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The Field Museum

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

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Museo Nacional de Historia Natural de Cuba

The Museum's core mission is to collect, research, conserve, and exhibit natural objects to promote scientific 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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Centro de Investigaciones de Medio Ambiente de Camagüey (CIMAC)

The institution's mission is to develop and competitively market research and development projects, and scientific services, that support conservation and the management of natural and socioeconomic resources in the region, with the goal of sustainable development.

In support of their environmental programs, CIMAC staff members conduct several types of research, including studies of biodiversity, the structure and function of ecosystems, management of protected natural areas and of the broader region, regional development, and the design and implementation of geographic information systems (GIS).

CIMAC is an organizational unit of CITMA, the Ministerio de Ciencia, Tecnología y Medio Ambiente. CIMAC's structure consists of General Management and three Divisions:

- Biodiversity and Function of Ecosystems
- Regional Management
- Information and Digital Cartography

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ACKNOWLEDGMENTS

Our visit to the Sierra de Cubitas and the adjacent savanna was even briefer than the typical "rapid inventory." Nevertheless, during the four days that we had in the field we registered new species for the site and for the region, and made a preliminary evaluation of the condition and distribution of the terrestrial habitats. Our data, combined with data compiled by biologists with the Museo Nacional de Historia Natural (MNHN, in Havana) and the Centro de Investigaciones de Medio Ambiente de Camagüey (CIMAC, in Camagüey), allowed us to reach the basic goals of our inventory. Much of this information is published here for the first time. Our team of scientists thanks all of the collaborators who have shared data from their field studies and revisions of the literature.

We are grateful to each and everyone who helped us before, during, and after the inventory. Although we name some individuals below, all who helped us deserve our warmest thanks. In Havana, Mariana Sáker, Yazmín Peraza, and Regla Balmori of the Museo Nacional de Historia Natural de Cuba shared their friendship and organizational abilities. Reynaldo Estrada, of the Centro Nacional de Áreas Protegidas (CNAP), provided very valuable comments on the results and recommendations arising from our field work. The Ministerio de Ciencia, Tecnología y Medio Ambiente (CITMA) helped coordinate access to the area and permission for us to collect specimens for Cuban museums. The Cuban Interests Section in Washington, D.C. kindly granted visas for North American participants.

We thank our CITMA guides, Jorge R. Aguilar Pérez, Osmany Ramos, y Wilton Machado, who shared their knowledge of the area, and HAVANATUR staff for providing transportation to and from the Reserve. Dan Brinkmeier, Álvaro del Campo, Isa Halm, and Julie Smentek supplied logistical help in the frantic days prior to presentation of our preliminary results in Santiago and Havana. Robin Foster and Bil Alverson are indebted to Ramona Oviedo Prieto and Eddy Martínez Quesada for their generous help with plant identifications, using photos we took in the field.

Sophie Twichell and Tyana Wachter successfully established the many elements central to the success of our work, making the difficult look easy. We thank Amanda Zidek-Vanega for her translations, and Eddy Martínez Quesada, Sara Thompson, Brandy Pawlak, Guillermo Knell, and Corine Vrisendorp for many hours spent gleaning errors and inconsistencies from the report. We are grateful to Courtney Platt (Courtney Platt Photography, Grand Cayman, Cayman Islands) and Merlin Tuttle (Bat Conservation International, Austin, Texas) for allowing us to use their photos of bat species that reside in the Sierra. Thanks are also due Brian Cressman (Michigan Science Art, Ann Arbor, Michigan) for the use of his illustration of a prehensile-tailed hutia, to Gill Carter (Weslaco, Texas) and Lee Ellington (Lyford, Texas) for their photos of the butterfly *Siderone galanthis*, to John Dunning (Cornell Lab of Ornithology) for his photo of Worm-eating Warbler, and to Tim Barksdale and Andrew Farnsworth (Cornell Lab of Ornithology) for their photos of Cuban Parrot and Cuban Trogon.

As always, Jim Costello and staff at Costello Communications were tremendously patient, creative, and helpful in getting the text and images into print.

Finally, we sincerely thank John W. McCarter Jr. for his unflagging support and encouragement of the Environmental and Conservation Programs. Funds for this rapid inventory were provided through the generosity of the John D. and Catherine T. MacArthur Foundation, and The Field Museum.

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	16–19 September 2002
Region	Reserva Ecológica Limones-Tuabaquey (Limones-Tuabaquey Ecological Reserve) and adjacent areas in the Sierra de Cubitas and the Sabana de Camagüey (also known as the Sabana de Cubitas or the Sabana de Lesca), in central-eastern Cuba, approximately 20–25 km northeast of the city of Camagüey. Together, the Sierra and Savanna occupy approximately 1,000 km^2 of Camagüey Province (Fig. 2A). The Reserve, 22.8 km^2 in size, was proposed for protection in 1998 by the Consejo de la Administración del Poder Popular Provincial. At present, its approval as a Reserva Ecológica at the national level is under review by the Consejo de Ministros (Cuban Council of Ministers).
Sites surveyed	The inventory team visited various localities in the Sierra de Cubitas, before and during the inventory: Cerro Pelado, Cerro Tuabaquey, Cerro Mirador de Limones, Paso de Lesca, Paso de Los Paredones, Paso de La Vigueta, Cueva de María Teresa, and Hoyo de Bonet. The inventory team also devoted much attention to accessible savanna habitats on the plain with serpentine soils immediately south of the Sierra.
Organisms studied	Vascular plants, mollusks, cockroaches, butterflies, ants, amphibians, reptiles, birds, and mammals. Our collaborators provided additional data, from previous studies in the area, relevant to relief, geology, soils, climate, vegetation, non-vascular plants, mammals, history of indigenous peoples, and current human communities.
Highlights of results	**Vegetation:** The region is a mosaic of vegetation types. The Sierra de Cubitas mainly contains two types: a complex of cliff and rock wall vegetation (*farallones* vegetation) and semideciduous forest on limestone. Farallones vegetation is generally open, with xerophytic shrubs, and is found on the steepest and most eroded limestone slopes (Fig. 2B). Semideciduous forest occupies various elevations, slopes, and flat areas (Fig. 3A); in parts of the Sierra it has been degraded by intensive and selective cutting of trees. Also of note are evergreen forest, gallery forest, and three types of vegetation that originate from human activities (degraded scrub, human-generated savanna, and cultural vegetation.) On the ophiolitic plain to the south of the Sierra, another type of vegetation, *cuabal* (spiny xeromorphic scrub) has developed on serpentine soils. The plain is dominated by this type of scrub, and degraded scrub, with abundant palms and low vegetation (Fig. 2C, and inside cover).

Highlights of results
(continued)

Flora: During the inventory we registered 250 taxa of vascular plants in the Sierra and the savanna immediately to its south (Fig. 3 and Appendix 2). Of these 250 taxa, 86 were not previously registered in the Sierra. Including the species newly observed in this inventory, 751 species, subspecies, and varieties of plants are registered from the Sierra and the adjacent savanna. (Appendices 1 and 2). Of these, 656 are seed plants (Spermatophyta), 60 are mosses and liverworts (Bryophyta), and 35 are ferns and fern relatives (Pteridophyta, Lycopodiophyta, and Psilophyta). Approximately 80–85 of the species are endemic to Cuba and 8 are considered globally threatened.

Mollusks: The Sierra de Cubitas stands out as one of the regions in Cuba with many species of terrestrial mollusks. We observed 16 species and registered 2 species (*Liguus fasciatus* and *Steatocoptis bioscai*) for the first time in the Sierra. With these, 50 terrestrial and fluvial mollusks have been registered for the Sierra and surrounding areas (Fig. 4A and Appendix 3).

Insects: Our inventory of **cockroaches** was the first in the region. We registered 12 species, of which 5 are Cuban endemics, 5 are native but not endemic, and 2 are introduced (Fig. 4C and Appendix 4). One species, *Nesomylacris fratercula*, is known only from Camagüey Province, and before the inventory was not documented from any specific locality. The introduced species can be used as bioindicators of human disturbance in the area.

We registered 44 species de **butterflies** in the Sierra (23) and the adjacent savanna (32), including 3 relatively rare species that are forest specialists and 1 endemic species that is a savanna specialist (Figs. 4B, 4D, and Appendix 5). We also observed 22 species of **ants**, including 4 species endemic to Cuba (Appendix 6). In general, the ant fauna was depauperate, perhaps due to the great abundance of a very aggressive species, the little fire ant (*Wassmannia auropunctata*).

Amphibians and Reptiles: We registered 13 species of amphibians and 27 of reptiles (Figs. 5A, 5B, and Appendix 7), of which 6 are new records for the localities visited and 32 (80%) of which are endemic to Cuban. Species with distributions limited to certain habitat types (e.g., *Eleutherodactylus thomasi*, a frog in caves or rocky habitats), and species endemic to the Sierra de Cubitas (*Sphaerodactylus nigropunctatus lissodesmus*, a gekko), are notable here. The rare, endemic Cuban false chameleon (*Chamaeleolis chamaeleonides*; Fig. 5A) was frequently observed during the inventory, which is unusual.

REPORT AT A GLANCE

Highlights of results (continued)

Birds: We registered 74 species of birds during the inventory (Appendix 8). Of the 23 endemic species of birds in Cuba, 10 to 12 live in the Sierra and the adjacent savanna. We have one new record for the Sierra, Swainson's Warbler (*Limnothlypis swainsonii*), a migrant species. When compared to the Sierra de Najasa—the other massif in Camagüey Province—the Sierra de Cubitas has a significantly higher species richness of North American migratory species. Yellow-throated Vireo (*Vireo flavifrons*) and Worm-eating Warbler (*Helmitheros vermivorus*; Fig. 5D) were unusually common. The population of Cuban Trogon (*Priotelus temnurus*; Fig. 5C) was remarkably dense. During the inventory, we did not observe two of the rare and threatened species, Cuban Parakeet (*Aratinga euops*; Fig. 5E) and Cuban Parrot (*Amazona leucocephala*), but they have been documented by recent observations in the Sierra.

Mammals: Considering living species (18), and extinct species or species extirpated from the region (7), 25 native mammal species have been registered in the area. Of these, 17 are bats (16 living species and 1 fossil), and 2 are hutias (Figs. 6A, 6B, and Appendix 9). During the inventory, we observed only individuals of Cuban hutia (*Capromys pilorides*), the most common of the hutias. This species, and the prehensile-tailed hutia (*Mysateles prehensilis*: Fig. 6C), are poached, and 7 species of the bats are considered threatened.

Human history: In the olden days, the Sierra de Cubitas and neighboring plains were occupied by indigenous groups who practiced farming and pottery making. The area's caves shelter some of their paintings and sculptures, including representations of reptiles, hutias, and birds.

Human communities: We did not carry out a rapid social assessment. The Sierra de Cubitas has a population of 2,584 and a population density of 11.6 inhabitants/km^2, distributed in 12 settlements and approximately 649 houses. The human population structure is young, and 65% of the immigrants to the region are female. The greatest rates of growth correspond to the towns with the largest number of residents, which are Vilató (with 986 or more inhabitants), Paso de Lesca (303), and La Cantera.

The Sierra de Cubitas is used for agriculture, cattle ranching, silviculture, gravel mining, military training, and tourism. Most of the labor force in the territory is dedicated to farming in the Sierra, and to a lesser degree, to mining activities. Agriculture is the fundamental activity, surpassed only by silviculture.

