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(for Color Plates, see pages 21-32)

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The Field Museum

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

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

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

BIOECO has four Divisions:

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

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

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Museo Nacional de Historia Natural de Cuba

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

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

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Unidad de Servicios Ambientales "Alejandro de Humboldt"

The "Alejandro de Humboldt Environmental Services Unit" was created in 2000 with a mission to protect, conserve, and manage the protected areas of Guantánamo Province administered by the Ministry of Science, Technology, and the Environment (CITMA) according to the demands of sustainable development. This unit also helps develop international projects and provides their scientific-technical and environmental services to others. It has a technical group, whose specialists are in charge of programs in all the designated protected areas and who monitor other areas.

This unit is in charge of administering and managing Alejandro de Humboldt National Park and the Hatibonico Ecological Reserve. In each of these areas, it has qualified staff in charge of the development of programs, as well as a large number of park guards who guide and help with research.

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Cornell Lab of Ornithology

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

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

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

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ACKNOWLEDGMENTS

Our rapid biological inventory of Alejandro de Humboldt National Park was a success, thanks to the efforts and generosity of many individuals. We extend our sincerest gratitude to all.

Information presented in this report combines data gathered during our rapid inventory with data collected over the years by biologists who work in the Park, in BIOECO, in the unidad de servicios Ambientales "Alejandro de Humboldt," and in the Museo Nacional de Historia Natural (MNHN, La Habana). The scientific team thanks all our collaborators who shared data from their field research and literature reviews.

We are grateful to the Ministry of Science, Technology and Environment (*Ministerio de Ciencia, Tecnología y Medio Ambiente*, CITMA), which granted us access and collecting permits. We would also like to thank the Cuban Interests Section in Washington, D.C., who provided visas to the participants from the United States. In Havana, Nadia Pérez, Yazmín Peraza, and Regla Balmori of the National Museum of Natural History of Cuba (Museo Nacional de Historia Natural de Cuba) shared their wonderful friendship and their organizational skills. Reinaldo Estrada of the National Center of Protected Areas (*Centro Nacional de Áreas Protegidas*, CNAP) offered valuable comments on the results and recommendations of our fieldwork.

Bernardino Suárez Fernández, Ifraín Diez Gainza, Jorge Lino Gámez Díaz, Rubén Pantoja Justiz, Eulicer Suárez Pantoja, Pascual Ramírez Samón, José A. Rodríguez Ortiz, Roelmis Ortiz Agüelles, and Oneil Durand Oliveros provided invaluable direct support during the fieldwork, especially by forging trails, guiding us to important biodiversity sites, and helping with collections and observations.

We thank everyone from Arroyo Bueno and La Naza who shared information about their lives and their community's history with the social inventory team. We also thank Genaro Ramírez, Exiquio Lamorut, Aida Justiz, and Isaías Suárez Fernández—members of the community—who provided cargo animals and food. Many thanks to our cooks at the camps: Emelina Martínez, Daisy Ramírez, Zoila Pantoja Justi, and Maria Alpoyin E. We thank drivers Rafael Ocaña Osorio, José Luis Fabar, Ramón Cueto, and Eduardo Ramos for providing transportation during the expedition. When all mechanical and animal transport failed us, it was the people of Arroyo Bueno who came to our aid and helped move the camp; we cannot thank you enough.

Kesia Mustelier is grateful to Daysi Reyes and Agueda Vicario. José L. Fernández thanks Jorge L. Reyes for helping process and identify material. Ansel Fong is especially grateful to Rolando Viña for all his valuable field support during various sampling trips before the rapid inventory. The botanists are indebted to Ramona Oviedo Prieto for her generous help identifying plants using photos taken in the field, and M. Lucia Kawasaki for help with the taxonomy and nomenclature of Myrtaceae. The zoologists would like to thank Pascual Ramírez Samón and Oliver Matos Sánchez for sharing data with them. The Foundation "Antonio Nuñez Jiménez de la Naturaleza y el Hombre" organized and financed several expeditions to different sites within the Park, from which we obtained valuable information included in this rapid inventory.

As always, Tyana Wachter and Guillermo Knell took care of all necessary coordination, making difficult tasks seem easy; Sophie Twichell helped us with coordination. Dan Brinkmeier provided logistic support and graphics in the busy days before we presented preliminary results in Santiago. We also thank Amanda Zidek-Vanega for translations, and Debby Moskovits, Nicasio Viña Bayés, Doug Stotz, José Leonardo Fernández, Brandy Pawlak, Marjorie Pannell, and Sarah Thompson for their careful review of report drafts.

Jim Costello and staff at Costello Communications demonstrated tremendous patience, creativity, and kindness as they put text and images into production.

The John D. and Catherine T. MacArthur Foundation and The Field Museum funded this rapid inventory.

