caniceps*), birds endemic to Cuba (*Accipiter gundlachi, Gymnoglaux lawrencii, Glaucidium siju, Priotelus temnurus, Todus multicolor, Xiphidiopicus percussus, Vireo gundlachii, Teretistris fornsi, Dives atroviolaceus*), North American winter migratory species (*Dendroica caerulescens, D. discolor, D. dominica, D. tigrina, Limnothlypis swainsoni*), including migratory raptors (*Pandion haliaetus, Elanoides forficatus, Buteo platypterus, Falco columbarius, F. peregrinus, Accipiter striatus*), and *Streptoprocne zonaris* and *Cypseloides niger*

METHODS

Melián, Stotz, and Moskovits were the ornithologists charged with the inventory of Pico Mogote Ecological Reserve. Rodríguez contributed additional information on migratory raptors and threatened species. We surveyed birds by walking along paths, recording each bird seen or heard. We began the surveys one-half hour to an hour before daybreak and remained in the field while light was available, except for a couple of hours during midday. We searched for nocturnal species (owls) at night, using the calls of these species. The number of individuals observed, for each bird species, was used to determine the relative abundance of the bird in the area.

RESULTS

We registered 48 bird species during the inventory, from 22 to 25 September 2002. For the area around the Reserve, 83 species are known (Appendix 11).

We surveyed elevations from 600 to 1,100 m in the Reserve, with the majority of the surveys between 750 and 1,000 m. The entire region is composed of broadleaf and secondary forests, as well as other areas planted with pines (*Pinus caribaea* and *P. maestrensis*).

Endemic species

Some 22 species of birds are endemic to Cuba (including Cuban Martin, *Progne cryptoleuca*, which is restricted to Cuba as a breeder but winters elsewhere, probably in South America). We observed 9 of

these endemic species during the inventory (Fig. 6): Gundlach's Hawk (*Accipiter gundlachi*), Cuban Bare-legged Owl (*Gymnoglaux lawrencii*), Cuban Pygmy-Owl (*Glaucidium siju*), Cuban Trogon (*Priotelus temnurus*), Cuban Tody (*Todus multicolor*), Cuban Green Woodpecker (*Xiphidiopicus percussus*), Cuban Vireo (*Vireo gundlachii*), Oriente Warbler (*Teretistris fornsi*), and Cuban Blackbird (*Dives atroviolaceus*).

The majority of the endemics are forest birds, an encouraging sign that, despite the disturbance in the area, a forest avifauna has been preserved. For this avifauna, the Reserve could serve as the foundation for the creation of a system of forest reserves with good populations of endemic species in the mountains east of Santiago de Cuba. Populations of two of the endemics, Cuban Tody (*Todus multicolor*) and Oriente Warbler (*Teretistris fornsi*), are dense.

Threatened species

Gundlach's Hawk (Accipiter gundlachi)

This species appears to have a substantial population in the area. During the inventory we observed Gundlach's Hawk (Fig. 6B) on three occasions and made another brief sighting of an *Accipiter* that was probably this species. It is threatened in this area primarily by hunting. Residents consider it a threat to domestic fowl, on which the hawks frequently feed. Another threat to this species in the area is the loss and fragmentation of its habitats (Collar et al. 1994). Recent studies (Rodríguez S., unpublished data) indicate that the Reserve and the Sierra de la Gran Piedra maintain a substantial population of this species. During a single year of work, Rodríguez found ten nests made by at least three pairs of Gundlach's Hawks in Gran Piedra Protected Natural Landscape alone, in addition to three other nest sites between Pico Mogote and the community of Gran Piedra. This subpopulation was not included as one of the five known populations centers of this species by Collar et al. (1992) but is important because of its considerable size.

Stygian Owl (*Asio stygius*)

This species is rare in Cuba, and its population in the Reserve is small. It was not observed during the inventory but has been reported previously for the area. The primary threat in the area is hunting. Local residents believe this species is an omen of bad luck and death, so individuals are killed when possible. Another threat is the loss and fragmentation of its habitats.

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

This species is very rare in the Reserve and in Cuba as a whole. It was not observed during the inventory but has been reported previously for the area. The primary threat is the loss and fragmentation of its habitats, as well as hunting. It appears to be in decline. No numerical data exist, but Melián has observed a decrease in its populations in areas bordering the Gran Piedra. The exact situation in the Gran Piedra is not known because the first report of this species for the area is recent (2002), by Melián

Extirpated species

Several bird species that at one time lived in the Gran Piedra and surrounding areas, including Pico Mogote Ecological Reserve, are no longer found there. Hunting, loss of habitats, and fragmentation and degradation of forest remnants are the primary cause of the disappearance of these species from the area.