Main threats

The size of the proposed Reserva Ecológica Limones-Tuabaquey (22.8 km^2) is very small in comparison to the area occupied by the Sierra de Cubitas (approximately 400 km^2). As a consequence, large areas in which live many rare, endemic, and/or threatened species, are vulnerable to human activities not compatible with conservation.

There is no comprehensive conservation plan for the extensive savanna immediately south of the Sierra de Cubitas, which also shelters rare, endemic, and/or threatened plants, invertebrates, amphibians, reptiles, and birds. Although an area has been proposed with a degree of protection, the Área Protegida de Recursos Manejados Escarpa y Humedales de San Felipe (Fig. 2A), it is not yet approved and it is not a large area (27.8 km^2).

Species of exotic, non-native plants and animal animals constitute serious threats, e.g., the expansion of an extremely aggressive, leguminous shrub, *marabu* (*Dichrostachys cinerea*), in the southern savanna. Populations of feral dogs and pigs harm populations of native species, especially of birds and mammals.

Some furtive hunting of birds and mammals occurs. This results in population reductions or movements to other areas (which are becoming less and less available) that offer better shelter.

Grazing in poor soils of the savanna, and forestry practices that are incompatible with conservation of native species, can severely reduce or eliminate populations of rare plants and animals adapted to the types of vegetation present in the Sierra.

Principal recommendations for protection and management

01 **Officially approve Reserva Ecológica Limones-Tuabaquey, 22.8 km^2 in size, at the federal level (Fig. 2A).**

02 **Expand the area managed for native biodiversity.** Federal ownership of the land, combined with a sparse human population in the area, can facilitate an expansion of the proposed limits of Reserva Ecológica Limones-Tuabaquey and the Área Protegida de Recursos Manejados Escarpa y Humedales de San Felipe (Fig. 2A). Other types of conservation management also can be used outside of the boundaries of these two reserves, with the overall goal of connecting the two reserves to make a larger conservation area that protects a significant portion of the Sierra and the adjacent savanna. To accomplish this, work through the normal legal processes governing protected areas, together with all parties interested in the natural resources of the Sierra and southern savanna.

REPORT AT A GLANCE

Principal recommendations for protection and management (continued)

03 **Develop effective means of controlling populations of exotic species,** e.g., feral dogs and pigs in the forests and, especially, the very aggressive leguminous shrub, *marabú* (*Dicrostachys cinerea*).

04 **Increase the number of forest rangers, and develop training programs that will increase the level of expertise of guards and other personnel and help them overcome obstacles they may face.**

Long-term conservation benefits

01 **Existence of a large protected area of national and international significance because of the biological, geological, paleontological, scenic, and historical-archeological treasures it holds.**

02 **A natural redoubt in Camagüey Province that safeguards particularly fragile ecosystems with species exclusive to them, including plants and animals, for the long term.**

03 **Undisturbed caves that retain their cavernicolous flora and fauna, and cultural artifacts of the Arawakan people who once lived in the area.**

04 **A local human population that benefits, tangibly and intangibly, from their participation in the conservation of the region's natural resources.**

Why Sierra de Cubitas?

Vast plains dominate the landscape of Camagüey Province, with the exception of two important massifs: the Sierra de Cubitas and the Sierra de Najasa. In satellite images of the region, the distinctive color of the Sierra de Cubitas jumps out because its forest cover is the most extensive in all of the Province. We were attracted to this region because it is the best preserved in the Province and serves as a refuge to a great diversity of species of plants and animals, many of which are Cuban endemics with small ranges.

Despite the biological treasures held within the Sierra, various threats menace this natural redoubt. Camagüey Province has experienced extensive agriculture and cattle ranching, which have reduced its natural resources. At present, some native species are experiencing population declines or have been completely extirpated from the Province.

The overall region, and particular areas within it, have been proposed for various management categories for their protection. We hope that our efforts increase the documentation of the biological value of the Sierra and the adjacent serpentine plain, and stimulate efforts to protect and wisely manage the biological resources of this magnificent landscape.

Conservation of the Sierra de Cubitas

CURRENT STATUS

The Sierra de Cubitas is an important refuge for plants and animals, and harbors relictual vegetation. It is the largest and best-conserved of the two large forested areas that remain in Camagüey Province. (The other is the Sierra de Najasa, to the south.) In the past, the Sierra and adjacent plains experienced a deterioration of some of their natural elements because of human activities. Agriculture and livestock in some areas caused soil compaction, erosion, and loss of nutrients from soils and vegetation. Certain forestry practices, employed since the beginning of the twentieth century, involved extensive cutting and extraction of marketable timber species and large areas in which the forest was heavily cut or removed for the establishment of agriculture or pasturelands. All these practices destabilized the forest ecosystems or impeded them from recovering from disturbances.

In 1998, the Consejo de la Administración del Poder Popular Provincial proposed the designation of 22.8 km^2 of the Sierra as the Reserva Ecológica Limones-Tuabaquey (Fig. 2A) because of the types of vegetation present and its scenic, floristic, faunistic, and historical-archeological values. At present, Reserva Ecológica Limones-Tuabaquey is under review for approval at the national level by the Comité Ejecutivo del Consejo de Ministros (CECM) de la República de Cuba.

The Reserva Natural Hoyo de Bonet, with an area of 0.02 km^2, is surrounded by Reserva Ecológica Limones-Tuabaquey. A proposed reserve occurs to the southwest (Fig. 2A), the Área Protegida de Recursos Manejados Escarpa y Humedales de San Felipe (27.8 km^2 in size), but it has not been approved as of the writing of this report. The Paisaje Natural Protegido Sierra de Cubitas (of 358.1 km^2 according to Primelles et al. 2002) is under discussion but has not been presented or approved by the CECM.

CONSERVATION TARGETS

Conservation targets are the elements of physiographic, biological, or cultural diversity that we want to persist in the landscape. The targets for the Sierra de Cubitas and the adjacent southern plains 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 Sierra 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	Evergreen forest, semideciduous forest, *cuabal* (spiny xeromorphic scrub on serpentine), and *farallones* (cliff and rock wall) vegetation in the Sierra; savanna vegetation with good potential for recuperation from human disturbance
Plants	Eight species considered threatened globally: *Zamia pumila* (Zamiaceae), *Coccothrinax pauciramosa* (Arecaceae), *Garcinia aristata* (Clusiaceae), *Behaimia cubensis* (Fabaceae), *Cedrela odorata* and *Swietenia mahagoni* (Meliaceae), and *Guaiacum officinale* and *G. sanctum* (Zygophyllaceae); and 80-85 Cuban endemics present in the Sierra de Cubitas or the adjacent savanna to the south
Mollusks	*Emoda bermudezi, Farcimen camagueyanum, Liguus fasciatus, Oleacina straminea, Opisthosiphon greenfieldi, O. banoense, O. obturatum, O. evanidum, Macroceramus hendersoni, Alcadia camagueyana, Cysticopsis naevula,* and *Steatocoptis bioscai* (especially the local endemics)

Conservation Targets (continued)

	Insects	Four species of **cockroaches** endemic to Cuba (all *Eurycotis*, Blattidae), especially *E. flavipennis* and *E. caudellana*; and *Nesomylacris fratercula* (Blattellidae), an endemic species previously known only from a vague type locality ("Camagüey") and first documented at a specific locality during this inventory Relatively rare species of **butterflies**, only seen in well-conserved habitats (*Hamadryas februa*, *Historis odius*, and *Siderone galanthis*, all Nymphalidae); and the Cuban endemic *Eurema amelia* (Pieridae) One species of **ant**, *Leptothorax squamifer* (Myrmicinae), a Cuban endemic notable for its striking appearance
	Amphibians and Reptiles	Species with distributions limited to narrowly specific habitat types (e.g., *Eleutherodactylus thomasi*, a frog of caves and rocky habitats, always associated with karst.) *Sphaerodactylus nigropunctatus lissodesmus*, a well-differentiated subspecies of gekko endemic to the Sierra de Cubitas Rare species, such as the endemic Cuban false chameleon (*Chamaeleolis chamaeleonides*, which appears to be abundant in the forests of the Sierra de Cubitas) The Cuban boa (*Epicrates angulifer*), which is persecuted because it is considered a predator of domestic birds and because its fat supposedly has curative properties

Birds	The 10 to 12 Cuban endemics that occur in the area Threatened species with depauperate populations: Gundlach's Hawk (*Accipiter gundlachi*), Cuban Parakeet (*Aratinga euops*), and Cuban Parrot (*Amazona leucocephala*) Migratory forest species that winter in Cuba, because the region is an important refuge for migrant birds
Mammals	Two species of rodents, the Cuban hutia (*Capromys pilorides*) and the prehensile-tailed hutia (*Mysateles prehensilis*), because they are hunted Seven threatened species of bats
Human Communities	Caves with paintings and sculptures made by people of Arawakan ancestry who once lived in the area The presence of local residents with knowledge of the flora and flora of the Sierra and adjacent savannas who are interested in issues related to biodiversity and education An educational system that can promote environmental education

A VISION FOR CONSERVATION

Taking into account the conservation targets suggested by the rapid inventory, as well as the current status and management of the Sierra de Cubitas, what is an ambitious but realistic vision for the future of the wild communities of plants and animals, and of the human communities, in the Sierra and the adjacent plain?

01 A large protected area of national and international significance because of the biological, geological, paleontological, scenic, and historical-archeological treasures it holds.

02 A natural redoubt in Camagüey Province with native vegetation types that represent perhaps 20% of their original coverage in the Province.

03 The conservation of particularly fragile ecosystems with species exclusive to them, including (1) local, regional, and national endemics, (2) vulnerable, threatened, or endangered species, and (3) migratory species that depend on the resources of the Sierra and the savanna that borders it to the south.

04 Undisturbed caves that retain all of their unique flora and fauna (e.g., cavernicolous invertebrates, amphibians, reptiles, and bats), and artifacts from the Arawakan culture.

05 Protection of the the Sierra and savanna, which constitute a Cuban patrimony and international treasure, by means of a model strategy that combines work with local communities, scientific institutions, and conservationists.

06 A situation in which local residents acquire tangible and intangible benefits in return for their support of regional conservation.

07 Presence of a field station that (1) supports scientific studies relevant to biological and cultural diversity in the region and (2) serves to involve local residents, and visitors from elsewhere in Cuba and the world, in conservation efforts in the Sierra and savanna.

THREATS

What threats oppose our vision of conservation in the Sierra de Cubitas? How do the largest threats affect the regional landscape? How do various threats, small and large, affect specific conservation targets? Although a detailed analysis is beyond the scope of this report, the following list can serve as a starting point for future analyses.

There are seven current threats and three potential threats.

01 **The small size of Reserva Ecológica Limones-Tuabaquey (2,280 ha) and Reserva Natural Hoyo de Bonet (2 ha) in relation to the large expanse of forest in the Sierra de Cubitas (approximately 40,000 ha)** implies that large areas (in which many rare, endemic, and/or threatened species live) are not protected and are vulnerable to human activities not compatible with conservation. The area covered by these reserves is very small in view of the diversity of ecosystems in the Sierra and savanna. Birds, for example, often have dynamic populations in the area that move outside of the reserves for feeding, nesting, and other activities.

02 **The savanna is not protected adequately.** The large expanse of savanna immediately south of the Sierra harbors many endemic plants that have adapted to its toxic serpentine soils. Although the Área Protegida de Recursos Manejados Escarpa y Humedales de San Felipe has been proposed (Fig. 2A), it is not formally approved at a national level and it is a small area (2,780 ha). Without formal protection and a management plan for the large savanna, it will be very difficult to protect the species of plants, invertebrates, amphibians, reptiles, and birds that live there.