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	February 12–22, 2004
Region	The inventory took place in Alejandro de Humboldt National Park, located in the Sagua-Baracoa massif in eastern Cuba, approximately 50 km northeast of the city of Guantánamo and 35 km northwest of the town of Baracoa (Figs. 2, 3A). It extends over Cuba's easternmost provinces: Holguín (Sagua de Tánamo and Moa Municipalities) and Guantánamo (Yateras, Baracoa, and Guantánamo Municipalities). Its total area is 70,680 hectares (273 mi^2), of which 2,250 hectares correspond to its marine portion and 68,430 hectares to its terrestrial portion. The Park is mountainous and maintains many original terrestrial habitats, including rainforests (*pluvisilvas*), natural pine groves (*pinares naturales*), evergreen and semideciduous forests (*bosques siempreverdes y semideciduos*), scrub formations (*matorrales*), and grasslands (*herbazales*) (Fig. 3B).
Sites surveyed	The biological team concentrated their efforts in four sites: El 26 Camp and surrounding areas (northeast of Arroyo Bueno), Cocalito Camp (at the confluence of Jaguaní River and Arroyo Cocalito, downriver and east of the community of Arroyo Bueno), Bahía de Taco (on the coast, northwest of Baracoa), and the scrub (*charrascal*) at Yamanigüey, northwest of Bahía de Taco (Fig. 3A). The social team worked in the communities of Arroyo Bueno and La Naza (Fig. 3A). This report also includes data from other sites within the Park collected by field team members during previous inventories (for example, the Altiplanicie El Toldo), or by collaborators.
Organisms studied	Terrestrial vascular plants (ferns and relatives, and seed plants), terrestrial mollusks, spiders and other arachnids, hymenopterans (ants, bees, and wasps), terrestrial amphibians and reptiles, and birds. We also studied the condition and distribution of vegetation types. Our collaborators provided additional data from their studies of liverworts, mosses, vascular plants, dipterans (flies), mammals, and the local use of fauna by humans. The communities of Arroyo Bueno and La Naza participated in the social inventory.
Highlights of results	The Park contains the largest well-conserved remnant mountain ecosystem in the country (Figs. 3B, 4). The majority of its vegetation types—rainforests (of diverse types), *Pinus cubensis* pine groves, evergreen forests, and charrascals—still cover large expanses of the Park in a complex mosaic resulting from a diversity of soil types, as well as differences in humidity, sun exposure, and altitude. Only a few small areas of semideciduous forest remain, and some forested areas have been perceptibly altered by previous timber extraction, mining, and agriculture. Overall, the Park contains a

Highlights of results
(continued)

large block of continuous, high-quality, natural forest that should retain the majority of native species present.

Using information we obtained during our fieldwork, along with data gathered from other collections, literature, and unpublished studies, we report the highlights below. We begin with nonhuman groups and conclude with human communities. We report data Park-wide and in many cases also per administrative sector of the Park.

Birds: We found high species richness and abundance of migratory land birds. We recorded 98 species in the Park and, based on previous work in the area, predict an avifauna of 150 species. We recorded 75 species in La Melba Sector (52 species in El 26 Camp and 63 in Cocalito Camp) and 81 species in Baracoa Sector (74 in Bahía de Taco, 33 in Cayo Guam, 55 in Nuevo Mundo, and 41 in Yamanigüey).

The Park harbors significant populations of endemic and threatened bird species (Fig. 8). We recorded 12 endemic and 8 threatened species, included Masked Duck (*Nomonyx dominicus*), Gundlach's Hawk (*Accipiter gundlachi*), Sharp-shinned Hawk (*A. striatus*), Gray-fronted Quail-Dove (*Geotrygon caniceps*), Cuban Parrot (*Amazona leucocephala*, abundant at times), Cuban Parakeet (*Aratinga euops*, abundant at times), Giant Kingbird (*Tyrannus cubensis*), and Bahama Swallow (*Tachycineta cyaneoviridis*). We recorded large numbers of Cuban Crow (*Corvus nasicus*), a species whose numbers are diminishing or even disappearing in other parts of eastern Cuba. We did not observe the Ivory-billed Woodpecker (*Campephilus principalis bairdi*) or the Cuban Kite (*Chondrohierax uncinatus wilsonii*). The Park represents a critical area for the ecology of Neotropical migrant birds that winter in Cuba and that pass through the region on their migrations.

Amphibians and reptiles: There are 20 amphibian (2 toads and 18 frogs) and 42 reptile species (32 lizards, 8 snakes, 1 turtle, and 1 amphisbaenian) in the Park (Fig. 7), with 3 additional species (lizards of the genus *Anolis*) possibly present. Of these, we observed 15 amphibians and 20 reptiles during the inventory, and we detected 5 of these species in localities not mentioned in the literature. The amphibians recorded in the Park represent 33.9% of all amphibian species in Cuba and 64.5% of those present in the Sagua-Baracoa Subregion, in which the Park is situated. Reptiles of the Park represent 30.7% of the total number of reptile species in Cuba and 68.8% of those present in the Sagua-Baracoa Subregion. The elevated percentages of amphibian and reptile species present, together with the relatively small size of the Park (0.64% of the area of Cuba), demonstrate its importance for Cuba's herpetological fauna.

REPORT AT A GLANCE

Highlights of results (continued)

Endemism is high: 90.0% of the amphibians and 73.8% of the reptiles in the Park are endemics, of which 9 are exclusive to eastern Cuba's mountainous massifs and 6 are known to exist only within the Park. Of the species recorded in the Park, 60.0% of the amphibians and 26.2% of the reptiles are considered threatened in Cuba, and 26.5% of Cuba's threatened amphibians and 22.6% of its threatened reptiles inhabit areas within the Park.

Mammals: Combining our work with data from other researchers allowed us to compile a list of 16 mammal species in the Park, all with living populations. Of these, 11 are native, including almiquí (*Solenodon cubanus*, an endemic and threatened insectivore, Figs. 9A–9C), manatee (*Trichechus manatus manatus*), 2 endemic hutia species—whose populations are subjected to serious poaching pressure in the Park (*Mysateles melanurus* and *Capromys pilorides*)—and 7 species of bats (including 2 endemic species and others with large and significant populations in the area).

Five species are established exotics: house mouse (very localized), black rat, and feral dogs, cats, and pigs. Not much is known about the black rats' ecology or impact in the Park, although it is clear that they can be found in almost all Park areas in high densities. The latter three species appear to be dispersed throughout the Park.