A hunter from the city of Santiago de Cuba reported catching a Cuban Parakeet (*Aratinga euops*), which was part of a flock, in the area around the Gran Piedra about 20 years ago. Populations of Cuban Parrot (*Amazona leucocephala*), previously widely distributed throughout the Sierra Maestra, have gradually decreased in this entire area and are now found only in the westernmost part of the massif, within Desembarco del Granma National Park. Because this latter species often inhabits areas and habitat types where Cuban Parakeet also lives, Cuban Parrot probably lived some years ago in the forests of the eastern Sierra Maestra, including the area that later became Gran Piedra Protected Natural Landscape and Pico Mogote Ecological

Reserve, and was eradicated at the same time as Cuban Parakeet. For both species, the cause was the same: capture for sale as pets, and the loss and fragmentation of habitats.

Rodríguez has reported Bee Hummingbird (*Mellisuga helenae*) consistently, since April 2001, in the coastal area of Siboney, south of the Gran Piedra. All have been juvenile males.

Melián obtained the last report of Giant Kingbird (*Tyrannus cubensis*) for the area around the Gran Piedra in 1975. No other nearby population center is known for this species in the easternmost part of the Sierra Maestra. Probably it has been eradicated from this area.

Given its past distribution in the Sierra Maestra, Cuban Crow (*Corvus nasicus*) probably once lived around the Gran Piedra. Its gradual disappearance in recent times from many localities of the Sierra Maestra makes us think that the same occurred long ago around the Gran Piedra. In the region of the Gran Piedra, remnant forests exist that have characteristics similar to those of forests still occupied by this species in the western part of the Sierra Maestra.

Cuban Solitaire (*Myadestes elisabeth*) is another bird species extirpated from the area of the Gran Piedra. According to Viña Bayés (pers. comm.), this species still occurred around the Gran Piedra in the late 1950s. Its current distribution in the Sierra Maestra is confined to the Turquino and La Bayamesa massifs, which are still covered by an expanse of remnant forest that is sufficient to maintain viable populations of this species.

Other observations

We observed a flock of 12 White-collared Swifts (*Streptoprocne zonaris*) on the afternoon of 24 September. This species, like Black Swift (*Cypseloides niger*), is rare as a permanent resident in Cuba. Both breed in the mountains around the Reserve.

Studies by Bildstein et al. (2002) and Rodríguez et al. (2001, 2002, 2003) have demonstrated that the Sierra Maestra, specifically the Sierra de the Gran Piedra, including the Reserve, is an important migratory route for raptors traveling from North America to or through the Caribbean, especially for Osprey (*Pandion haliaetus*) and Swallow-tailed Kite (*Elanoides forficatus*). Previously ornithologists thought that the kite's migratory route through Cuba included only the westernmost tip of the island. However, we now know that a small part of the North American population of this species migrates to the eastern tip of Cuba and probably to other Caribbean islands. In addition to these two raptor species, Broad-winged Hawks (*Buteo platypterus*), Merlins (*Falco columbarius*), Peregrine Falcons (*Falco peregrinus*), and Sharp-shinned Hawks (*Accipiter striatus*) migrate over the Gran Piedra.

Other migratory species

Although this inventory was conducted somewhat early in the migration season for a large number of North American migratory species, the Reserve apparently serves as an important area for some, such as Black-throated Blue Warbler (*Dendroica caerulescens*), which migrates exclusively to the Caribbean. This species was the most abundant migratory bird observed. Cape May Warbler (*D. tigrina;* Fig. 6D), another species that migrates exclusively to the Caribbean, may also overwinter in the area in significant numbers. Other migratory species observed regularly were Black-and-white Warbler (*Mniotilta varia*), Prairie Warbler (*Dendroica discolor*), and Yellow-throated Warbler (*D. dominica*). Swainson's Warbler (*Limnothlypis swainsonii*), a scarce migratory bird that spends winters in Cuba, was seen only once. This species probably does not remain in this area during the winter. Because this inventory was carried out during the migratory period, the importance of the Reserve as a winter home for many migratory species would have to be determined by an additional study during the winter.

Abundance of small, fruit-eating birds

Certain species of frugivorous passeriform birds, as well as the primarily nectarivorous Cuban Emerald Hummingbird (*Chlorostilbon ricordii*), were abundant. We saw large flocks of Stripe-headed Tanager (*Spindalis zena*) and Red-legged Honeycreeper (*Cyanerpes*

cyaneus), mixed with other bird species. We observed flocks of up to 15 individuals of each species on several occasions, and daily totals for these species were around 100 individuals. Both species were attracted, along with other birds, to the fruits of a small tree (*Trema micrantha*, Ulmaceae), which grows along forest edges. Other resident species that were part of these flocks included Oriente Warbler (*Teretistris fornsi*), Cuban Bullfinch (*Melopyrrha nigra*), and Cuban Vireo (*Vireo gundlachii*).

