

Citation for attached reprint:

Smith, M. L., S. B. Hedges, W. Buck, A. Hemphill, S. Inchaustegui, M. Ivie, D. Martina, M. Maunder, and J. F. Ortega. 2005. Caribbean Islands. Pp 112-118 in R. A. Mittermeier, P. R. Gil, M. Hoffman, J. Pilgrim, T. Brooks, C. G. Mittermeier, J. Lamoreux, and G. A. B. da Fonseca (eds.), *Hotspots revisited: Earth's biologically richest and most endangered terrestrial ecoregions*. Mexico City: CEMEX.

Note: This reprint was supplied by the publisher, with photos removed. The font is small because book is 12" x 14". It is 392 pp (9 pounds!) with many color photos. See website: www.biodiversityhotspots.org

Although the Mexican portion of the hotspot accounts for the largest relative area of land under protection (41 835 km²), this represents only 6.7% of the total 625 700 km² of the area of the hotspot in Mexico.

Conservation action to counter the ongoing threats to the Mesoamerica Hotspot concentrates on the creation and maintenance of the Mesoamerican Biological Corridor, as well as numerous other initiatives to integrate sustainable development with biodiversity conservation. Adopted by a host of donors, the region's governments, and four major international conservation groups—Conservation International, the World Wildlife Fund, The Nature Conservancy, and the Wildlife Conservation Society—during the 1980s, the Mesoamerican Biological Corridor has three objectives: to maintain the integrity of the protected areas that already exist in the Mesoamerica Hotspot; to determine where new protected areas need to be created in order to extend the corridor concept; and to connect these new and existing protected areas through the establishment of high conservation value forestry plantations and agroforestry systems that run between the corridor's existing parks, refuges, and biosphere reserves. This large-scale corridor strategy has gained wide support because it presents a simple, yet elegant structure on which to promote a wide range of conservation activities, such as biodiversity protection, buffer zone management, regional planning, and sustainable private enterprises based on regional development goals. This region is particularly important strategically for food security, since it is home to wild relatives of important crops such as maize, cacao, beans, and others.

A regional perspective such as the Mesoamerican Biological Corridor, among others, offers a much broader perspective concerning the natural range of variability seldom captured by national policy and within political borders. Planning should seek to combine local policy with the specific objectives of habitat connectivity for area-sensitive species, such as the jaguar, habitat-specialists, such as the resplendent quetzal, and narrow-ranging species, such as some *Atelopus* toad species. Equally important is the representation of the full range of the wide variety of ecosystems within protected areas. There is great potential to develop a regional network of transboundary protected areas, such as exists between Costa Rica and Panama (La Amistad International Park), a concept which is emerging elsewhere as well. The Critical Ecosystem Partnership Fund (CEPF) is facilitating a regional approach to promote conservation by supporting bi- and tri-national initiatives that rely on cooperation of governments and NGOs. The fact that there are eight countries in this hotspot, each with disparate political agendas and motivations, makes this a great challenge.

The Mesoamerica Hotspot also has within it a globally recognized model for the value of ecotourism as a foreign exchange earner and as an alternative to harmful extractive industries. For a variety of reasons, Costa Rica recognized early on the great potential for ecotourism and structured itself to take advantage of this source of

income. As a result, Costa Rica earned \$1.25 billion in tourism-related industries in 2000, and it is estimated that 70.7% of tourists visit natural protected areas—an enormous figure for a small country with a population of only 3.9 million people. On the other hand, there remains a very delicate balance between tourism potential and agriculture-based revenue generation.

In conclusion, although the problems in this region are many and the commitment to conservation varies from country to country, there exists in Mesoamerica a variety of mechanisms for regional-level government dialogue on the environment which are far better than in many other hotspots that spread over several sovereign nations. Other positive indicators include the shared vision of the Mesoamerican Biological Corridor; the high percentages of national territory already in parks and reserves in four of the eight nations (Costa Rica, Guatemala, Panama, Belize); the strong and growing local capacity that exists within the region; the proven value of alternatives like ecotourism and non-timber forest products; the development of several national-level institutions for biodiversity research and conservation; the promotion of sustainable use initiatives; and the continuing interest and involvement of a variety of donor agencies and international conservation organizations.