Invertebrate animals: We observed 16 families, 27 genera, and 45 species of **terrestrial mollusks** in the Park. Families with the highest numbers of species include Camaenidae (7), Helminthoglyptidae (6), Urocoptidae (5), Helicinidae (4), and Oleacinidae (4). Terrestrial malacofauna endemism is high: 75.6% of the Park's species are endemic, 12 (26.7%) are found only in the Park, and 12 (26.7%) are endemic to the Sagua-Baracoa Subregion. Eleven species (24.4%) are exotics (non-native), introduced in the Park.

There are 106 **spider** species present in the Park belonging to 32 families and 82 genera. Best-represented families include Araneidae, Theridiidae, Salticidae, and Tetragnathidae. During this inventory, we recorded 11 new species for the Park, including 3 new records from the Hersiliidae, Mimetidae, and Segestriidae families. There are 33 endemic spider species present, including 4 that are endemic to Eastern Cuba, 2 endemic to the Sagua-Baracoa Subregion, and 7 that are known only from one or two localities within the Park (*Barronopsis campephila*, *Kaira levii, Lycosa ovalata, Scaphiella bryantae, Dolomedes toldo, Selenops iberia*, and *Cyrtopholis plumosa*).

We observed 17 species, belonging to 6 orders, 7 families, and 12 genera of **other arachnids** (scorpions, whipscorpions, solpugids, and hooded tickspiders).

In the literature, there is one additional genus with 2 species recorded for the Park, but we did not observe either. Of the Park's 19 species, 5 are new to science (2 *Ammotrechella* solpugids, 1 *Cazierius* scorpion, 1 *Rowlandius* schizomid, and 1 schizomid that represents a new genus and species). Fourteen of the 17 species are endemic to Cuba.

We found 108 species of **dipterans** in the Park (13.4% of the 804 species recorded in Cuba), belonging to 71 genera and 34 families, with 11 endemic species (5.3% of Cuba's endemic dipteran species). Of the endemics, 4 are national endemics, and 7 are considered local Park endemics: *Epiphragma cubense* (Tipulidae), *Beameromyia cubensis* (Leptogastridae), *Lamprempis setigera* (Empididae), *Proctacanthus nigrimanus* (Asilidae), *Stenotabanus fairchildi* (Tabanidae), and *Micropeza verticalis* and *Grallipeza baracoa* (Micropezidae).

A wide diversity of important and significant **hymenopterans** (ants, bees, and wasps) inhabit the Park. We found 298 species, belonging to 35 families, which is approximately one-fourth of the 1,156 known species in the country and more than three-fourths of those recorded in the Sagua-Baracoa Subregion. Eighteen species (6.1% of the Park's total) are endemic to Cuba. We estimate that the actual number of species present in the Park easily surpasses 400.

Nonvascular plants: The list of **liverworts and relatives** includes 235 species, of which 234 are liverworts (Marchantiales, Monocleales, Metzgeriales, Jungermanniales) and one is a hornwort (*Notothylas breutelii,* Notothyladaceae). This is a significant percentage of all the liverworts and relatives reported for the country and the Sagua-Baracoa Subregion. Of the Park's species, there are 8 endemic liverworts (3 of which are also considered threatened) and 10 non-endemic, threatened species. The **moss** flora is represented by 156 infrageneric taxa belonging to 69 genera and 33 families, which is 38.0% of those recorded in Cuba and 58.8% of the mosses known for the Sagua-Baracoa Subregion. Ten moss species are globally threatened and 4 are endemic to Cuba.

Vascular plants: The Park possesses a rich pteridoflora (**ferns and fern relatives**), estimated at 650 species. To date, 298 species belonging to 72 genera and 23 families have been recorded, which represents 45.7% of the ferns in Cuba. We found 37 species currently categorized as, or proposed as, Threatened. There are 41 endemic and possibly endemic species, for an endemism rate of 13.8%, one of the highest in the country. Of the 41 endemic/possibly endemic species, 6 are known only from the Park. We had 5 new records for Cuba, 2 new records for the Park, and 3 very rare species were rediscovered.

Highlights of results (continued)

We recorded 1,071 species, subspecies, and varieties of **spermatophytes** (seed plants), belonging to 472 genera, and 123 families. We estimate that throughout the Park there are 1,500 species. Of those registered, 97.8% are native (1,000) or probably native (48), and 57.7% are endemic to Cuba (595) or probably endemic (24). There are only 4 naturalized species (0.4% of the total number of species) and 19 introduced species (1.8%). The families presenting the most species, subspecies, and/or varieties are Rubiaceae (85), Asteraceae (67), Orchidaceae (66), Euphorbiaceae (61), Melastomataceae (56), Fabaceae s.l. (55), and Myrtaceae (45). The families with the highest number of endemic species include Rubiaceae (58), Euphorbiaceae (47), Asteraceae (45), Myrtaceae (40), and Melastomataceae (38).

Human communities: Members of the rapid social inventory team worked in the La Melba Sector, which covers parts of Moa and Yateras Municipalities, in Holguín and Guantánamo Provinces, respectively. Within the sector, most people live in two communities: Arroyo Bueno (also called "La Melba") and La Naza, with 382 inhabitants dedicated mostly to mining, subsistence agriculture, and to a lesser degree working in local education, cultural, commercial centers, and local establishments in which food is prepared.

Arroyo Bueno has a grade school (35 students), a library, a computer and video center, a pharmacy, a medical center, a store for food products, a bakery, two television parlors, a cultural center, a sawmill, and an integrated hair salon and barbershop. La Naza also has a grade school (12 students), a library, a computer and video center, and a television parlor; inhabitants have to go to La Melba for the other services.

Fortunately, there is a local environmental education program that includes local participation in its implementation. Residents recognize Alejandro de Humboldt National Park as a protected area, and as a result, there is motivation to participate in the environmental education program's activities. There are specialists, technicians, park guards, and groups of community activists in the Park and the existing educational, cultural, and health system contributes to developing and implementing the Park's environmental education program.