Conservation opportunities

The avifauna of Cuba is diverse as compared with that of the rest of the Antilles, having the greatest number of endemic species and greatest total species richness. The Eastern Region of Cuba is an important center of diversity for many endemic taxa. Birds are relatively more widespread than most other endemic taxa, and most Cuban endemic birds occur or occurred through much of Cuba. Because of the loss of most lowland forests in Cuba, however, montane forests act as refuges for many bird populations that used to occur more widely at low elevations. Although the area protected in the Reserve is not extensive and the habitat has been degraded, the large populations of many forest-dwelling species suggest that continued protection and management could sustain an important population center for a suite of Cuban endemic and near-endemic birds.

The Reserve is currently under restricted and controlled access, and a corps of rangers in the area offers some protection. BIOECO, a scientific institution in Santiago de Cuba with the capability to develop and establish management plans in the area, can aid in research or conservation actions.

The region neighboring the Reserve, Gran Piedra Protected Natural Landscape, has been well studied and offers an opportunity for limited use as an area for nature tourism.

Many opportunities exist for the study and development of management techniques for reforestation and the control of invasive species, as well as for ecological studies (for example, studies of the impact of management actions on the avifauna of the area, and population studies on the ecology of threatened, endemic, and migratory species in native remnant forests and in secondary forests). The existence of an ecological station (Fig. 2A) and of an adequate infrastructure, as well as access to the city of Santiago de Cuba, may facilitate these studies greatly. Also, a migratory raptor observatory at Gran Piedra provides a great opportunity for environmental education for residents of the area, who assisted with species counts on a volunteer basis during a two-year inventory organized by BIOECO staff.

THREATS AND RECOMMENDATIONS

The primary threats detected in the Reserve arise from the introduction of plants and animals, e.g., dogs, cats, rats, and pigs. Pigs, in particular, destroy the understory of the areas they pass through. A plan should be developed and implemented to (1) control and eliminate introduced plants, as well as to control the population of feral dogs, (2) eliminate or control the population of feral pigs, and (3) prevent the introduction of other animals by the residents of the area. Such programs should involve local residents in conservation actions.

Some families practice agriculture within the Reserve. Others have clandestine plots in areas of native forest along the Reserve's borders (which can be considered buffer zones). We consider both activities potential threats to its biodiversity. Ways to lessen the impact of these actions include developing other economic options for these area residents, improving relations with them, and improving protection of the Reserve.

Another potential threat is the use of improper methods of road contruction, which cause excessive erosion. This can be addressed by continued work with the forest management agency in the area, the Empresa Forestal Integral Gran Piedra.

Hunting, especially of Gray-headed Quail-Dove, Gundlach's Hawk, and Stygian Owl, may lead to the extirpation of these species in the area; other species

have suffered this fate. The development of new, specific laws to protect these threatened species, in particular Gundlach's Hawk and Stygian Owl, as well as environmental education of area residents, may aid their conservation significantly. The development of a pilot program to compensate residents for losses caused by the nesting of Gundlach's Hawk on their lands could contribute to the conservation of this species.

Other recommendations for the area include the following:

- Conduct population inventories of migratory North American birds
- Locate the nesting sites of White-collared Swift and of Black Swift and ensure their protection
- Create maps of the distribution of all remnant native forest stands, to facilitate management actions
- Study the status of threatened bird populations, especially those of Gundlach's Hawk
- Investigate the causes of extinction of several bird species in the area of the Gran Piedra
- Study habitat use by birds (especially comparing the use of old, native forests versus young, secondary forests and introduced plants)
- Continue to track raptor migration

MAMMALS

Participant/Author: Nicasio Viña D.

Conservation targets: Endemic species and bat communities

METHODS

I base the following account on two sources of information: data from several years of work in the area, which recorded mammal species present, and published literature (Alayo 1958; Silva 1979).

RESULTS

Six native species of bats and three native rodent species have been reported in the Reserve (Appendix 12). Six introduced species of mammals are also known.

Bats

All of the reports of bats are based on occasional captures. No large caves or large bat colonies exist in the study area. Populations are limited to small groups of tree-roosting species (which can be caught only with nets) and a few colonies of species that live in crevices within rock outcrops.