03 **Aggressive, non-native species of plants.** Over time, the introduction of certain exotic plants to Cuba has caused the local extirpation of some native plants and animals, and changes in behavior or migrations by others. This threat includes uplands of the Sierra as well as the extensive plains. One particularly grave threat is the expansion of marabu (*Dichrostachys cinerea*), an extremely aggressive exotic, into the lowland plains at the base of the Sierra.

04 **Feral animals.** Escaped domestic animals, such as dogs and pigs, have significantly negative effects on populations of native species, especially birds and mammals.

05 **Furtive hunting of birds and mammals** has reduced populations of some native species or has encouraged migration to other areas that are better protected (but which are not extensive or common).

06 **Grazing on the poor, toxic soils of the savanna.** Although cattle grazing is a valid use on some areas within the plains, evidence from studies elsewhere suggests that grazing can severely reduce or eliminate populations of rare plants and animals that have adapted to the serpentine savannas. At present, there are no areas in the savanna that are protected from grazing.

07 **Certain forest practices that are incompatible with the conservation of native species.** Within the Sierra de Cubitas trees are cut for firewood, construction, and agricultural use. Cutting has been most prevalent on the north flank of the Sierra, where slopes are more gradual. Where the forests are degraded by these practices, habitats for native animals are altered.

08 **Uncontrolled tourism is a potential threat to sensitive areas in the Sierra,** if tourism expands considerably in the future. Tourists visit areas and sites that retain important natural and historical-cultural features, such as subterranean caverns, sinkholes, canyons, and highland outcrops. Tourism brings the opening of paths, collection of plants and pieces of rock formation, writing on rock walls and deterioration of indigenous art, trash, bonfires, and the forcing of natural events like rockslides and the collapse of karst structures.

09 **Changes in the frequency of fires** is the second potential threat in the area. Fires affect certain localities within the Sierra. Intentional or accidental fires originating from humans can cause biotic and abiotic changes that degrade habitats. On the other hand, it is likely that some of the species of the adjacent savanna are fire-adapted (as long as fires are not too frequent

or intense), such that the prevention of fires in the plains may constitute a threat, especially if the lack of fire facilitates the invasion of exotic plants.

10 **Local effects of mining.** An active quarry (the Cantera Viet Nam Heroico) mines limestone and produces gravel and crushed limestone. This intensive activity is very concentrated at the center of the southern flank of the Sierra and supplies materials for construction. Rock or gravel used for roadways, hydroelectric projects, and construction also is extracted from other small, dispersed areas (borrow pits) in the south, southeast, and western parts of the Sierra. At present, the effects of these activities are local but expansion of mining to new areas of the Sierra is a potential threat.

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 the Sierra de Cubitas and the adjacent southern plains. 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 **Officially approve Reserva Ecológica Limones-Tuabaquey, 22.8 km² in size, at the federal level (Fig. 2A).**

02 **Expand the area managed for native biodiversity.** Federal ownership of the land, combined with a sparse human population in the area, can facilitate an expansion of the proposed limits of Reserva Ecológica Limones-Tuabaquey and the Área Protegida de Recursos Manejados Escarpa y Humedales de San Felipe (Fig. 2A). Other types of conservation management also can be used outside of the boundaries of these two reserves, with the overall goal of connecting the two reserves to make a much larger conservation area that protects a significant portion of the Sierra and the adjacent savanna. To accomplish this, work through the normal legal processes governing protected areas, together with all parties interested in the natural resources of the Sierra and southern savanna.

One important advantage of designating a large area for conservation planning is that, in contrast to small areas such as the two reserves proposed above, one can better provide for the requirements of species that with dynamic populations (e.g., some birds) or those that benefit from multiple subpopulations (e.g., some mollusks, reptiles, and amphibians).

03 **Develop means to effectively control populations of exotic species,** e.g., feral dogs and pigs in woodlands and *Dichrostachys cinerea* in the savanna.

04 **Increase the number of forest rangers, and develop training programs that will increase the level of expertise of guards and other personnel** so that they can effectively regulate exploitation of natural resources in conservation areas. There now exists a severe deficit in the number of forest rangers (*guardabosques*), which decreases protection of the area. With additional resources and training, the rangers can reduce furtive wood harvest and hunting of birds and mammals, keep cattle and goats out, and monitor the occurrence of fires and tourism not compatible with regional conservation goals.

Additional inventories and research	01 **Carry out new field work in areas indicated in Figure 2A of this report, using available satellite imagery.** The rapid inventory team did not have the opportunity to visit and evaluate these areas but it is possible that patches of native vegetation of high quality remain in some. 02 **Study the population dynamics of native species most important for conservation in the region,** including doves, parrots, parakeets, hutias, and some species of mollusks, amphibians, and reptiles. 03 **Study aspects of the region's ecosystems that will shed light on important management issues, and document dynamic aspects so as to incorporate them into conservation efforts.** For example, little is known about the effects of fire frequency on endemic plants or amphibians and reptiles in the savannas. Nor do regional data exist relevant to the effects of cattle grazing on the abundance and distribution of endemic plants in the savannas. 04 **Conduct additional inventories of invertebrates,** which should include other taxonomic groups not included in our rapid inventory. These new inventories would fill some of the large gaps in our knowledge of the biodiversity of the region. 05 **Study the taxonomy of poorly known groups,** for example, the mollusks of the genus *Opisthosiphon*, so that conservation efforts can be focused on the taxa that need protection. 06 **To facilitate these studies, establish a bare-bones ecological station as a base for investigators.** The station could also be used for ecotourists, with space reserved for local naturalists, who could collaborate in studies with the scientists and interact with tourists interested in natural history.
Education and training	01 **Develop programs and materials for environmental education aimed at adult residents and students in the region** with the goal of raising awareness about conservation and the use of natural resources. To do this, work with regional entities of the Centro de Investigaciones del Medio Ambiente (CITMA) and programs of environmental education already in place in the educational system. 02 **Provide materials about the local flora and fauna to environmental education programs in the schools.**

OVERVIEW OF INVENTORY SITES

The Municipality of Sierra de Cubitas extends north of Camagüey and occupies 2,700 km^2. The drainage of the Máximo and Jigüey Rivers make up its eastern and western boundaries, respectively. Its southern margin is defined by the outskirts of the city of Camagüey, and the Caribbean coast borders the Municipality to the north.

The karstic nature of Sierra de Cubitas and its related manifestations—such as its huge gaps, caves, and sinkholes—results in heterogeneous ecological conditions supporting a unique biota. Extensive plains isolate the Sierra from the remaining mountainous groups in the country (such as the Sierra de Najasa, to the south). Multiple caves shelter a distinct cavernicolous fauna and provide a valuable fossil record of animals that once inhabited the region. The highest points within the provincial territory are found here: Cerro Tuabaquey (to 335 m in altitude) and Cerro Mirador de Limones (to 309 m). Throughout its extension, karstic gaps or secondary faults cleave the Sierra. Historically, nearby residents used these as routes to cross from one side of the region to the other, and for this reason they are called *pasos*.

Sierra de Cubitas, and the adjoining plains to the south, contain significant landscape and ecosystem diversity. The historical relationships among these ecological centers and ecosystems in other regions of the country have important biogeographic consequences.

Today, the Cubitas region is a relic, an area harboring the most remaining forest coverage in Camagüey Province and a distinct flora of the northern serpentine peneplains. The rest of the province has been devastated almost entirely by livestock and farming (Fig. 2A).

SITES VISITED BY THE BIOLOGICAL TEAM

The field team sampled several locations within Sierra de Cubitas, including Cerro Tuabaquey, Cerro Pelado, Cerro Mirador de Limones, Paso de Lesca, Paso de La Vigueta, Paso de Los Paredones, Hoyo de Bonet, and Cueva de María Teresa, as well as the Sabana de Cubitas immediately to the south. We did not establish camps, but visited the sites both during the day and at night.

In this report, we also include results from studies we conducted previously, or that our collaborators conducted, in other locations in the Sierra.

Cerro Tuabaquey (21°35' N, 77°45' W, 335 m altitude)

This site is the highest point within Sierra de Cubitas and is 24 km northeast of the city of Camagüey. Semideciduous forests and microphyllous evergreen forests on limestone dominate the area. In one sector on the southwestern slope, spiny xeromorphic scrub vegetation grows. The limestone rock outcrops weather into sharp points or *diente de perro* ("dogtooth rock") or loose chips that made climbing some of the slopes difficult. The Cueva de Pichardo is one of the area's most important geographical features because it contains indigenous pictographs. These pictographs are highly valued because of their uniqueness and excellent state of conservation.

Cerro Mirador de Limones (21°36' N, 77°48' W, 309 m)

This is the second highest point and it is located 25 km northeast of the city of Camagüey. Semideciduous forest growing on limestone predominates.

Paso de Lesca (21°37' N, 77°51' W)

This site is located 12 km northwest of the Máximo River dam (at 21°37' N, 77°50' W). It is a fluviokarstic, tectonic gap traversing the Sierra, making it an important travel route between the municipality of Sierra de Cubitas and the city of Camagüey. The predominant forest type is semideciduous forest on limestone, with two arboreal layers, the lower from 8 to 10 m and the upper from 12 to 15 m.

Paso de La Vigueta (21°35' N, 77°46' W)

Located 23 km northeast of the city of Camagüey, this also is a tectonic gap cutting through the mountain range. As was the case with Paso de Lesca, the predominant forest type is semideciduous forest growing on limestone with two arboreal layers.

Paso de Los Paredones (21°36' N, 77°47' W)

Paso de Los Paredones is 24 km northeast of the city of Camagüey. It is approximately 1 km long and crosses the Sierra from southwest to northeast. It is the most scenic of the many gorges cutting through Sierra de Cubitas. It has vertical, karstic walls 40 m in height (Fig. 2B), where morphostructural and exogenous processes have exposed the layers of limestone rock of Cretaceous and Paleogene formations. The predominant vegetation is semideciduous mesophyll forest, although there evergreen microphyll forest and elements of the vegetation of mogotes complex occur near the top of its rock walls.

Hoyo de Bonet (21°36' N, 77°47' W)

Hoyo de Bonet is a conspicuous sinkhole, 80 m deep and 140 m in diameter, which is 24 km northeast of the city of Camagüey. Evergreen forest grows here, with a variant evergreen forest towards the western and northern region that has characteristics resembling a pluvial forest. Its walls are karstic, as are the numerous outcroppings within the sinkhole. Humidity and temperature in this area differ from those in the rest of the Sierra.

Cueva de María Teresa (21°35' N, 77°47' W)

This cave is about 13 km southwest of the town of Sola. It reaches a depth of 100 m below ground and is 92 m long. There are three entrances; its main entrance is vertical (19 m deep) and 4 m in diameter. The cave is surrounded by semideciduous forest and has indigenous pictographs inside.

Sabana de Cubitas (northern serpentine peneplain, for example, a transect 21°36' N, 77°51' W to 21°35' N, 77°52' W)

This plain extends south of the Sierra de Cubitas (Fig. 2A). It is formed by serpentine soils on which characteristic vegetation grows (with many endemic species), including various *Coccothrinax* palms, shrubs, and herbaceous plants (Fig. 2C). It is commonly referred to as the Sabana de Lesca or Sabana de Camagüey, as well.