A collaborator conducted a study of the use and knowledge of the local fauna in the communities of La Melba and Piedra La Vela, both situated in rainforest areas within the Park. The study suggests that the level of interaction with elements of the local fauna is relatively low. Fauna species most often reported as part of the local diet include hutias (with 21 responses), wild birds (for example, crows, hawks, parrots, with 17 responses), pigs (16), and Cuban boas (7). Hunting pressure on certain important native species, some of which are listed

as Conservation Targets in this report, could be high. Community members also report consuming wild exotic species, like wild boars (i.e., feral pigs). Data regarding community knowledge of animals functioning as biological controls, and those acting as disease vectors, show that awareness-raising environmental education programs are needed. These environmental education programs serve as a catalyst to involve more people in conservation planning and decision making.

Main threats

01 **Destruction and alteration of native habitats in the Park.** Despite the Park's current protection, some habitats are being transformed, fragmented, or otherwise degraded by human activities; and others may be threatened by these same activities. Deforestation and the presence of extensive agricultural zones are the principal causes of habitat destruction. Rainforests on poorly drained soils are especially vulnerable, not only because of their intrinsic fragility, but also because they occupy a small area. Deforestation has also seriously altered the coastal and precoastal belts of vegetation growing on limestone.

Subsequent erosion of deforested areas (especially in areas that are converted to agricultural lands) may cause severe damage to the Park's aquatic habitats. Inhabitants' land use practices, which are incompatible with the area's management category, threaten its conservation. Another threat, especially to amphibians, aquatic invertebrates, and fish, is water contamination of rivers and groundwater by residuals of mining activities and coffee processing.

02 **Invasive and exotic species.** Noncultivated, exotic species that are capable of displacing native vegetation are a serious potential threat in some areas of the Park. For example, even though populations of albaricoque (*Syzygium malaccense*, Myrtaceae), pomarrosa (*S. jambos*), and a species of *Casuarina* (Casuarinaceae) have not displaced extensive areas of native vegetation, they should be watched carefully and controlled if their populations begin to spread aggressively, as has occurred in other tropical habitats.

03 Once introduced animal species—such as pigs, dogs, and cats—go wild, they turn into serious predators, hunting amphibians, reptiles, birds, and mammals, and damaging native vegetation. We have verified this current threat during fieldwork and by reports from Park staff. Predation is not selective and it affects practically all species.

04 **Illegal extraction.** Illegal logging, wood extraction to make charcoal, hunting of birds and mammals for food, and collecting or capturing native plants and animals for commercial sale are all activities that seriously threaten Park

REPORT AT A GLANCE

Main threats (continued)	biodiversity. For example, the terrestrial malacofauna is affected by illegal sale of the shells of *Polymita* species. Hunting and collecting impact two threatened reptile species: the Cuban iguana and the Cuban boa. Both are consumed and the boa is targeted for elimination because people are afraid it will hunt their poultry. 05 **Lack of knowledge, leading to incorrect management.** Despite considerable efforts, there are still many gaps in our understanding of the Park's biology. Several species living in the Park have not received research attention—even some of the most ecologically important species—and as a result, we do not have information about many species' basic biology. There is also very little understanding about how to actively and passively manage the Park's species to assure their survival and (in some cases) produce direct benefits for local residents.
Current status	This Park is one of Cuba's most important strictly protected areas (Category II, World Conservation Union, IUCN). In 2001, UNESCO declared it a World Heritage Site.
Principal recommendations for protection and management	01 **Reduce or eliminate deforestation or degradation of forested habitats.** Protect remaining forests, especially rainforests, evergreen forests, and gallery forests, by controlling processes that convert land use from natural forests to pasture, agricultural, or mining areas. 02 **Reduce or eradicate exotic species, focusing on the most damaging ones first.** Prevent introduction of harmful animals in the forest, and seek additional resources to implement control and eradication plans of exotic plants and animals currently in the Park. 03 **Control illegal extraction.** Eliminate commercialization of Cuban Parrot (*Amazona leucocephala*), other birds, and snails of the genus *Polymita*. Stop hunting of Cuban iguana and Cuban boa. Limit collecting of botanical samples from rainforest on poorly drained soils, and prohibit new trails and roads.

Why Alejandro de Humboldt National Park?

Forests throughout the Insular Caribbean suffered immensely when large expanses of land were converted to sugarcane, coffee, plantain, and cacao plantations. Extensive areas of the original forests fell under the axes of colonists, along with the plants and animals living in them. Now, islands retaining original or slightly altered forests are extremely privileged. In eastern Cuba, the most extensive rainforests in the entire Caribbean are found within the borders of Alejandro de Humboldt National Park.

The Park is an important haven for flora and fauna. Its exuberant tropical forests harbor thousands of species, many of which are unique and extraordinary. The last reports of Cuban Kites and Ivory-billed Woodpeckers in Cuba were from remote corners of the Park, where there is still hope that they will be found again. The area's pristine conditions allow the almiquí, an endemic, insectivorous mammal, to survive; its largest population is found in the Park and is an important conservation target. Endemic birds, such as Giant Kingbird and Bee Hummingbird, frequent different parts of the Park, and the Park also receives a large number of migratory bird species (and individuals) from North America.

The Park extends northeast to the coast and into the sea, where it protects a manatee population sheltered by the tranquil Bahía de Taco. In many places within the Park, beautiful *Polymita* mollusks move slowly over vegetation growing on limestone substrates. Places like Yamanigüey, El Toldo, and Monte Iberia harbor exceptional quantities of endemic plants, with endemism reaching 70%.

As if this tremendous biodiversity was not enough to confirm the Park's significance, a renowned Cuban naturalist once described the Toa River as the most important source of fresh water in the Insular Caribbean—most of this river's tributary streams and rivers spring from the Park. These waters, an invaluable resource in today's world, flow clean and pure thanks to the natural forests that protect them.