Two of these bat species (*Artibeus jamaicensis parvipes* and *Brachyphylla nana nana*) inhabit abandoned woodpecker nests or natural cavities in large tree boles; the first of these two species is frugivorous and the second pollinivorous. *Macrotus waterhousei minor* and *Eptesicus fuscus dutertreus* are insectivores and live in fissures in rock outcrops. *Molossus molussus tropidorhynchus* also is insectivorous, but its presence is associated with human homes. *Phyllonycteris poeyi* is essentially pollinivorous. It is the only endemic species among the six bats and is strictly a cave dweller. It probably uses the Reserve because it is known from the general area, and can fly great distances.

Native rodents

We found two species of native rodents, the hutias *Capromys pilorides* and *C. melanurus*, although, according to some descriptions, *C. prehensilis* may also be present. These hutia species are widespread in the area and historically have been hunted with traps and firearms. Although these species are covered by a permanent hunting ban, they continue to be caught surreptitiously. No one has studied their populations or the impact of hunting on them.

Introduced species

Of the six introduced species, three are rodents: *Mus musculus brevirostris, Rattus norvegicus*, and *R. rattus rattus*. All arrived accidentally with European colonization.

The other three species are domesticated animals that have escaped from captivity and have adapted to life in the wild. Dogs (*Canis familiaris*), cats (*Felis catus*), and pigs (*Sus scrofa*) all have established populations in the Reserve.

The impact of the six introduced species on the native fauna remains unevaluated.

THREATS AND RECOMMENDATIONS

Threats

- Illicit hunting of hutias.
- Potential competition with, and predation by, introduced mammal species.

Recommendations

- Study the impact of introduced species on populations of native mammals.
- Increase conservation action on behalf of the hutias, giving priority to work with communities. Studies of population status and the effectiveness of management are high priority.
- Increase knowledge of resource use in bats in the Sierra de la Gran Piedra.

HUMAN HISTORY

Participant/Author: José Jiménez Santander

Conservation targets: Archeological remains of the French coffee plantations La Gran Sofía and Kentucky, and the aquaeduct system of the old La Africana coffee plantation

Almost a secret, the area around Pico Mogote, an undisturbed mountain peak, was sparsely inhabited during the first 70 years of the nineteenth century, a period during which it must have acquired its name (in reference to the similarity of its shape to dome-shaped mountains in western Cuba). It was not populated by pre-Columbian peoples, even though the foothills of the Sierra de la Gran Piedra had an indigenous presence from very early times.

The first written reference to Pico Mogote was made by Grand Admiral Christopher Columbus on Tuesday, 1 May 1494: "…sailing close to the island's shore, and I saw, every hour, marvelous harbors [Guantánamo Bay], which the island certainly has; they saw high mountains [Pico Mogote and the Gran Piedra] and rivers running out to the sea [the Baconao River]..." (Las Casas 1875).

Colonization of the island of Cuba began 16 years after that first of May. Seven towns were initially founded. In the last, Santiago de Cuba, new plantations were established where the inhabitants of the island were concentrated. The areas around Pico Mogote were within the boundaries of these plantations, but they were not populated and perhaps not even visited.

The scarcity of gold, the coveted treasure that brought the Spaniards to America, obliged them to look for other, fundamentally agricultural, economic alternatives, e.g., sugarcane, tobacco, and lumber. The island became full of sugar mills and tobacco plantations, but Pico Mogote was not exploited until 390 years later.

Human colonization in the region was provoked by a historic, international event: the revolution in Haiti in the last decade of the eighteenth century. The rebellion of the slaves against their masters compelled the coffee farmers of that country to leave quickly for other places in the Caribbean, and they mainly chose eastern Cuba. Deteriorating relations between Spain and France during those years forced these first immigrants, after much negotiation, to establish themselves in the mountainous area outside the city, finally settling in the Sierra de la Gran Piedra, where they acquired land for coffee production, decisively establishing this industry in Cuba.

This settlement radically changed the destiny of what later became Baconao Biosphere Reserve. Hundreds of coffee plantations were constructed with slave labor, and the construction of an important network of roads and paths was promoted, many of which, after 200 years, are still in use. The plantations nestled deep within, or with land holdings in, Pico Mogote Reserve were La Gran Sofía, La Africana,

San Antonio, San James, and La Carolina. Important to these plantations was the slave work force, which, in the second decade of the nineteenth century, reached a total of approximately 361 individuals.

The collapse of these five plantations occurred in the 1870s, caused by a drop in coffee prices, the height of the war against Spain for independence and against slavery (which began in 1868), and the strengthening of antislavery sentiment around the world. Some plantation owners established new lives in the city of Santiago de Cuba, while others returned to France. The vast majority of slaves made their way to the city in search of better fortune; a smaller number remained on those lands full of the pain of slavery.