RELIEF, GEOLOGY, AND SOILS

Authors: Jorge Aguilar Pérez, William Olivera Azcario, Francisco Prada Alfara, Luis Alfonso Ferrá, Gustavo Martínez Morales, Regelio Meriño Fernández, and Andrés Díaz López

RELIEF

Sierra de Cubitas and nearby territories possess highlands that occupy more than 50% of the zone. This geographical-geomorphological characteristic stands in contrast to the rest of Camagüey's territory, where plains dominate. Nevertheless, along its northern, eastern, and southern limits, and even within the Sierra, plains exist, represented by karst valleys and poljes (extensive depressions in karst terrain closed on all sides, with flat bottom and steep walls; Monroe 1976).

GEOLOGY AND SOILS

Continental and oceanic domains characterize Camagüey's geological composition. The territory's continental crust is composed mostly of carbonated rocks from the Jurassic to the Eocene Periods. The oceanic domain belongs to the ophiolitic association of the Triassic to Early Cretaceous Periods and the depositions are made up of sedimentary rocks from the Late Eocene to the Oligocene Periods (Iturralde Vinent 1989).

Sierra de Cubitas comprises tabular karst, characterized by large massifs that range from 5 to 20 km in width, cut and dissected by valleys with steep slopes and canyons. It is made up of Cretaceous-age carbonates (biogenic limestones, biodetritic limestones, micritic limestones, and dolomites, in addition to clayey limestones and mudrocks) of a carbonated platform, geologically belonging to the southern continental margin of the North American Plate. These sequences form part of the Cuban fold and thrust belt, and as a result have suffered from an intense tectonic deformation before being pushed against the continental margin, leaving folds, faults, and thrust faults that determined its actual position.

Because of the lithologic composition, tectonic fissuring, rich vegetation cover, and abundant rain, the Sierra has been affected by karstic processes that have created dissolved cavities, included gaps with almost vertical walls and significant depths (100–300 m).

The geological evolution of the Sierra de Cubitas includes violent upheavals and subsidences of limestone blocks. In the territory that presently constitutes the massif, the great number of crevasses and faults produced by this geological history determine, to a large extent, the morphology of the underground karstic environment. Due to these geological conditions, more than 80% of the territory's karstic cavities are vertical or semivertical, originating from tectonic fractures that facilitated the dissolutive action of water, from both streams and ground water.

Sierra de Cubitas' karstic openings or secondary faults are commonly called pasos (natural passes) because they are used as travel routes. The Sierra has important underground karstic manifestations (e.g., the presence of many caves, of which more than 300 are known), as well as aboveground (such as the cone karst outcroppings called dogtooth rock, and sinkholes).

To the north, plains of red, lateritic soils that have developed over tertiary carbonated sequences border the Sierra de Cubitas.

On the southern side, the Sierra is in abrupt contact, separated by deep tectonic faults, with ultrabasic rocks that form an ophiolitic association (serpentine, peridotite, dunite, gabbro, diabase, anortite, and albite), which represents relics of the ocean floor's ancient crust (Jurassic-Cretaceous in age). Lateritic soils develop here that are poor in organic matter but rich in minerals, with abundant oxides of iron, chromium, and manganese, among others.

The majority of the fluvial watersheds, which open like fans and hug the Sierra, develop in the serpentinite peneplains known as the Sabana de Cubitas. Its soils are not very fertile. The lack of surface running water in the northern peneplain is due its well-drained, rocky nature, while in the Sierra de Cubitas itself, the causative factor is its karstic composition. Subterranean waters in the Sierra de Cubitas lie at depths greater than 100 m. In the premontane plains, the waters lie

at 20–30 m. In the intermountain valleys, waters are found 80 m deep, on average.

CLIMATE

Authors: Ada Roque, Dositeo García Bargados, René Cruz, and María Elias

Central Camagüey Province shows signs of continentality because of its extensive area, the predominance of plains, and frequent winds. The winds off the northern coast shift from east to northeast during the day.

From November to April, monthly average temperature oscillates between 22.6ºC and 24.7ºC, and the coldest months are January and February. From May to October, average temperature varies between 25.6ºC and 27.6ºC and July and August are the hottest months. Annual average temperature for the Municipality of Cubitas is 25.1ºC. It is estimated that in the upper elevations (above 200 m), the annual temperature ranges from 20.0ºC to 26.0ºC.

Average annual precipitation in the province varies between 1,400 and 1,600 mm. Precipitation decreases towards the coast, where on average annual precipitation does not surpass 1,200 mm (Díaz 1989). The distribution of precipitation is markedly seasonal. The rainiest season is between May and October, and the driest season is between November and April. During the rainy season, rainfall in the Municipality varies from 684 to 997 mm. Its distribution is regular; almost the entire northern to central portion of the territory reports more than 800 mm of precipitation, and the southern portion reports slightly higher totals. During the rainy period, the least amount of precipitation falls during July. In the majority of the sites inventoried (including Cordero and Vilató), the rainy season extends from May to November. This phenomenon is considered atypical since it differs from the predominant rain pattern felt in the rest of the province (two periods: rainy from May to October, and less rain between November and April). During the drier period, precipitation ranges from 300 to 400 mm, with the maximum precipitation is in the zone near Cordero. The annual distribution of precipitation tends to increase as one moves from north to south, with values between 1,000 and 1,280 mm. The most precipitation (more than 1,400 mm) falls in Cordero. Typically in the mountains, windward zones receive abundant precipitation, have lower temperatures, and increased relative humidity, which is similar to what normally occurs in the eastern and northeastern part of the Sierra.

Average monthly and annual relative humidity are lower (76%–78%) during March and April. There is also increased insolation during these months, with an of average 8.4 hours of light per day (April is also the windiest month of the year). High relative humidity (85%–90%) is reported during October, November and December. The bioclimate is characterized as *termoxerochiménico* (Vilamajó 1989) with a dry period. Throughout most of the province, on average there are 3–4 months of drought. In the Sabana-Camagüey island group and the northern littoral zones, it is drier, with 5–6 months of drought (Vilamajó 1989).

VEGETATION

Authors: Everardo Pérez Carreras, Néstor Enríquez Salgueiro, Carlos Martínez Bayón, and José Camero Álvarez

Conservation targets: Evergreen forests, semideciduous forests, *cuabal* (spiny xeromorphic scrub on serpentine), and cliff vegetation in the Sierra; anthropogenically disturbed savannas with high potential for ecological restoration

INTRODUCTION

While much of Camagüey's land is dedicated to livestock and sugar cane, it retains valuable native vegetation in (1) the highlands of Cubitas, Najasa, Guaicanámar, El Chorrillo, and Maraguán, (2) the Sabana-Camagüey island groups, (3) the Doce Leguas keys, and (4) the coastal zones in the north and south.

Within the province, forest types include mesophyll, microphyll, and notophyll evergreen forests, swamp forests, mangroves, and mesophyll and microphyll semideciduous forests. The scrub forests are made up of

communities such as spiny xeromorphic scrub (*cuabal*), and coastal and subcoastal xeromorphic scrub. Tall grasses are found in swampy areas and along edges of streams and rivers. Vegetation complexes include those of mogotes (rounded, rocky prominences) and those of sandy and rocky coasts. Secondary vegetation and cultural formations are found throughout the province (Capote et al. 1989; García et al. 1989).

In Figure 2A, forest coverage in the Sierra de Cubitas region appears in orange. Semideciduous forests dominate, although there are also evergreen forests and mogote-vegetation complexes. The vegetation of the southern plains (appearing in green in the satellite image) include grasslands, palm stands, and low shrublands growing on ophiolitic-serpentine soils and rocks.

METHODS

We used Capote and Berazaín (1984) and Capote et al. (1989) for the classification of plant formations in Sierra de Cubitas, of which there are eight:

- Evergreen forest
- Semideciduous forest
- Gallery forest
- *Cuabal* (spiny xeromorphic scrub on serpentine)
- Degraded scrub
- *Farallones* (cliff and rock wall) vegetation
- Savanna
- Cultural vegetation

RESULTS

Evergreen forest

Semideciduous and evergreen forests supposedly dominated Cuba at the beginning of the sixteenth century. The evergreen forests were originally found in lowlands, up to 800 m altitude. At present, this forest type in the Sierra de Cubitas is confined to a few peaks and abrupt, hard-to-reach slopes at the highest elevations. This forest type's current structure is affected by human activities and as a result its state of conservation varies, depending on the specific location (although overall it is better conserved than the Sierra's semideciduous forest).

In the best conserved forested areas, the microphyll evergreen forest's arboreal layer reaches 10–15 m, and the emergents can reach 25 m. Species composing this forest include *Caesalpinia violacea* (*yarúa*), *Lysiloma sabicu* (*sabicú*), *Peltophorum adnatum* (*sabicú moruro*), *Poeppigia procera* (*tengue*), *Trophis racemosa* (*ramón de caballo*), *Myrciaria floribunda* (*mije*), *Buchenavia capitata* (*júcaro amarillo*), and *Oxandra lanceolata* (*yaya*), among others whose leaf length does not surpass 8.0 cm.

The notophyll evergreen forest covers more gradual slopes and is been affected by human activities to a greater degree than the microphyll forest, although it retains an relatively continuous and homogeneous arboreal layer. The canopy reaches 15 m and there are only a few emergents, among those include (*Bursera simaruba* (*almácigo*) and *Ateramnus lucidus* (*yaití*). The rest of the arboreal layer is made up of *Celtis trinervia* (*hueso*), *Andira inermis* (*yaba*), *Trichilia havanensis* (*siguaraya*), *Pera bumeliifolia* (*jiquí*), and *Guaiacum sanctum* (*guayacancillo*), and others with leaf length between 8.1 and 10.5 cm.

The meso-notophyll evergreen forest covers portions of the slopes and valley. Its extension is limited in relation to the microphyll and notophyll evergreen forests. Tree height varies between 10 and 12 m and there are no emergents. Typical species include *Spondias mombin* (*jobo*), *Cedrela odorata* (*cedro*), *Zanthoxylum martinicense* (*ayúa*), *Licaria triandra* (*levisa*), and *Amyris balsamifera* (*cuaba*), with leaf length between 10.6 and 13.0 cm.

The subcanopy layer is made up of many of the same species present in the canopy, and a few other abundant species such as *Capparis flexuosa* (*mostacilla*), *Canella alba* (*canela*), *Erythroxylum confusum* (*arabo*), *Eugenia axillaris* (*guairaje*), and *Eugenia maleolens* (*guairaje*), among others. The herbaceous layer is sparse, with some Poaceae and Cyperaceae. Lianas are not well-

represented, while epiphytes, such as bromeliads and orchids, abound.

Semideciduous forest

This forest type is found at several elevations, on slopes and plains, and has much more forest coverage than the evergreen forest. The best-conserved semideciduous forests are of meso-notophyll (10.6–13.0 cm leaf length) and mesophyll (greater than 13.0 cm leaf length) physiognomic structure. However, intensive and selective logging have degraded several zones within the Sierra.

The semideciduous forest's arboreal layer reaches 10–12 m, with some individual emergent species such as *Calycophyllum candidissimum* (*dagame*) *Zanthoxylum martinicense* (*ayúa*), and *Sideroxylon salicifolium* (*cuyá*). Other canopy trees include *Allophylus cominia* (*palo de caja*), *Pseudolmedia spuria* (*macagua*), *Amyris balsamifera* (*cuaba*), *Clusia rosea* (*cupey*), *Metopium brownei* (*guao*), and *Genipa americana* (*jagua*), among others.