Conservation in the Park

CURRENT STATUS

Alejandro de Humboldt National Park covers portions of Cuba's easternmost provinces: Holguín (in Sagua de Tánamo and Moa Municipalities) and Guantánamo (Yateras, Baracoa, and Guantánamo Municipalities). Of the Park's 70,680 hectares, 2,250 hectares correspond to its marine habitats, while the remaining area is terrestrial.

This Park is one of Cuba's most important strictly protected areas (Category II, World Conservation Union, IUCN) in terms of biodiversity, not only because it possesses the country's highest levels of species richness and endemism, but also because it is the largest remnant of Cuba's conserved mountainous ecosystems. In 2001, UNESCO declared the Park a World Heritage Site. In addition, the Park constitutes the core of the Cuchillas del Toa Biosphere Reserve.

CONSERVATION TARGETS

Conservation targets are the elements of physiographic, biological, or cultural diversity that we want to persist in the landscape. We used the following criteria to choose these targets:

C1 Wild vegetation types or aquatic habitats that are the foundations of native biodiversity

C2 Vegetation types or aquatic habitats that are especially species rich, diverse, or threatened

C3 Wild communities/assemblages that are especially species rich, diverse, or abundant in comparison to those of other landscapes in the country or region

C4 Species, subspecies, or communities/assemblages that are endemic to the country, to the region, or to the locality

C5 Species, subspecies, or communities/assemblages that are rare, threatened, endangered, vulnerable, or declining (including species of economic importance)

C6 Species or subspecies under such intense local harvesting pressure that their populations may be in jeopardy (sufficient information is lacking)

(Codes continued on next page)

During the rapid inventory of Alejandro de Humboldt National Park we identified the following conservation targets. Site managers and planners will need more research to refine these selections. Codes in parentheses refer to the criteria described to the left. Detailed targets lists are found at the beginning of each group's chapter in the Technical Report.

Physiographic Features	▪ Clean rivers and streams, free of toxins and sediments of anthropogenic origin that harm native amphibians, fish, and aquatic invertebrates (C1, C10) ▪ Karstic sites (of small extensions) within the Park that are essential for maintaining the strictly cave-dwelling bat species (C10)
Terrestrial Vegetation Types	▪ Large expanses of undisturbed vegetation, including the main vegetation types in the Park: rainforest, evergreen and semideciduous forests, pine groves, and scrub formations (C1, C2), some of which are local and unique groupings of species (C4)
Nonvascular Plants	▪ Eight endemic species of **liverworts**, of which 3 are also threatened (C4, C5), plus the 10 non-endemic threatened species (C5) ▪ One threatened **moss** species (*Fissidens duryae*), which is endemic to eastern Cuba (C4, C5), and the 9 other threatened species (C5)
Vascular Plants	▪ Thirty-seven species of **ferns** that are either categorized as, or being considered for categorization as, Threatened (C5) ▪ Thirty-eight endemic fern species, and 3 possible endemics (C4) ▪ Tree ferns (C5)

Conservation Targets (continued)

C7 Concentrated populations of migratory species (either as passage migrants or as seasonal residents) that may be vulnerable through their dependence on the landscape's resources C8 Institutions, social assets (including human resources), or built structures that are significant for the diversity of the landscape, especially if threatened C9 Human land uses and social/ecological practices that apparently support or are compatible with biodiversity conservation C10 Physiographic features of the landscape that harbor significant native biodiversity and are at risk	Vascular Plants (continued)	▪ Eight endemic species of **spermatophytes** (plants with seeds) considered Endangered worldwide, 15 endemic species considered Vulnerable, and other rare endemic species (C4, C5)
	Mollusks	▪ The 34 species endemic to Cuba (C4)
	Arachnids	▪ Populations of 33 endemic **spider** species present in the Park, especially the 4 endemic to Eastern Cuba, 2 endemic to Sagua-Baracoa Subregion, and 7 known to exist only in one or two localities within Park borders (C4)
	Insects	▪ The 11 endemic dipterans (**flies**), especially the 7 species that are only known to exist within the Park (C4) ▪ Communities of **hymenopterans**, especially the ants, since the Park harbors the most ant diversity known in Cuba (C3); endemic ant species of the genera *Camponotus* and *Temnothorax* (C4); and genera and species of *Platymistax* and *Dipogon* that, so far in Cuba, have only been found in this region (C5)
	Amphibians and Reptiles	▪ Threatened species (12 amphibians and 11 reptiles), most of which are also endemic to Cuba (C4, C5) ▪ Five species endemic to the Sagua-Baracoa Subregion (not considered threatened) (C2) ▪ The Cuban iguana (*Cyclura nubila*) and the Cuban boa (*Epicrates angulifer*), that are locally pressured by human collection and that are included on IUCN's Red List of threatened species (C5, C6)

Conservation Targets (continued)

Birds	▪ The Giant Kingbird (*Tyrannus cubensis*), Cuban Parrot (*Amazona leucocephala*), Cuban Crow (*Corvus nasicus*), Cuban Parakeet (*Aratinga euops*), Gundlach's Hawk (*Accipiter gundlachi*), Masked Duck (*Nomonyx dominicus*), Bee Hummingbird (*Mellisuga helenae*), Sharp-shinned Hawk (*Accipiter striatus*), and Gray-fronted Quail-Dove (*Geotrygon caniceps*) (C5) ▪ Migratory birds originating from North America (C7) ▪ Cuban Kite (*Chondrohierax uncinatus wilsonii*), and Ivory-billed Woodpecker (*Campephilus principalis bairdi*), if present in the area (C4, C5)
Mammals	▪ The almiquí (*Solenodon cubanus*), an endemic and threatened insectivore (C4, C5) ▪ Manatee (*Trichechus manatus manatus*), a threatened species (C5) ▪ Two endemic hutias (*Mysateles melanurus* and *Capromys pilorides*) whose populations are subjected to serious capture pressure in the Park (C4, C6) ▪ Two endemic bat species (C4), and significant bat populations in the area (C3)
Human Communities	▪ Specialists, technicians, park guards, and groups of community activists in the Park (C8, C9) ▪ An environmental education program included in the Park's management strategy, and educational, cultural, and health systems in place that contribute to developing and implementing the program (C8, C9)