CARIBBEAN ISLANDS

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The Caribbean Islands Hotspot consists mainly of three large groups of islands between North and South America: the Bahamas, the Greater Antilles, and the Lesser Antilles. In contrast to the previous definition under the name Caribbean Hotspot, we now exclude southern Florida and its islands on the North American Continental Shelf because that area has greater floristic affinity to the rest of the continent, has few endemics, and has had only a marginal role in the phylogeographic history of the Antilles (Graham 2003). The Caribbean Islands themselves vary in their floristic affinities, but have in common a history of limited contact with the diverse biotas

A red-billed streamertail (*Trochilus polytmus*), a hummingbird species endemic to the island of Jamaica.
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On the opposite page, *Ricard's iguana* (*Cyclura ricardi*), a Critically Endangered iguana species that is endemic to a very small area in the southern part of the Dominican Republic on the border with Haiti. It is sympatric with the more widespread rhinoceros iguana (*C. cornuta*), from which it can be readily distinguished by its red eyes.
 © Cristina G. Mittermeier



of the continents. As a result, their biotas share an “oceanic” character marked by a relatively low representation of higher taxa, but also having extraordinary diversity within those higher phyletic groups that are present.

The Caribbean Islands Hotspot is commonly referred to as the West Indies in the English-language literature. Our definition differs only in a few minor details from a biotic region formally defined by James Bond in his *Birds of the West Indies* (1936). The islands of the West Indies have a terrestrial surface area of only 229 549 km². The four largest islands, Cuba (105 806 km²), Hispaniola (73 929 km²), Jamaica (11 190 km²), and Puerto Rico (9 100 km²) make up over 90% of the land area of the hotspot, but the myriad smaller islands harbor large numbers of endemic species far out of proportion to their size. Geologically, the West Indies are a mix of old regions of the Caribbean Tectonic Plate (Cuba, Jamaica, Hispaniola, Puerto Rico, the Virgin Islands, and their satellite islands), the tops of volcanoes (the active volcanic arc from Saba to Grenada), and slightly raised limestone platforms (the Caribees from Sombbrero to Barbados, plus the Bahamas, the Cayman Islands, southern Dutch islands, and Aves Island). Elevations range from over 3 000 m (the formerly glaciated summit of Pico Duarte) to a desert depression 40 m below sea level, both on Hispaniola.

Politically, this is a very diverse hotspot, with thousands of islands governed by 18 nations. Twelve of these are independent island nations (Commonwealth of the Bahamas, Republic of Cuba, Jamaica, Republic of Haiti, Dominican Republic, Federation of St. Kitts and Nevis, Antigua and Barbuda, Commonwealth of Dominica, Barbados, St. Lucia, St. Vincent and the Grenadines, and Grenada). Fifteen polities are dependencies of, in free association with, or integral parts of: the United States of America (Puerto Rico, U.S. Virgin Islands, Navassa); the United Kingdom (Cayman Islands, Turks and Caicos Islands, British Virgin Islands, Anguilla, Montserrat); the Kingdom of the Netherlands (Aruba and the Netherlands Antilles including Curaçao, Bonaire, Saba, St. Eustatius, and St. Maartin); the Republic of France (Departments of Martinique and Guadeloupe, including its dependencies St. Martin and St. Barthelemy); the Republic of Honduras (Swan Islands), or the Bolivarian Republic of Venezuela (Aves Island west of Dominica, and oceanic islands from Blanquilla to Islas las Aves).

The vegetation of the Caribbean Islands is variable due to the influences of climate and Earth history. Low-lying islands tend to be semiarid, and most were originally dominated by dry evergreen bushland and dry evergreen thicket, with savanna occurring on parts of Barbuda, Jamaica, and Puerto Rico (where the average rainfall at low elevations is only 300–600 mm per year). On the other hand, wetter environments occur where trade winds encounter the higher Caribbean mountains, giving rise to a variety of moist tropical forest types including marsh forest, various types of seasonal forest, montane forest, and elfin woodland (Beard 1955). In moister areas, around lagoons and river mouths, permanent brackish and freshwater swamps give way to ex-

tensive mangrove forests. The previously extensive low-land rainforests have mostly been destroyed.