The canopy of the semideciduous forest is discontinuous when the forest is degraded and different successional stages are present in which larger trees are interspersed among small trees and shrubs, with an abundance of sun-loving climbers. Semideciduous mesophyll and meso-notophyll forests with some degree of disturbance have emergents such as *Ceiba pentandra* (*ceiba*), *Schefflera morototoni* (*yagruma macho*), *Cecropia peltata* s.l. (*yagruma hembra*), *Acrocomia aculeata* (*corojo grande*), *Gastrococos crispa* (*corojo chico*), and *Roystonea regia* (*palma real*). The rest of the canopy is fragmented and reaches 8 m. Species such as *Drypetes alba* (*hueso*), *Nectandra coriacea* (*cigua*), *Sideroxylon salicifolium*, *Ficus membranacea* (jagüey), *Metopium brownei* (*guao*), *Zuelania guidonia* (*guaguasí*), *Cupania glabra* (*guárana*), and *Syzygium jambos* (*pomarrosa*) are present. The latter species is a very aggressive invasive shrub that irreversibly modifies the forest composition and structure.

In the understory, species such as *Celtis iguanaea* (*zarza blanca*), *Chrysophyllum oliviforme* (*caimitillo*), *Pisonia aculeata* (*zarza*), *Comocladia dentata* (*guao de sabana*), and *Hybanthus havanensis* (*hierba de San Martín*) abound. Lianas, in comparison to the epiphytes, are better represented in this vegetation type. The most abundant climbers include species of *Aristolochia*, *Chamissoa altissima*, *Echites umbellata*, and *Rhabdadenia biflora*. The herbaceous layer is dominated by diverse grasses, including *Setaria parviflora*, *Chloris ciliata*, *Cynodon dactylon*, and *Pharus latifolius*.

Gallery forest

This forest type is found along river and stream banks. It usually exhibits both evergreen and deciduous elements. Emergents to 30 m make up its arboreal layer. Notable species include *Ceiba pentandra, Roystonea regia*, and *Sabal palmetto* (*palma cana*). In the rest of the canopy, which occurs as a narrow and fragmented belt, species such as *Bucida buceras* (*júcaro negro*), *Calophyllum antillanum* (*ocuje*), *Cordia gerascanthus* (*varia*), *C. collococca* (*ateje*), *Spondias mombin* (*jobo*), and *Tabebuia angustata* (*roble blanco*) are found. Shrub and herbaceous layers exist in some parts, and sometimes become quite dense. They are dominated by *Dichrostachys cinerea* (*marabú*). Lianas abound, including *Chamissoa altissima* and *Forsteronia corymbosa*.

Spiny xeromorphic scrub on serpentine *(cuabal)*

This vegetation type is located south of the limestone hills, mostly in the undulating transition zone at low elevations, known as "the Sierrita," and other areas nearby Sabana de Lesca (Sabana de Cubitas). There are many palms here, including *Coccothrinax miraguama* subsp. *miraguama* (*miraguano*), *C. pseudorigida*, *C. hospita* (*guano hediondo*), and *Copernicia cowellii* (*jata enana*). Shrubs are common here, including *Byrsonima crassifolia* (*peralejo*), *Ateleia cubensis* var. *cubensis* (*rala de gallina*), *Henoonia myrtifolia* (*rascabarriga*), *Brya ebenus* (*granadillo*), *Pictetia mucronata* (*yamaquey negro*), among others, which in some places form a dense and impenetrable layer reaching 2.5 m. Species such as *Cyperus swartzii* and *Scleria lithosperma*, *Paspalum caespitosum*, and

P. minus abound in the herbaceous layer. A peculiar situation is seen in an area close to the top of Cerro Tuabaquey, where this vegetation type resembles xeromorphic semispiny-scrub on serpentine (called *charrascal*) that is normally found at elevations not present in Camagüey.

Degraded scrub

A low canopy formed by shrubs and topped by a few palms, small trees, and taller shrubs predominates in this vegetation type. This scrub alternates with extensive anthropogenic savanna, and it is situated on serpentine or limestone soils, to which it adapts its physionomy. It contains relictual stands of xeromorphic spiny scrub typical of cuabales in Camagüey's serpentinite district and other common species that grow on serpentine as well as limestone. This shrub habitat can be dense or open, depending on the site, and can reach 5 m. Common species include *Dichrostachys cinerea, Comocladia dentata* (*guao de sabana*), *Metopium brownei*), *Chrysophyllum oliviforme* (*caimitillo*), *Pisonia aculeata* (*zarza*), and *Senna spectabilis* var. *spectabilis* (*algarrobillo*). Among the dispersed trees and small trees, palms commonly known as *corojos* (*Acrocomia aculeata* and *Gastrococos crispa*) are abundant as are different species of *Coccothrinax* and *Copernicia* (called *guanos*).

Cliff and rock wall vegetation *(farallones)*

This vegetation type is found in areas where limestone blocks form mogotiform structures, mostly on the steepest slopes, eroded from limestone, in the passes that cut through the Sierra. Paso de Los Paredones (Fig. 2B) is the most representative of these because of its geological and geomorphological characteristics. Vegetation is sparse, with xerophytic shrubs that have hard, needle-like leaves and spines. The most common taxa include *Agave legrelliana* and *Furcraea hexapetala* (*magueyes*), *Bromelia pinguin* (*piña ratón*), *Acacia maschalocephala*, *Bursera simaruba* (*almácigo*), *Capparis flexuosa*, *Coccothrinax muricata* (*guanito*), *Comocladia dentata*, *Ouratea ilicifolia* var. *ilicifolia*, *Philodendron consanguineum* and *P. lacerum* (macusey hembra macho and macusey macho), *Opuntia stricta* var. *dillenii* (*tuna brava*), and *Selenicereus grandiflorus* (*pitahaya*).

Savanna

The savanna occupies the plains, small intramountain valleys, and several forest clearings (called *calveros*). They occur mostly because of anthropogenic activity (e.g., forest clear-cuts, forest fires, agricultural plots), all of which occurred without any management plans. Anthropogenic savannas have a dominant herbaceous layer reaching 0.5–1.5 m in height. There are also dispersed trees, small trees, shrubs, as well as presence of abundant palms and climbers, and other sun-loving, invasive, and pioneer species (Fig. 2C). Most common taxa include *Acrocomia aculeata, Gastrococos crispa, Chrysophyllum oliviforme, Cecropia peltata* s.l., *Schefflera morototoni, Comocladia dentata, Dichrostachys cinerea, Leersia monandra* (*guinea cimarrona*), *Lasiacis divaricata* (*tibisí de monte*), *Anthaenantia lanata* (*arrocillo*), and *Panicum maximum* (*hierba de guinea*).

Cultural vegetation

Cultural vegetation completes the Sierra's mosaic of vegetation types. It is found in many areas, especially in the plains, and is made up of crops, and plantations of fruit trees and some timber species. The most economically significant crops include sugarcane (*Saccharum officinarum*), yuca (*Manihot esculenta*), plantain (*Musa paradisiaca*), avocado (*Persea americana*), mamey (*Pouteria mammosa*), sweet potato (*Ipomoea batatas*), taro (*Xanthosoma* sp.), oranges and limes (*Citrus aurantium, C. limon, C. sinensis*), and guava (*Psidium guajava*). These crops were established in the Sierra decades ago and in general, most are cultivated in response to economic interests far from this mountainous territory.

FLORISTIC RICHNESS AND ENDEMISM

Participants/Authors: Adelaida Barreto Valdés, Eddy Martínez Quesada, Efraín Rodríguez Seijo, Néstor Enríquez Salgueiro, Robin B. Foster, and William S. Alverson

Conservation targets: Eight species considered to be globally threatened by the World Conservation Union (IUCN 2004): *Zamia pumila* (Zamiaceae), *Coccothrinax pauciramosa* (Arecaceae), *Garcinia aristata* (Clusiaceae), *Behaimia cubensis* (Fabaceae), *Cedrela odorata* and *Swietenia mahagoni* (Meliaceae), *Guaiacum officinale* and *G. sanctum* (Zygophyllaceae); and the 80–85 species endemic to Cuba that occur in the Sierra de Cubitas and the adjacent savanna to the south

INTRODUCTION

The province of Camagüey harbors approximately 26.2% of the vascular plants of Cuba and 10% endemism. Its floristic relationship is closest with neotropical and Antillian flora (Martínez 1997). Within this context, the Sierra de Cubitas occupies a privileged place. Before the rapid inventory, 713 infrageneric vascular and non-vascular plant taxa were known throughout the territory (Pérez et al. 2002). The other large, elevated, natural area in the province is the Sierra de Najasa, which harbors only 367 vascular plant species (Barreto et al. 2002; Barreto et al. in press). Non-vascular plants have not been inventoried in the Sierra de Najasa.

METHODS

During the four days of the inventory, 16–19 September 2002, two of us (RBF and WSA) walked paths in and around the Sierra de Cubitas (e.g., Paso de Lesca and the savannas to the south) and in the accessible habitats of Reserva Ecológica Limones-Tuabaquey (the Limones-Tuabaquey Ecological Reserve), including Paso de Los Paredones, margins of Hoyo de Bonet, Cerro Pelado, and areas near the Río Máximo dam). We were not permitted to collect botanical material for which we had interest, doubt, or were unable to identify, but we took photographs of the unknown taxa that were later identified by Ramona Oviedo and Eddy Martínez Q. These photos will be available on the web (*www.fmnh.org/rbi*).

Four of us (ABV, EMQ, ERS, NES) conducted field studies over an 8-year period (1994–2002) and present the results here. We also consulted Pérez et al. (2002) for additional data. Unfortunately, Cuban and North American authors did not have the opportunity to work together in the field or the herbarium, and as a result harmonizing our results was very difficult. In Appendix 2, we provide a preliminary list of the vascular plant taxa in the Sierra in which the species observed by RBF and WSA during the inventory are marked. The degree of threat was determined using IUCN's Red List (IUCN 2004).

RESULTS

During the rapid biological inventory, we recorded 250 vascular plant taxa, which represent 36% of the 690 taxa documented in Sierra de Cubitas and the adjacent southern plains (Appendix 2). Of these, 86 were not recorded for the Sierra although many of these additions corresponded to species of the adjacent savanna.

Taking into account the additional species observed during this rapid inventory, there are now 751 species, subspecies, and varieties of plants recorded for the Sierra and adjacent savanna (Appendices 1 and 2). Of these, 656 are seed plants (Spermatophyta), including 654 plants with flowers (Magnoliophyta) and 2 species of *Zamia* (Cycadophyta); 60 are mosses and liverworts (Bryophyta); and 35 are ferns and fern allies (Pteridophyta, Lycopodiophyta, and Psilophyta).

BRYOPHYTA

The mosses and liverworts of the Sierra de Cubitas include 60 species in 39 genera and 28 families. Most are found at Hoyo de Bonet, including *Lejeunea longifissa* (Lejeuneaceae) and *Radula cubensis* (Radulaceae), which are endemic to eastern and central Cuba (Appendix 1). In southeastern Cuba, the latter species is only known from the Sierra Maestra, Sagua-Baracoa, and Hoyo de Bonet (Méndez et al. 1990; Yamada 1988).