THREATS

Destruction and Alteration of Native Habitats

Despite the Park's current protection, some habitats are being transformed, fragmented, or degraded by human activities, and others are threatened by the possibility. Many native species are completely dependent on very specific microhabitats for survival. Not only are trees and shrubs affected by deforestation, but also different groups associated with these species, whose connections and specifications are still unknown. This is the case for the majority of liverwort species, which live only in the understory, or grow on certain plant species in these forested ecosystems, and need specific microhabitats of a certain age, with specific pH, shade, and humidity requirements for growth and reproduction. Many of the mollusks, arachnids, and insects, as well as the amphibians and reptiles, are extremely sensitive to even localized habitat loss or destruction.

Logging (for example, in submontane rainforest on poorly drained soils, north of La Melba) and conversion to agricultural lands (for example, in Santa María-Nibujón, Cayo Berraco, and the lower part of Naranjo River Basin) are the main causes of habitat destruction. The rainforests on poorly drained soils are especially vulnerable, not only because of their intrinsic fragility, but also because they occupy a small area. In addition, deforestation has altered significantly the limestone coastal and precoastal belts of vegetation.

Erosion subsequent to deforestation, especially in areas that are converted to agricultural lands, may cause severe damage to the Park's aquatic habitats. Inhabitants' land-use practices are incompatible with the area's management for conservation. Another threat, especially to amphibians, aquatic invertebrates, and fish, is contamination of rivers and groundwater from residuals of mining activities and coffee processing. Both activities liberate organic and inorganic contaminants, which are carried to the water (non-point pollution) or directly dumped in the water (point pollution), with direct consequences (still unknown) for the amphibians, especially for those species with eggs and aquatic developmental stages.

Invasive and Exotic Species

Noncultivated exotic species that are capable of displacing native vegetation are a serious threat in some areas of the Park. Non-native introduced animals also can threaten some areas. For example, the lowland and submontane rainforests on metamorphic soils are reasonably well conserved, but destructive animals like pigs are being introduced with increasing frequency. In addition, once the dog (*Canis familiaris*) and cat (*Felis catus*) turn feral, they prey upon amphibians, reptiles, birds, and mammals. We have verified this current threat during fieldwork and by reports from Park staff. Predation is not selective and it affects practically any individual of these mentioned groups.

Several populations of non-native plant species exist in the Park's forest, including albaricoque (*Syzygium malaccense*, Myrtaceae), pomarrosa (*S. jambos*), and a species of *Casuarina* (Casuarinaceae). These species have not displaced extensive areas of native vegetation, but they should be managed carefully to prevent them from spreading aggressively, as has occurred in other tropical habitats.

Illegal Extraction

Illegal logging, wood extraction to make charcoal, hunting of reptiles, birds, and mammals for food, and collecting or capturing native plants and animals for commercial sale are all activities that seriously threaten biodiversity in the Park. Terrestrial malacofauna are affected by illegal sale of the shells of *Polymita* species. Hunting and collecting seriously impact the Cuban iguana (*Cyclura nubila*) and Cuban boa (*Epicrates angulifer*). These species, both of which are included on IUCN's Red List (IUCN 2004), are captured for food, and the boa is killed on sight because people are either afraid of it or they are worried that it could go after their poultry.

Poaching of some species to sell as pets, such as the Cuban Parakeet and Cuban Parrot, threaten the health of their populations. Gundlach's Hawk and other hawks are hunted because they often consume rural farmers' chickens. In fact, BirdLife International reports this as the main reason why Gundlach's Hawk has become threatened (Rodríguez-Santana, unpublished data).

Lack of Knowledge Leading to Incorrect Management

Despite efforts, there are still many information gaps regarding our understanding of the Park's biology. Several species living in the Park have not received research attention—even some of the ecologically important species—and as a result, we do not have information about the basic biology of many species. We also understand very little about how actively and passively to manage the Park's species to assure their survival and, in some cases, to produce direct benefits for local residents.

For example, parasitic and predator species make up the majority of the hymenopterans (wasps, bees, and ants) in the Park. Their survival depends on the availability of host insects and/or prey (many times specific) that establish complex and delicate multitrophic relationships, as is also the case for phytophagous species and their specific host plants. Given the high level of floral endemism in the Park, we assume that this interdependency exists between many hymenopterans and plants. Habitat destruction is thereby a major threat to hymenopterans. This holds true for other insects and arachnids, and to a certain degree for nonvascular and vascular plants, as well.

Lack of knowledge is a threat even to better known taxonomic groups. For example, some areas within the Park are completely unknown or understudied with regard to the herpetofauna. Many aspects of these species' natural histories are also unknown, including habitat use and sources of food. This information is essential for developing conservation strategies and for planning effective management actions for the area.

Frequently, the origin of seeds used in plantations of *Pinus cubensis* and other broadleaf species is unknown. Plantations displace native vegetation and could alter the genetic bank of some native species.

In human communities, the principal threat is inappropriate land use that comes from lack of knowledge. As emphasized by the chapter on human uses of the fauna, there is a need to disseminate biological information about the Park, which could benefit the local inhabitants and animals.