The Cuban Revolution of 1959 changed the Cuban countryside yet again. The Sierra de la Gran Piedra received schools and doctors' offices. Highways were paved and made safe to travel. A hotel, a museum, and a garden were built. Electricity was brought in, and laws were passed to manage and protect the region.

Today, seven families—fewer than 25 inhabitants—live in the territory of Pico Mogote Reserve. They have inherited, along with their adjacent neighbors, a rich oral tradition full of legends, beliefs, and realities. Their religious beliefs range widely, from Catholic and Evangelical to sorcerer and spiritualist, an inheritance of the diversity of the population. But everyone is in agreement that this is a land privileged by the gods, provided with material and spiritual wealth, and they highly value the curative properties of certain plants that have been used since the earliest times. During the 1950s, one of the strongest and best-organized Cuban spiritualist sects placed a large cross on the western height of Pico Mogote, which could be seen from the entire southern part of the current Biosphere Reserve. It was torn down in 1963.

Pico Mogote, majestic, imposing, standing before all, maintains its secrets and its riches, and its human residents help sustain its mysteries.

THREATS AND RECOMMENDATIONS

The main threat to the historical record of the Reserve is the degradation of the plantation ruins at La Gran Sofía. Vegetation and water drainage are eroding these structures. I recommend that the ruins be protected from these processes so that they can persist as part of the cultural heritage of local communities, as well as a source of information for historians and visitors to the Reserve.

HUMAN COMMUNITIES

Participants/Authors: Mayelin Silot Leyva, Yazmín Peraza, and Aleine Paul

Conservation targets: Local residents interested in issues of biodiversity and education, an educational system that can readily accommodate environmental education activities, an ecological station near Gran Piedra (the community) and the Gran Piedra (which serves as a tourist attraction) that serves as a base for conservation operations in the area

INTRODUCTION

Although the historical effects of human actions are evident in the area (coffee and pine plantations, roads and paths, lumber extraction, and the introduction of exotic species), the human population is very sparse and scattered. Residents value activities that do not harm local biodiversity. Here we characterize the specific infrastructure and community focus on biodiversity of the residents of Gran Piedra, a community less than 8 km from the area where the rapid biological inventory took place. A previous study of environmental education in the community provided additional information on sustainable use and local conservation.

METHODS

From 22 to 25 September 2002, we used sociological techniques such as participant-observation, review of documents, and interviews with key members of the community, e.g., teachers, a doctor, a nurse, and a farmer. To assess the relationship of local residents with biodiversity, we held a workshop in the community.

RESULTS

The rugged geography of the zone does not permit concentration of dwellings. Of the 109 inhabitants of the community, approximately 25 live or use land within the boundaries of Pico Mogote Ecological Reserve.

The primary vocation is agriculture. Most workers are employed by commercial entities such as the forestry agency (Empresa Forestal Integral Gran Piedra) and the ornamental plant garden (Jardines de Plantas Ornamentales). A smaller number are employed by the local hotel. Access to the community is difficult because of the scarcity of transportation to and from Santiago and other population centers.

Living conditions in general are typical for rural people in remote places with difficult access. Structures have wooden walls and roofs made of cardboard or zinc shingles.

At present, the student population of the community center for primary education is only four individuals. Continued study at the secondary or university level takes place in distant locations, in the city of Santiago de Cuba or at boarding schools in other parts of the province.

In our view, the use of the natural resources by the residents of this region does not appear to constitute an immediate threat to conservation. A few cultivated plots for local consumption are managed in a way that degrades soil and vegetation. Illicit agriculture and wood harvest inside the Reserve now occur at a small scale but could increase without local surveillance and regulation.

THREATS AND RECOMMENDATIONS

Our social assessment revealed some strong assets for conservation, including (1) professionals and other personnel within the region who are prepared to develop environmental education programs and (2) specialists in the region who study biodiversity and systematics.

Nevertheless, several threats now handicap the prospects for conservation: (1) a shortage of resources for environmental education, (2) insufficient or ineffective signs and markers in the protected area, and (3) insufficient information available to local residents on the potential damage that their actions can cause in wild communities and the buffer zone.

We recommend the following:

- 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.
- Support park guards and local residents interested in the Reserve by providing more information about the local benefits that it provides. Supply them with guidelines for its use and protection, e.g., permitted activities and boundaries. Create and install additional, more informative signs about the Reserve, aimed at both local residents and visitors.
- Provide more materials about local flora and fauna to the environmental education program at Gran Piedra's school.