PTERIDOPHYTA

The ferns and fern relatives sampled in Sierra de Cubitas and in the southern savanna are represented by 35 species belonging to 10 families, of which Aspleniaceae and Pteridaceae had the most species present (Appendix 2); 16 genera are present in the area. Hoyo de Bonet had the highest species richness of sites surveyed (27 species), followed by Paso de Los Paredones (14). This species richness correlates with the high humidity of these sites.

MAGNOLIOPHYTA

For the Sierra and adjacent savanna, 654 taxa of flowering plants have been reported, which belong to 401 genera and 98 families. The families with the most species are Fabaceae (60), Poaceae (41), Orchidaceae and Rubiaceae (36 each), Euphorbiaceae (33), Asteraceae (25), Apocynaceae and Malvaceae (17 each), and Arecaceae (16). The largest genera are *Tillandsia* (Bromeliaceae), with 11 taxa; *Paspalum* (Poaceae), with 10; *Solanum* (Solanaceae), with 9; *Eugenia* (Myrtaceae) and *Psychotria* (Rubiaceae), each with 8; *Cordia* (Boraginaceae) and *Sida* (Malvaceae), each with 7; and *Coccothrinax* (Arecaceae), *Ipomoea* (Convolvulaceae), *Passiflora* (Passifloraceae), and *Epidendrum* and *Vanilla* (Orchidaceae), each with 6 taxa.

Of the flowering plants 13%–14% are Cuban endemics (Appendix 2), the majority pan-Cuban (44), followed by those of central-eastern Cuba (25), central Cuba (11) and central-western Cuba (4). The principal floristic relationship is with the Neotropics, fundamentally with Antillian and Caribbean floras (Table 1 and Appendix 2).

Table 1. Floristic relation of the taxa present in Sierra de Cubitas.

Geoelement	Number of taxa
Neotropical	197
Antillian	118
Caribbean	100
Cuban endemics	80–85
Pantropical	82
Paleotropical	18
Subcosmopolitan	4
Cosmopolitan	3

FLORISTIC ZONES

In Table 2, we summarize the localities for 310 taxa of flowering plants collected in Sierra de Cubitas before the rapid inventory.

Table 2. Pre-inventory collections of flowering plants in Sierra de Cubitas, by locality.

Localities	Number of taxa
Mirador de Limones	238
Paso de Los Paredones	152
Cerro de Tuabaquey	150
Hoyo de Bonet	87
Paso de La Vigueta	57

In the Sierra itself, the most interesting areas from a floristic point of view are Cerro de Tuabaquey, Mirador de Limones, Paso de Los Paredones, Hoyo de Bonet, and Paso de La Vigueta, all of which are part of Reserva Ecológica Limones-Tuabaquey, the proposed conservation category for the area included between the two highest points in the Sierra (Fig. 2A; CNAP 2002).

The savanna immediately south of the Sierra is floristically very distinct and because of its distinct flora, it is an important zone (León et al. 2004). It has poor and toxic soils derived from ultramafic and ophiolitic rocks and is home to many provincial and national endemics. However, the area is not protected because it is outside of the limits of Reserva Ecológica Limones-Tuabaquey (Fig. 2A).

Méndez et al. (1986) reported 173 species of flowering plants for Cerro Tuabaquey. Rapid ecological monitoring expeditions, conducted between 1994 and 2002, reported the presence of 150 taxa, 120 of which had been previously noted by Méndez et al., and 30 that had not been seen before. This suggests that the plant formations of this specific location are well conserved due to adequate management for biodiversity.

USEFUL PLANTS

Some of the plants in the Sierra have a single recognized use by humans, but most plants have two or more uses and several species have up to six uses. There are 241 taxa useful to humans for distinct purposes (Table 3 and Appendix 2). A management strategy is needed to conserve this diversity in the area.

Table 3. Economic potential of flowering plants in Sierra de Cubitas.

Uses	Number of taxa
Medicinal	212
Nectar, pollen for bees, honey	145
Timber	144
Food	111
Industrial or handicraft	93
Ornamental	56

TERRESTRIAL AND FLUVIAL MOLLUSKS

Participant/Author: Alina Lomba G.

Conservation targets: *Emoda bermudezi, Farcimen camagueyanum, Liguus fasciatus, Oleacina straminea, Opisthosiphon greenfieldi, O. banoense, O. obturatum,* and *O. evanidum, Macroceramus hendersoni, Alcadia camagueyana, Cysticopsis naevula,* and *Steatocoptis bioscai*

INTRODUCTION

Prior to our inventory, previous studies registered 46 terrestrial mollusks in the area of which 26 are local endemics (Espinosa and Ortea 1999).

METHODS

I detected individuals using direct observation during the three days of the inventory (16–19 September 2002). Imaginary transects were defined along roads or trails, or along slopes at the base of rock walls. I recorded the presence of live individuals as well as shells observed, keeping in mind that the timing of the inventory was very close to winter when the mortality of terrestrial mollusk populations increases considerably. For the fluvial mollusks, I sampled the shores of the Máximo Reservoir.

RESULTS

I observed 16 species, of which 2 were new records for Sierra de Cubitas: *Liguus fasciatus* (Fig. 4A) and *Steatocoptis bioscai*. This elevates the total number of terrestrial and fluvial mollusk taxa in the Sierra de Cubitas and adjacent areas to 50 (Appendix 3). I observed great diversity and mollusk abundance at every sampled site. The most abundant species were *Caracolus sagemon* and *Zachrysia trinitaria* followed by *Opisthosiphon greenfieldi, O. banoense, O. obturatum*, and *O. evanidum*, which were also particularly abundant. Regarding these last four species, I made an important observation during the inventory. Individuals of the four species were seen copulating with one another and I was able to determine that females always have a a pattern of dark stripes on their shells, while the males have pale or dark shells without these stripes. This observation should serve as the starting point of a taxonomic review of the genus *Opisthosiphon*.

In Paso de Paredones, I found *Steatocoptis bioscai*. This find is significant because it is a new record for the zone and the species is considered rare. Its populations are usually very small, usually making it difficult to locate.

Regarding fluvial mollusks, I found two species around Máximo Reservoir. They were *Pomacea palludosa* and *Tarebia granifera,* which are both very common in all of Cuba's bodies of water.

THREATS AND RECOMMENDATIONS

Sierra de Cubitas is one of the regions in the country that harbors a very high number of local endemic species. The Sierra's mollusk habitats should be included in any project aimed at supporting its conservation.

Most of the mollusk species selected as conservation targets are locally endemic to Sierra de Cubitas (except *Liguus fasciatus*). Forest destruction or degradation, whether from logging or forest fires, will lead to irreversible reductions in population size of these species. Regardless of whether they are calciphiles, arboreal, or ground dwellers, all terrestrial mollusks depend on specific temperature-moisture equilibriums provided by forest in their respective microhabitats. Large-scale logging reduces the survival of mature individuals of the tree-dwelling species (for example, mature *Liguus fasciatus* prefer substrates above 3 m), which could be particularly because adults are responsible for reproduction.

Extensive pig farming represents a very menacing threat for mollusks living at ground level (like *Farcimen camagueyanum* and *Oleacina straminea*) because mollusks are part of the pigs' diet. Even arboreal species can be affected because pigs root around in the soil and expose their eggs, which then desiccate and die.

COCKROACHES (Dictyoptera: Blattaria)

Participants/Authors: Esteban Gutiérrez and Ana E.Tejuca

Conservation targets: Four Cuban endemics present in the area (all members of the genus *Eurycotis*, Blattidae), especially *E. flavipennis* and *E. caudellana* (originally known from a single female specimen); and *Nesomylacris fratercula* (Blattellidae), an endemic species previously known from its type locality (Camagüey), and relocated for the first time in this inventory

INTRODUCTION

To date, 87 species of Cuba's cockroaches have been registered (Gutiérrez 1995, 1996, 1999, 2001; Gutiérrez and López 1999). More than 60% of Cuba's species are endemic to the archipelago. They are present in all natural ecosystems and make up an important food source for many vertebrates and invertebrates. In addition, they are excellent transformers of dead organic material and of great value to the forests they inhabit.

A review of the studies providing locality records for cockroach species present in Cuba, including those published by Guérin-Meneville (1857), Saussure (1862, 1864), Brunner (1865), Bolívar (1888), Saussure and Zehntner (1893–1894), Rehn (1903, 1909, 1930, 1932), Cabrera (1922), Rehn and Hebard (1927), Gurney (1942), Pruna (1974), and Bonfils (1977), revealed that no cockroach records from the Sierra de Cubitas. Only one species, *Nesomylacris fratercula* Rehn 1930, was identified as native cockroach fauna for Camagüey, but without an exact location within the province. Thus, our list represents the first inventory of cockroaches in Sierra de Cubitas. This is the first time in Cuba that this taxonomic group has been included in a rapid inventory for conservation purposes.

METHODS

We conducted visual inspections during the day and at night. Because cockroaches are almost entirely nocturnal, we examined natural hiding places during daytime expeditions, such as in epiphytic plants (e.g., bromeliads), leaf litter, and fallen tree trunks, and under bark and rocks. At night these species are active and we observed them on the ground and on vegetation. We collected and observed small species with a binocular stereoscopic zoom microscope to facilitate identification.

We use only the scientific names because many cockroach species do not have common names.

RESULTS

During the inventory we registered 12 species, 5 of which are considered endemic to Cuba. Another 5 are

native, and the remaining 2 are introduced (Appendix 4). All of the species represent new records for the study area. Of the native species, it was impossible to identify two to the species level (a *Neoblattella* sp. and a *Symploce* sp., both Blattellidae) because only female specimens were obtained. (Males are needed to determine their complete taxonomy.) These species were found hiding in bromeliads during the day.

Endemic species

Among the notable records is that of *Nesomylacris fratercula* (Blattellidae), a species described by Rehn in 1930 whose type locality was identified as "Camagüey." Because our record documents the exact habitat and locality of this endemic species for the first time, it is of great value for the conservation. We observed *N. fratercula* hiding under rocks and leaf litter during the day.

Eurycotis flavipennis (Blattidae), described by Saussure and Zehntner in 1893, was known from a single locality, Monte Ramonal, in Villa Clara Province. Our record represents an expansion of the species' distribution. It was found in the Sierra itself, as well as in the nearby plains where palms grow over serpentine. We observed several females and males during their night activities on the ground and vegetation.

Eurycotis opaca (previously known from western Cuba) and *E. taurus* (of the east) were found for the first time occurring sympatrically in the study area (central Cuba). This situation changes the known distribution pattern for both of these endemic species. We saw individuals of the two species using the sheathing leaf bases of royal palms (*Roystonea regia*) as refuge during the day, and we observed oothecae (egg cases) on fallen palm fronds on the ground.

Eurycotis caudellana, described by Gurney in 1942, is known to science because of a single female individual from Río de Auras, Unión de Reyes, Matanzas Province. Presence of *E. caudellana* in Camagüey (Fig. 4C) increases its known distribution in Cuba. We found individuals hidden under rocks and leaf litter in the forest during the day.

The presence of these species in the region holds scientific importance both for taxonomic and biological reasons. Their biology is almost completely unknown and this influenced us to select them as conservation targets.

Introduced species

Several introduced species are bioindicators of anthropogenization. *Periplaneta australasiae* (Blattidae) and *Pycnoscelus surinamensis* (Blaberidae) have circumtropical distributions. Both species, introduced in America by human commerce, are associated with transformed or altered areas, such as farmland, roadsides and highways, and human homes. They are never found in completely natural areas. They are useful bioindicators of anthropogenization because their presence indicates alteration of the landscape by humans. In this inventory, these introduced species were found in a small house (*Periplaneta australasiae*) and along the road to the Sierra (*Pycnoscelus surinamensis*).