Small Population Sizes of Some Species

Another important consideration is the fragility of some populations of species with small distributions (ranges), as they will no doubt be the first to disappear if habitat loss increases. Destruction of vegetation and its corresponding leaf litter layer, whether because of logging or increased frequency of set fires (which drastically alter microclimate parameters such as humidity and level of insolation), is a current and potential threat for amphibians, arachnids, insects, and many plant species that have small population sizes.

RECOMMENDATIONS

Considering Alejandro de Humboldt National Park's conservation targets and threats, we recommend the following goals and preliminary strategies for management and protection, additional scientific studies (inventories, research, and monitoring), and for human communities and environmental education. Detailed and specific recommendations for each organism group are found in the full Technical Report.

Protection and Management

01 **Eliminate deforestation and degradation of forested habitats.**

- Protect remaining forests, especially rainforests, evergreen forests, and gallery forests, by controlling processes that convert land use from natural forests to pasture, agriculture, or mining; in particular, emphasize conservation of lowland rainforests on metamorphic rocks and submontane rainforests on poorly drained soils (because their distribution within Cuba is found entirely within the Park).
- Stop logging and tree and shrub clearing or removal, especially in Baracoa and Cupeyal del Norte Sectors, and prohibit vegetation clearing in Yamanigüey-Río Seco's coastal charrascals.

02 **Reduce or eradicate exotic species, focusing on the most damaging ones first.**

- Prevent introduction of non-native animals in the forests, especially in lowland and submontane rainforests on poorly drained soils.
- Strengthen existing programs for erradicating invasive plants and animals (such as feral dogs and cats) and seek additional resources or financing to implement these plans more efficiently and extensively throughout the Park.

03 **Control illegal extraction.**

- Limit collections of botanical samples in rainforests on poorly drained soils, and prohibit the opening of new trails and roads.
- Eliminate the commercialization of the Cuban Parrot (*Amazona leucocephala*), other birds, and *Polymita* snails.
- Limit local hunting of the Cuban iguana and Cuban boa.

04 **Protect special habitats.**

- The Giant Kingbird population is a significant conservation element. Where it occurs, focus on maintaining appropriate conditions for this species, such as preserving large trees for nesting and perching, and protecting palms for food. (Ecological research is needed to achieve this conservation goal.)
- Keep a strict vigilance over Monte Iberia's lakes, as their communities are unique. Only research access should be permitted.

RECOMMENDATIONS

Protection and Management (continued)

05 **Maintain and improve water quality, preventing sedimentation and contamination of aquatic habitats.**

- Take measures to prevent contamination, dam construction, and river and tributary diversions in La Melba and Ojito de Agua Sectors.
- Communicate and insist on the need to conserve and protect the Altiplanicie El Toldo (the El Toldo high plateau) from mining activities.
- Monitor and regulate coffee-processing plants to guarantee that they have measures in place to stop dumping wastes that harm amphibians into rivers.

Additional Inventories

Information about native species and their distribution in the Park is lacking. Many specific recommendations can be found in the Technical Report. Here we highlight some of the most pressing recommendations.

01 Prioritize studies of the flora and vegetation in the pine grove communities, rainforests, and charrascals. Specifically, focus on the following areas: south of La Melba; the Lirios, Jiguaní, and Naranjo River basins; Sierra Azul; ophiolites between Santa María and the Altiplanicie de Monte Iberia; rainforests and charrascals of Cupeyal del Norte; the extreme western section of the Park; Farallones de Moa; and El Toldo's southern slope (the entire Altiplanicie El Toldo for bryophytes and pteridophytes).

02 Collect **nonvascular plants** (liverworts and bryophytes) from all areas with appropriate growing conditions, especially in Ojito de Agua Sector, which has not been studied thoroughly, during rainy and drier seasons.

03 Most Park areas lack studies of the **ferns and fern relatives**, and some places have never been studied. Conduct rapid inventories in these areas and include the pteridoflora along the limestone coastal and precoastal belts in order to develop appropriate conservation recommendations.

04 Conduct inventories of **spiders** during different times of the year and in additional habitats.

05 Study **ants, wasps, and bees** (Hymenoptera) in the Park's canopy layers. This park is most appropriate for such studies. We propose developing an annual inventory in the most promising areas, including El Toldo, Las Tetas de Julia, and some places near Cupeyal, which has been the least studied to date.

06 Conduct long-term inventories with the participation of foreign taxonomic experts to increase knowledge of Park **flies** (Diptera) and to contribute to their management and conservation.

Additional Inventories (continued)	**07** Conduct additional **amphibian and reptile** inventories in different areas of the Park to add to the incipient knowledge of the herpetofauna. For example, the herpetofauna of Cupeyal del Norte Sector is barely understood, and the majority of this sector has not been studied at all. **08** Conduct additional **bird** inventories to verify whether or not populations of Cuban Kite (*Chondrohierax uncinatus wilsonii*) or Ivory-billed Woodpecker (*Campephilus principalis bairdi*) still exist in Cuba, since the most recent sightings of these birds were from a region that includes Alejandro de Humboldt National Park. Determining whether their populations exist, and where, are priorities in avian conservation. **09** The Park maintains significant populations of various endemic and threatened bird species, including Gundlach's Hawk, Cuban Parrot, Cuban Parakeet, Giant Kingbird, and Cuban Crow, as well as small populations of Gray-fronted Quail-Dove, Bee Hummingbird, and maybe even Blue-headed Quail-Dove (*Starnoenas cyanocephala*). Documenting the size and distribution of these species is the necessary first step for developing conservation management plans for these species in the Park. **10** Complete inventories of those groups of **mammals** for which additional species are predicted and for those groups with significant information gaps, such as bats.
Research	**01 Research active and passive methods for restoring damaged forests.** ▪ Conduct studies in areas affected by logging in submontane rainforests on poorly drained soils (in the upper part of Jiguaní River, north of La Melba), and in lowland rainforests over metamorphic rocks impacted by human intervention. ▪ Study *Pinus cubensis* communities and their successional stages, how they develop in plantations, and how they are affected by shrub-layer removal. Learn how to manage and restore pine communities. ▪ Study areas affected by fire and mining in El Toldo to determine restoration actions. **02 Study the effects of introduced and exotic species on native biodiversity. Determine which species are the most harmful, then study their population biology in the Park.** Once results are obtained, management actions should be designed to reduce the threat. For example, the impact of feral cats and dogs on amphibians and reptiles is unknown. And, research is needed to