Plant diversity and endemism in the Caribbean Islands Hotspot are both very high, with a total of 13 000 species estimated to occur in the Caribbean region (Davis et al. 1997), including perhaps 6 550 single-island endemics. Cuba's flora is particularly rich, with an estimated 6 505 vascular plant species, of which 3 224 are endemic (Davis et al. 1997); this represents 54% of the endemic plants for the hotspot as a whole, and indeed would qualify Cuba as a hotspot in its own right. Plant endemism at the generic level is also high in these islands. Of an estimated 2 500 genera of seed plants in the Caribbean, 204 angiosperm genera and one gymnosperm genus (*Microcycas*) are endemic to the Greater Antilles. Of these, fully 118 are restricted to single islands. Important families with endemic genera include Asteraceae (32), Rubiaceae (30), Euphorbiaceae (14), and Leguminosae (13). There is one endemic plant family, the Goetzeaceae (Davis et al. 1997). Even mosses, with notoriously broad distributions, have around 500 species in the Caribbean Islands, with about 10% endemism (Delgado et al. 1995).

Vertebrate diversity and endemism in this hotspot are noteworthy. Mammals are represented by 89 extant species, of which 41 are endemic, including two endemic families: the solenodons (*Solenodon* spp.), with two species of rare giant shrews, and a large radiation of rodents called hutias (family Capromyidae), which are related to guinea pigs. The region hosts 15 endemic genera, including the fruit-eating bat genus *Brachyphylla*, with two species.

Birds are represented by 607 species, of which 167 are endemic, with many of those restricted in total range to small areas within islands. A remarkable 35 genera are endemic, and there are also two endemic families: the palmchat (*Dulus dominicus*) of the family Dulidae, and the todies (Todidae). The bird list includes some important flagship species, such as the St. Vincent parrot (*Amazona guildingii*, VU) from the island of St. Vincent, the St. Lucia parrot (*A. versicolor*, VU) from the island of the same name, and the imperial parrot (*A. imperialis*, EN) from Dominica; the bee hummingbird (*Mellisuga helenae*) from Cuba, the world's smallest bird; and the ivory-billed woodpecker (*Campephilus principalis*, CR), last recorded with any certainty in Cuba in 1987.

The Caribbean Islands Hotspot is particularly rich in reptiles with 499 native species, of which 468 are endemic. There are several large evolutionary radiations of lizards, such as the anoles (*Anolis*; 154 species, 150 endemic) with their colorful dewlaps used in displays; dwarf geckos (*Sphaerodactylus*; 86 species, 82 endemic) that include the world's smallest lizards (e.g., *S. ariasae*, with a body length of 18 mm); and curly tails (*Leiocephalus*; 23 species, all endemic) that hold their tails in a coil as they run. There are 11 species of rock iguanas (*Cyclura*), including some measuring more than one meter in length, and one that is blue (*C. lewisi*); one of these species, the Jamaican iguana (*C. collei*, CR), is confined to the Hellshire Hills in Jamaica. A species considered to be an

ancient relict in the lizard family Xantusiidae, *Cricosaura typica*, occurs only in a remote part of eastern Cuba. Major radiations of snakes include the large boas (*Epicrates*, nine species); a genus of boldly patterned snakes that change colors (*Tropidophis*; 26 species, all endemic); fast-moving racers (*Alsophis*; 13 species, all endemic); and some pencil-thin and smaller burrowing snakes (*Typhlops* and *Leptotyphlops*) that include the smallest snake in the world (*L. bilineata*; 108 mm). The Aruba Island rattle-snake (*Crotalus unicolor*, CR) is found only on Aruba.

All 165 native species of amphibians present in the hotspot are frogs, of which 164 (99%) are endemic to the region. All but a few are endemic to single islands. The frog fauna is dominated by those of the genus *Eleutherodactylus* (139 spp.), which are forest frogs that lay eggs on land and hatch into miniature adults with no tadpole stage. One Cuban species (*E. iberia*, CR) is the smallest tetrapod in the Northern Hemisphere, with a length of only 10 mm, while a golden-colored species in Puerto Rico, possibly Extinct, is one of only a few species of frogs in the world known to be live-bearing. One of the largest tree frogs (Hylidae) in the world, the Jamaican snoring frog (*Osteopilus crucialis*, EN), has a length of about 120 mm and occurs in Jamaica, where males of this declining species make a loud snoring call from within giant, hollow trees. The toads (*Bufo*; 11 species) have also radiated in the West Indies, and captive-breeding programs have been implemented for the Puerto Rican crested toad (*B. lemur*, CR). An edible species of frog endemic to Dominica and Montserrat, the “mountain chicken” (*Leptodactylus fallax*, CR), is one of the largest frogs in the Western Hemisphere, but has been rapidly declining in numbers due to human consumption, habitat loss, and an outbreak of chytridiomycosis on Dominica.