THREATS AND RECOMMENDATIONS

Deforestation for farming is a primary threat to native cockroaches because it destroys natural refuges and food resources for endemic species. We recommend additional inventories to determine if other species occur in the region and to obtain additional samples that will facilitate identification to the species level of the (a *Neoblattella* sp. and a *Symploce* sp. collected during this inventory.

BUTTERFLIES

Participant/Author: Jorge Luis Fontenla R.

Conservation targets: Relatively rare species, observable only in well-conserved habitats (*Hamadryas februa, Historis odius*, and *Siderone galanthis*, all Nymphalidae); and Cuban endemic *Eurema amelia* (Pieridae)

METHODS

I made observations in a narrow gorge, Paso de Los Paredones, which passes through a semideciduous

forest between limestone walls, and in the serpentine savanna extending to the south from the mouth of this gorge. Observations were made between approximately 7:30 a.m. until 5:00 p.m.

RESULTS

I observed a total of 44 species (Appendix 5). Hernández and Rodríguez (1998) recorded 125 species for the entire province of Camagüey. Of those, I observed 23 in Paso de Los Paredones and 32 in the savanna. None of my observations resulted in new records for Camagüey Province. I think that the number of species listed in Hernández and Rodríguez (1998) approximates the number of species expected in the Sierra and the adjacent savanna.

THREATS, OPPORTUNITIES, AND RECOMMENDATIONS

Deforestation is the principal threat. Opportunities exist to conserve rare species and habitat specialists, such as *Siderone galanthis* (Figs. 4B, 4D), *Historis odius, Hamadryas februa*, and *Eurema amelia*. The first three species are forest specialists, and the latter (endemic to Cuba and Isla de Pinos) inhabits areas of savanna in central and western Cuba.

ANTS

Participant/Author: Jorge Luis Fontenla R.

Conservation targets: The species *Leptothorax squamifer* (Myrmicinae), an endemic species of the Macromischa group, characterized by its striking colors

METHODS

I made observations in a narrow gorge, Paso de Los Paredones, which passes through a semideciduous forest between limestone walls, and in the serpentine savanna extending to the south from the mouth of this gorge. Observations were made between approximately 7:30 a.m. until 5:00 p.m.

RESULTS

I observed 22 species (Appendix 6). The ant fauna in this area is not rich. Most likely this is due to the great abundance of little fire ants (*Wasmannia auropunctata*), an aggressive species capable of displacing or impeding colony settlements of many species. I observed the Cuba endemics *Atta insularis, Crematogaster sanguinea, Leptothorax squamifer*, and *Pseudomyrmex pazosi*.

THREATS, OPPORTUNITIES AND RECOMMENDATIONS

Deforestation is the principal threat. There are opportunities to conserve rare species or habitat specialists such as *Leptothorax squamifer*, which primarily builds its nests in epiphytes.

AMPHIBIANS AND REPTILES

Participant/Author: Luis M. Díaz

Conservation targets: Species restricted to a narrow range of habitats (e.g., *Eleutherodactylus thomasi*, which dwells in rocky habitats and caves); *Sphaerodactylus nigropunctatus lissodesmus*, a subspecies of gekko endemic to the Sierra de Cubitas; rare species like *Chamaeleolis chamaeleonides*, which appears to be abundant in the Sierra; and the Cuban boa (*Epicrates angulifer*), because it is persecuted by humans

METHODS

Observations made during this rapid inventory (16–19 September 2002) in various localities (Cueva de María Teresa, Hoyo de Bonet, Cerro Tuabaquey, Paso de La Vigueta, Paso de Lesca, and Sabana de Cubitas) are provided here, as well as results from a previous expedition conducted by the author in 1996.

To detect different amphibian and some reptile species at night, I walked study sites between 7:00 p.m. and 12:00 a.m. Using flashlights, I checked shrubs, cliffs and rock walls, paths, surfaces of palms, and other habitats where active nocturnal species and sleeping diurnal reptiles could be found. I located the majority of the *Eleutherodactylus* species and the small species

of *Bufo* (*B. empusus* y *B. gundlachi*) from their vocalizations. I used a rake to overturn fallen trunks, rocks, and leaf litter. I checked dry agave plants and inside bromeliads. I detected the presence of certain species fby indirect evidence, such as eggs (as was the case for *Tarentola americana*) and skin molts (for the snakes), but adults and/or young of all these species also were found in the study area.

RESULTS

I observed 13 amphibian and 27 reptile species (Appendix 7). Six species were considered new records for Sierra de Cubitas. I recorded 11 species of endemic amphibians (19% of those found in Cuba) and 16 Cuban endemic reptiles (11% of reptiles endemic to Cuba).

Noteworthy records

New records include the amphibians *Eleutherodactylus varleyi*, *Bufo gundlachi*, and *B. empusus*; and the reptiles *Anolis porcatus*, a species of *Tropidophis* that will be described below, and *Sphaerodactylus notatus atactus*. These three amphibian species are widely distributed in Cuba and have been recorded for Camagüey Province but never specifically for the inventory area until now.

In the serpentine savanna I found that calling patterns of individuals of *Eleutherodactylus varleyi* co-varied with morphology—differences in size and general aspect—which could be an interesting focus of future research.

The *Anolis* population of the *argillaceus* group inhabiting Sierra de Cubitas and the adjoining serpentine savanna is tentatively presented here as related to *Anolis centralis* until new revisions are conducted. These animals are of small size, with a short snout and a reduced dewlap fold, of light orange color.

I saw the two large, syntopic toads known for Cubitas: *Bufo peltacephalus* (Fig. 5B) and *B. taladai*. The other toads observed, *Bufo empusus* and *B. gundlachi*, are much smaller and prefer arid savanna habitats where they excavate tunnels for refuge during the dry season. They are explosive breeders during the rains, at which time they meet in temporary puddles to reproduce and create a great chorus. I located several of these puddles and taped some individuals.

I collected two young dwarf boas (locally known as *majacito bobo*) belonging to the genus *Tropidophis*. These might belong to *T. pilsbryi*, which would be an important finding, but adult individuals are needed to confirm their taxonomic status. To date, two subspecies of *T. pilsbryi* are known: *T. pilsbryi pilsbryi* (Santiago de Cuba and Guantánamo Provinces, in eastern Cuba) and *T. pilsbryi galacelidus* (from Macizo de Guamuhaya, in the center of the island). The two young individuals I collected in Cubitas cannot be assigned clearly to either of these subspecies.

Other observations

I heard almost all of the anuran species because the rains and high humidity during the days of the inventory favored their activity.

I found some reptiles that are normally hard to see because of their reclusive or underground habits, including blind snakes (*Typhlops lumbricalis*), which are very common in Cubitas; a galliwasp (*Diploglossus delasagra*), of which I collected a sample; the geckos (*Sphaerodactylus nigropunctatus lissodesmus* and *S. notatus atactus*); the giant Cuban gecko (*Tarentola americana*); and a small anole, *Anolis ophiolepis*, which may be rather abundant but it is hard to observe because it lives in the grass and escapes quickly.

During the inventory, and especially during my previous visit to Cubitas in 1996, I observed with unusual frequency the Cuban false chameleon (*Chamaeleolis chamaeleonides*; Fig. 5A) as both adults and young. Snails make up a large part of the diet of this species, and the abundance of mollusks on the Sierra's rocky soils may explain why they were easy to observe at relatively low elevations at certain times of day.

I observed most of the Cuban boas (*Epicrates angulifer*) around the Sima de Rolando (21°51' N, 78°32' W) during my visit in 1996. I detected several inactive individuals during the day, while they rested, coiled in trees more than 8 m off the ground. At night

they could be seen slithering over the ground or along the crevices of the cliffs and cave walls.

THREATS AND RECOMMENDATIONS

The Cuban boa is threatened as the result of popular prejudice: it is considered a predator of domestic birds. Also, its fat is used because it supposedly has curative properties. The boa's bad reputation with rural farmers extends to other serpents, which likewise are persecuted. Rural farmers often fear other reptiles, especially large anole lizards, because they erroneously think that their bites are venomous and cause fever. As a result, these are also annihilated.

Study and monitoring of the amphibians are important because they can serve as bioindicators of some aspects of ecosystem health. Even though alarming amphibian population decreases have not been documented in Cuba as they have in many parts of the world, this does not mean that these species are unaffected. Rather, some species could be in decline but the trend undetected.

In the future, additional sampling and taxonomic study are needed for the Sierra's populations of *Anolis* and *Eleutherodactylus*. Studies of the status of these species and could result in the description of new taxa.

BIRDS

Participants/Authors: Arturo Kirkconnell and Douglas Stotz

Conservation targets: Threatened species (Gundlach's Hawk, Cuban Parakeet, and Cuban Parrot), endemic species, and migrants that use forest habitats or overwinter in Cuba

INTRODUCTION

A previous study (Concepción and Tadeo 1997) registered 56 bird species, including notable species such as Blue-headed Quail-Dove (*Starnoenas cyanocephala*) and the Gray-headed Quail-Dove (*Geotrygon caniceps*). Blue-headed Quail-Dove was observed at Cueva Lechuza and Gray-headed Quail-Dove at Cueva Rolando. Both species are considered globally threatened (BirdLife International 2000). Snail Kite (*Rostrhamus sociabilis*) also was observed.

METHODS

We conducted the inventory of birds from 16 to 19 September 2002 along trails where they could be observed or heard. Observations began about one hour before sunrise. We remained in the field all morning and on one occasion we stayed until midday. We made observations during one evening to detect owls. We concentrated the inventory on the lower slopes of the limestone mountains and in the valleys between hills, although we also included agricultural land, savannas, and reservoirs.

RESULTS

The Sierra de Cubitas is one of the most important faunal refuges in Camagüey Province. During this inventory, we registered 74 bird species (Appendix 8). Species richness in the Sierra was greater than that detected in the nearby savannas.

Endemic species

Of the 23 bird species endemic to Cuba, 10 have been documented in the Sierra de Cubitas (of the 12 endemic species expected to occur there). The population of Cuban Trogon (*Priotelus temnurus*; Fig. 5C) is unusually dense.

Migrant species

Among the migratory birds, we have one new record for the Sierra, Swainson's Warbler (*Limnothlypis swainsonii*). Species richness of migratory birds is greater here than that found in Sierra de Najasa, Camagüey's other highlands with forest cover. We also observed Yellow-throated Vireo (*Vireo flavifrons*) and Worm-eating Warbler (*Helmitheros vermivorus*; Fig. 5D). This last species was unusually common during our inventory.

Threatened species

The Sierra de Cubitas' population of Gundlach's Hawk (*Accipiter gundlachi*) is one of the most significant in Camagüey Province. It is a rare forest hawk and was

registered for the area previously but not observed during this inventory.

Cuban Parakeet (*Aratinga euops*; Fig. 5E) is a very rare species in the Sierra de Cubitas. It was not registered during this inventory, but A. Kirkconnell observed it there once and local guides claim to have seen groups of up to 12 individuals. Both Gundlach's Hawk and Cuban Parakeet are associated with forest, therefore maintaining ample forest cover will improve their chances for survival in the region.