RECOMMENDATIONS

Research
(continued)

achieve more efficient control and eradication of feral dogs and cats. We also need to know the effects of feral pigs and goats, and other introduced species, on ground-nesting birds, reptiles and amphibians, and on understory vegetation.

03 **Document the effects of hunting and capturing birds for the pet trade.** Study the effects of hunting and capture on populations of Cuban Parrots and other birds.

04 **Research the effects of naturally occurring or human-induced fires on the Park's ecology.** Frequency of forest fires might be higher in altered forests than in pristine forests. This potential threat should be studied to determine if human-induced fires change the Park's fire regime.

05 **Study the effects of effluents from mining and coffee-processing plants, and from sedimentation from soil erosion in areas where humans have eliminated forest cover.** Specifically, we recommend studying the effects of water contamination on amphibians and aquatic insects, focusing on contamination coming from mining and coffee-processing plants, in an effort to understand the need for regulation and, if needed, to improve regulation plans.

06 **Study the taxonomy, ecology, and population biology of rare and threatened species, focusing on endemic and migratory species first.**

- Increase studies on distribution, ecology, and phenology of threatened and endemic **mosses** and research the taxonomy of certain moss groups.
- Increase our knowledge of the Park's **pteridoflora** growing on serpentine soils and the selectivity some species show towards this type of ecosystem, including epiphytes. Likewise, studies on the reproductive biology and survival strategies of naturally rare species are needed.
- Carry out population studies of the seven **spider** species with distributions restricted to the Park to determine (1) actual distribution within the Park, (2) location and description of the male *Scaphiella bryantae*, (3) actual habitat requirements, and (4) location of *Lycosa ovalata*.
- Develop research on taxonomy and ecology of Cuban **dipteran** groups that are not well understood and that could serve as indicators of ecosystem health (for example, Chironomidae).
- Conduct research of those range-restricted **amphibians and reptiles** and study the reptiles hunted by humans in order to understand the "health" of their populations, which will serve as the basis for developing management actions and a starting point for monitoring.

- Sample bird populations to determine possible and actual effects of West Nile virus on the Park's birds, including Cuban Crow and migratory species (for example, Chuck-will's-widow).
- Study the Giant Kingbird's habitat availability and use, and its natural history in the region.
- Determine the importance of shade-grown coffee plantations for migratory and resident species of particular interest. Investigate the population densities harbored by these plantations and investigate the ways in which shade-grown plantations differ from sun-grown, secondary forests, and from primary forests, in terms of their value as bird habitats.
- Determine the requirements for those species nesting in secondary cavities in the Park. What species create cavities, and are there preferences among species when selecting cavities created by certain species? Is cavity availability limited for those secondary-cavity nesting species in the region? If so, is a nest-box program appropriate for Cuban Parrots?
- Study the importance of fruit resources for local avifauna, including research on seasonal fruit usage in relation to seasonal movements, the degree to which migratory birds use fruit resources and a quantitative evaluation of the importance of fruit in local birds' diets.
- Historically, what birds have inhabited the Park? Thoroughly evaluate community knowledge and review previous research in the Park.

Monitoring and Surveillance

01 In general, site managers should give special attention to endemic species categorized as Endangered and Vulnerable (see Conservation Target lists). Monitoring strategies of these species should be established, analyzing potential threats and estimating species' distributions in the area. These actions will help maintain populations of threatened endemics in the Park over the long term.

02 Monitor population densities and relative abundance of *Polymita* species to understand to what degree illegal sale of their shells is threatening their populations and to propose measures to conserve their populations, unique in the world.

03 Establish an amphibian monitoring program in different points of the Park to detect early signs of declines or extinctions and to respond rapidly, implementing management actions. Even though amphibian declines and extinctions recorded in other Latin American sites have not been documented in Cuba, the possibility cannot be dismissed, especially considering lack of research on the subject on the island.

RECOMMENDATIONS

Human Communities and Environmental Education

01 **Consolidate park management, providing additional resources and personnel training.**

- Increase the efficiency of control efforts to reduce or stop unregulated agriculture, logging, illegal hunting, and aggressive non-native flora and fauna within the Park.
- Continue to develop and refine the Park's Management Plan, using information from this and future inventories and research to protect ecosystem integrity and indigenous species.

02 **Increase public awareness of the Park's value and benefits.**

- Carry out environmental education activities in the community to raise awareness of threatened fauna, specifically focusing on the following: (1) terrestrial mollusks and *Polymita* protection, in an effort to stop illegal commercialization of their shells; (2) the importance of conserving Cuban iguana and Cuban boa; and (3) the importance of conserving birds typically captured and sold as pets.
- Increase fund-raising efforts to obtain financial resources needed to purchase environmental education materials for use in the communities, such as paper, informational materials, binoculars, compasses, and local flora and fauna guide books.
- Increase the environmental education program to include those dispersed communities/houses in areas with high potential for impacting the Park's ecosystems.
- Obtain financing to develop actions that improve local residents' quality of life and cultural environment without threatening biodiversity.
- Teach sustainable agricultural techniques to rural farmers, to improve soil use and to reduce erosion and subsequent sedimentation of rivers and streams.