The hotspot's inland fishes include 161 species, of which 65 are endemic to one or a few islands. Nearly half of the endemics are restricted to very small ranges, often consisting of a single lake or springhead, and these sites constitute the sole opportunities for conservation of these species in nature. As in other hotspots that are composed of islands, the freshwater fish fauna consists of two distinctive elements. The smaller and younger islands have faunas dominated by species that are widespread in marine waters, but that enter fresh water to some degree, especially when obligate freshwater species are absent or few in number. This component accounts for the relatively high diversity at the family level. The larger and older islands of the Greater Antilles differ in having faunas dominated by several groups that are old enough to have occupied inland waters of the proto-islands and continental coasts prior to extensive plate tectonic movements. These groups (e.g., gars, killifishes, silversides, and chichlids) include significant local radiations, which account for the hotspot's moderate number of endemic species. The hotspot's five endemic fish genera all have distributions that overlap in western Cuba, apparently the oldest part of the hotspot that has remained continuously above sea level.

Humans first populated the islands about 4 000 years ago, and there is evidence that even the early inhabitants were involved in modifying the biota through direct use or, perhaps more far-reaching, through the introduction of species from the continents. Early species introductions include the agouti on Dominica, tortoises on many islands, and possibly even large animals such as white-tailed deer (*Odocoileus virginianus*) on Curaçao. Introductions of species were enormously accelerated after the arrival of Europeans, whose transportation technologies led to the import of species—both intentionally and accidentally—from all parts of the globe. The introduction of the Indian mongoose (*Herpestes auripunctatus*) from Asia in 1872 resulted in a series of extinctions as it was moved from island to island. Even small, uninhabitable islands such as Navassa and Sombbrero now have floras dominated by continental weed species, and throughout the hotspot native amphibian, reptile, and bird faunas have been devastated by rats and domestic cats and dogs. In total, some 36 vertebrate species are considered to have gone extinct in the region since 1500, including species like the Cuban macaw (*Aratinga tricolor*), Jamaican giant galliwasp (*Celestus occidentalis*), and four species of *Nesophontes* (relatives of the solenodons).

The islands have been subject to Western-style development including extensive monoculture for five hundred years, longer than any other part of the New World. For most of this period, the exploration and development of the islands' natural resources were carried out by colonial centers outside the Caribbean Basin. In many cases, Caribbean natural resources were simply liquidated (e.g., semiprecious hardwoods of Haiti and many other states). The widespread cultivation of sugarcane (*Saccharum officinarum*) was also conducted for the benefit of foreign economies and, similarly, resulted in broad transformation of island landscapes. Consequently, as a result of changes that have taken place since European arrival, only a small portion of the vegetation that once existed still remains in more or less pristine condition, and it is estimated that intact vegetation covers no more than 10% of the original extent of the land area. Interestingly, although less than 15% of Cuba's original forests remain intact, they still represent the largest forested areas remaining in the Antilles.

According to the World Database on Protected Areas, some 12.9% of the hotspot is officially protected in a variety of different conservation units, although only 7.1% is conserved in protected areas classified in IUCN categories I to IV. In the largest Caribbean country, Cuba, about 15% of the total land area falls within protected areas, including the 300-km² Zapata Swamp, home to the Cuban crocodile (*Crocodylus rhombifer*, EN), the Zapata rail (*Cyanolimnas cerverai*, EN), the Zapata wren (*Ferminia cerverai*, EN), and the dwarf hutia (*Mesocapromys nanus*, CR), all threatened species found nowhere else. The country of Dominica leads in percentage coverage, with 21.4% of its territory designated for protection, while other countries also report relatively high protection (for example, the Dominican

On pp. 114–115, *Los Haitises National Park in the Dominican Republic, one of an extensive network of protected areas in this small island nation.*

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Above, besides a population recently discovered on Isla de la Juventud, the Endangered Cuban crocodile (*Crocodylus rhombifer*) is known only from the Zapata Swamp, also in Cuba. Three other highly threatened species are found only in this extremely important national park.