The Cuban Parrot (*Amazona leucocephala*) is rare in the Sierra de Cubitas. It has been observed regularly in Paso de Lesca during the past two years (2004 and 2005). Prior to 2004, it was not seen often or consistently there. A. Kirkconnell observed it on only three occasions in 1999 and 2000. We did not observe it during our rapid inventory. This and the Cuban Parakeet require further studies to ensure that their feeding and nesting sites receive protection.

Other observations

On several occasions we observed Crested Caracaras (*Caracara cheriway*) in the savannas near the base of the Sierra de Cubitas.

THREATS AND RECOMMENDATIONS

The threats influencing the survival of the area's avifauna include (1) the conversion of forests into agricultural land and easy access to the area via many trails (which makes it difficult to control deforestation); (2) the presence of densely populated and agricultural areas, like the Valle de Corea; (3) the invasion of *Dichrostachys*, an exotic species that replaces native plants; (4) feral animals, such as pigs (which destroy the understory and ground-dwelling organisms) and dogs; (5) livestock grazing in the savannas; and (6) poaching of doves.

For bird conservation and management in the region, we recommend the following: (1) extend the protected area (or at least extend the management zone for native biodiversity) to include the all of the forest in the Sierra; (2) increase the number of forest guards; (3) protect the palm-savannas, which are areas that still retain much native biodiversity; (4) eliminate or control feral animals (especially pigs and dogs) in the forest; (5) increase the area's fencing to keep cattle and goats out; and (6) promote and protect nesting sites of Cuban Parakeets and Cuban Parrots to augment their populations in the region.

MAMMALS

Participant/Author: Stephen Díaz-Franco

Conservation objects: Cuban hutia (*Capromys pilorides*) and prehensile-tailed hutia (*Mysateles prehensilis*) because they are hunted, and species of bats considered as near-threatened World Conservation Union

INTRODUCTION

Eighteen species of living mammals have been recorded in the literature for the Sierra de Cubitas (Silva 1979; Camacho et al. 1995).

METHODS

To detect the presence of mammals, I used a combination of direct observation and indirect evidence (such as identifying scat found between the limestone crevices), following methods used by Garrido (1971). During the rapid inventory, I visited Paso de Lesca, Paso de La Vigueta, and other nearby areas.

RESULTS

During the inventory, I observed only Cuban hutia (*Capromys pilorides*), the most common of our hutias. Including living, extirpated, and extinct mammals, there are 3 orders, 11 families, 21 genera, and 25 species recorded in the Sierra (Appendix 9).

The 17 species of Chiroptera (bats) recorded in the area represent 68% of Cuba's bat species (Figs. 6A, 6B). Of the Sierra's bats, 16 are living species and *Natalus major primus* is known only from bone remains.

The next most abundant mammal group is the Rodentia (with 24% of the species known from the area), of which 2 are living species: Cuban hutia (*C. pilorides*) and prehensile-tailed hutia (*Mysateles prehensilis*; Fig. 6C). A fossil hutia is known from the area, and 3 rodents are extinct Cuban species.

The two species of Soricomorpha are extinct in the area: *Solenodon cubanus* is extirpated in the region but lives elsewhere in Cuba, and *Nesophontes micrus* is an extinct Cuban species. There are no relic mammal species in the region.

I did not find written references of any study that has been conducted on the effect of introduced animals in the study area. Although I did not encounter them during the inventory, introduced animals probably are present, and their general effects on native fauna are well known.

THREATS AND RECOMMENDATIONS

Mammal species of the Sierra de Cubitas have a wide distribution in Cuba, expect for the hutias and seven of the bat species, which according to the World Conservation Union (IUCN) are categorized as threatened (see Appendix 9). Poaching puts pressure on populations of the two hutia species—they are a local food source—yet they are still present. Studies should be conducted to estimate their population sizes, and population monitoring and management should be undertaken to retain these species in the area.

THE REGION'S FIRST HUMAN INHABITANTS

Authors: Marta González Díaz and Oscar Baró Ramos

In the olden days, the Sierra de Cubitas and neighboring plains were occupied by indigenous groups who practiced farming and pottery making. These groups of Arawakan ancestry brought to Cuba religious ideas that, in general, helped explain the phenomena of the world they knew. Tangible representation of these ideas was needed and was expressed in different rituals that associated fantastic notions with objects upon which all emotional energies could be focused. After humanizing these ideas and imbuing them with supernatural power, these people tried to act upon them using their rituals. These personifications were represented materially by concrete images that looked like the living beings and the non-living factors familiar to them (Calvera et al. 1980).

They expressed themselves using two art forms: paintings and sculpture. Cave paintings found in the Sierra de Cubitas express the relationship of these people with their natural environment, on which they depended for their survival. Their paintings show a great many elements from the flora, fauna, and their own process of adapting to the environment. For example, these include the zoomorphic figures represented in the Cueva María Teresa, which were elaborated using geometric elements like triangles and rhombi but also possess predominately natural stylistic elements.

Figure 7.

Figure 7 represents a reptile that could very well be a crocodile or an iguana; there is evidence that both existed in the region during pre-Columbian times and even recently. It is likely that these humans consumed both species. An archeological excavation corroborated this when it uncovered iguana remains. Hutias are also clearly depicted in the cave in both naturalistic and stylized forms (Calvera et al. 1980). There are other zoomorphic figures in some caves, such as those representing birds or those in the form of *cemíes* (sculptures made of clay, wood, or bone and used as idols), which occupy the principal wall in Cueva de El Indio. The figures in this cave are unique because

they have one white eye. Other representations often depict the eye in the form of a coffee bean, as seen in the Pichardo and El Indio caves. This design element is very common in the art of this past culture in Cuba.

Diadems or other head ornaments are also represented in the caves. These are seen on three of the cemíes in Cueva de El Indio and on the idol of the ceremonial hall in Cueva Pichardo within Cerro Tuabaquey. The diadems vary from simple lines, which could be represent feathers, to solid elements—actual crowns—as seen on one of the cemíes in Cueva de El Indio.

Tears are another decorative element, represented as straight lines that run directly from the eyes down the cheeks, or as straight lines falling off the chin. This design type is probably related to a cosmic deity of this culture, called *Boynabel*, who represented rain. Similar pictographs are found in Hispañola and in the "1 de Borbón" cave. The flora is represented by a leaf-shaped pictograph in Cueva de Los Generales that is very similar to other paintings in Cuba and the rest of the Antilles.

Elements from the initial stage of the Conquest are also represented in pictographs found in Los Generales and Matías caves, for examples horses with riders, and human figures—men and women—dressed in European styles.

HUMAN COMMUNITIES

Authors: Marta González Díaz and Oscar Baró Ramos

POPULATION

Information here is from Gonzáles and Baró (1994).

Inhabitants

Sierra de Cubitas's current population is 2,584 inhabitants (11.6 habitants per km^2) and approximately 649 homes. People are concentrated in 12 settlements, including Vilató, Paso de Lesca, La Cantera, El Rosario, La Entrada, La Güira, Banao, and Las Veguitas, which together have 1,802 inhabitants. The remaining 782 inhabitants are dispersed in the area.

From 1981–1995, the population centers showed considerable growth (5.4%). The highest growth rates were experienced in the largest communities, including: Vilató (986 or more inhabitants), Paso de Lesca (303), and La Cantera (163).

Vilató stands out because it is the largest community (54.7% of the total population of the main populated centers) and has the most services, which exerts an attractive force on the rest of the region's populated centers. The remaining settlements have no more than 300 people and only basic infrastructure. The growth in Vilató results from social investments carried out under a policy that encourages the rural population to concentrate. In La Cantera, mining activity (which does not occur elsewhere in the region) prevails. People believe that mining offers more employment possibilities and better standards of living and work for those engaging in it. Population growth at La Cantera can be seen in the increasing number of typical rural homes present, and is encouraged by favorable access that facilitates communication between La Cantera and the provincial capital via the Cubitas-Camagüey road.

Demographically, the population is young; 58.2% of the people are of working age (17 to 55 years old). Those under the working age represent 32.1% of the population; of this 15.2% are between the ages of 0 and 5 years old. Overall, population is stable but shows signs of slow growth.

Immigration

Another notable aspect in the region is immigration. A majority of the immigrants (65%) are women. Most immigrants (85%) originate from Camagüey Province itself, specifically from nearby areas because of the efforts to concentrate rural populations and because of the construction of a nearby dam (Embalse Máximo).

Most people arrived in the territory during the 1970s. Almost 25% of all immigration occurred

at that time, indicative of a provincial development policy that worked to concentrate rural populations in an effort to improve the delivery of basic services and improve the standards of living of rural people. Academic level of the immigrants is high: 23.6% reached mid-level, 12.7% reached upper-mid level, and 3.7% reached upper level. Only 7.3% have a low level of education. On average, immigrants possess a higher level education than the region's previous residents.

When surveyed, nearly half (48%) of the region's residents said that the landscape and the tranquility is what they like most about living here, followed by the ease of raising animals and farming.

SOCIO-ECONOMIC ACTIVITY

Most of the labor force in the territory is dedicated to farming in the Sierra, and to a lesser degree, to mining activities. Agriculture is the fundamental activity, surpassed only by silviculture. As is the case with other economic activities, entities with land tenure are responsible for the territory's farming development. Among those, La Cuba farm is the largest and occupies 82% of the total area. The private sector follows and covers only about 5%. Other land holders occupy small parcels only.

Silviculture

Forestry activity is concentrated on 144 timber species (Appendix 2), including: black pera (*Pera bumeliifolia*, Euphorbiaceae), mahogany (*Swietenia mahagoni*, Meliaceae), Spanish cedar (*Cedrela odorata*, Meliaceae), and false mastic (*Sideroxylon foetidissimun*, Sapotaceae). Precious woods are used for fine furniture and interior decorations. Other, less valuable species are used for posts, rural buildings, *cujes* for tabacco (horizontal beams supported by vertical posts, on which tobacco plants are hung during harvest), firewood, and charcoal. Other timber species are used as seed sources. Non-timber, multiple-use species include the royal palm (*Roystonea regia*, Arecaceae), various species of palms called *guanos* (*Coccothrinax* and *Copernicia* spp., Arecaceae) and other palms called *corojos* (*Acrocomia aculeata* and *Gastrococos crispa*, Arecaceae). They provide important products like fruits, leaves, fibers, oils, other food products, and primary building material for local residents.

In 1990, the Empresa Forestal Integral stopped forestry activity so that the area's forests could recover by natural succession. It also began to apply *Ecotecnología de Reforestación Sucesional* (methods of reforestation based on ecological principals) on a regional basis to reforest degraded forests. For many decades before this date, uncontrolled deforestation and overharvesting by the state and private organizations altered the territory. Methods for proper silviculture management were not followed nor were provisions made to allow areas affected by timber harvest to recover properly.

Agriculture and livestock

The main agricultural crops include yuca, sweet potato, taro (*Xanthosoma* sp.), plantain, squash, and beans. The best represented non-citric fruits include avocado, mamey, and guava, The best represented citric fruits are Valencia oranges.

Livestock includes cattle, horses, sheep, and goats. Economic plans aim to increase the area dedicated to livestock by 72%.

Viet Nam Heróico Quarry

Construction materials are extracted from this economically important quarry. It produces gravel and crushed rock for construction. The quarry's primary material is limestone and dolomite. Exploitation began in 1970. This important industry, along with others in the province, supplies primary material for construction in Camagüey's territory. Significant growth is not foreseen and the current plan is to balance production and sustainability of gravel and rock resources on a regional basis.