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A handful of hatching Cuban crocodiles from a breeding facility in Cuba. This Endangered species is endemic to Cuba and is now restricted to the Zapata Swamp and Isla de la Juventud.

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Republic, with 15%). However, in many of these countries, the existing protected area network is ineffective and poorly managed, while in other nations in the Caribbean protected areas are almost nonexistent. Haiti and Grenada, for example, both have only 1.7% of their respective land areas under protection, while Barbados and Aruba Island each have less than 1%. Indeed, in a recent global gap analysis, the Caribbean Islands emerge as a region of high urgency for expansion of the protected areas network (Rodríguez et al. 2003).

Prospects for the protection of biodiversity have been greatly enhanced by the development of alliances between major industries, such as tourism, and the governmental and private organizations that carry out conservation on the ground. Protected area systems are now being designed for the dual goals of safeguarding biodiversity and contributing to island livelihoods. A significant advance occurred in 2000, when the Protocol for Specially Protected Areas and Wildlife (SPA-W) came into force. Created at the initiative of the Caribbean countries themselves, this protocol provides region-wide standards and mechanisms for harmonizing conservation efforts across the hotspot's diverse cultures and political systems.

CALIFORNIA FLORISTIC PROVINCE

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The California Floristic Province is one of the five Mediterranean-type hotspots and the only hotspot that occurs largely within the borders of the United States of America. Stretching nearly 1 800 km along the western coast of North America, most of its 293 804 km² are

found within the State of California, with extensions into southwestern Oregon and northwestern Baja California, Mexico. All areas west of the peaks of the Cascade and Sierra Nevada ranges are included within its boundaries, as are a handful of islands off California's southwestern coast, including the Channel Islands (913 km²), and Isla Guadalupe (264 km²), located some 300 km west of Baja California.

As its name implies, the California Floristic Province is an ecological construct based on plant species composition, a unique mixture of northern temperate and southern xeric elements fostered by a Mediterranean climate of hot, dry summers and cool, wet winters. Four other hotspots share this climate: Central Chile, the Cape Floristic Region, Southwestern Australia, and the Mediterranean Basin (Barbour et al. 1993; Dallmann 1998).

Four subregions within the Province stand out as centers of exceptionally high plant diversity: the Sierra Nevada, Transverse Ranges, Klamath-Siskiyou region, and Coast Ranges (Stebbins 1978; Davis et al. 1997). Rare plant communities of the southern Sierra Nevada include the giant sequoia (*Sequoiadendron giganteum*) forest, piute cypress woodland, and lone manzanita shrubland (Grossman et al. 1994). The Transverse Ranges are a narrow strip that runs east to west in southern California, separating the Coast Ranges to the north from the Peninsular Ranges to the south. At least 10 rare plant communities have been recorded from this region. The Klamath-Siskiyou region bridges the coastal mountain ranges of California and Oregon, and is home to approximately 20 rare plant communities, including the most diverse temperate coniferous tree community in the world (Vance-Borland et al. 1995-1996). This region also represents the contact zone between the Pacific Northwest Floristic Province and the California Floristic Province. The Coast Ranges comprise a wide variety of habitats, including coastal dune, coastal salt marsh, maritime chaparral, coastal cypress forest, redwood forest, mixed evergreen forest, mixed hardwood-redwood forest, northern yellow pine forest, southern oak forest, *Calocedrus* forest, mixed hardwoods, valley oak savanna, coastal prairie scrub, vernal pools, and freshwater marshes, within which at least a dozen rare plant communities can be found (Steinhart 1994; Davis et al. 1997). The unusually high plant diversity in the Coast and Transverse ranges, coupled with the disproportionate human habitat preference for lowlands and foothills near the coast, puts these regions at special risk (Seabloom et al. 2002).

Some of the highest levels of plant diversity within the California Floristic Province are found in the southern part of the Sierra Nevada Range and in the Klamath-Siskiyou region (Davis et al. 1997). In addition, serpentine soil habitats occur along fault zones in the Central and North Coast and Cascade ranges, from sea level to an elevation of 2 900 m. Due to specific chemical and physical characteristics of the soils, these habitats are nutrient-poor, and this has led to the

On the opposite page,
rhododendrons in bloom, Redwood
National Park, California, U.S.A.
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