

THE CONSERVATION ATLAS
OF
TROPICAL FORESTS

THE AMERICAS



11 Hispaniola

DOMINICAN REPUBLIC

Country area 49,730 sq. km
Land area 48,380 sq. km
Population (mid-1994) 7.8 million
Population growth rate 2.2 per cent
Population projected to 2025 11.4 million
Gross national product per capita (1992) US\$1040
Forest cover for 1990 (FAO, 1993) 10,770 sq. km
Annual deforestation rate (1981–1990) 2.8 per cent
Industrial roundwood production 6000 cu. m
Industrial roundwood exports —
Fuelwood and charcoal production 976,000 cu. m
Processed wood production —
Processed wood exports —

HAITI

Country area 27,750 sq. km
Land area 27,560 sq. km
Population (mid-1994) 7.0 million
Population growth rate 2.3 per cent
Population projected to 2025 13.1 million
Gross national product per capita (1992) US\$380
Forest cover for 1990 (FAO, 1993) 230 sq. km
Annual deforestation rate (1981–1990) 4.8 per cent
Industrial roundwood production 239,000 cu. m
Industrial roundwood exports —
Fuelwood and charcoal production 5,812,000 cu. m
Processed wood production 14,000 cu. m
Processed wood exports —



The forested habitats of the Dominican Republic and Haiti, which comprise the island of Hispaniola, are undergoing accelerating degradation. The prospects for conservation are particularly poor in Haiti, but even in the Dominican Republic the forested lands face virtually unrestricted development for tourism and agriculture.

INTRODUCTION

The island of Hispaniola includes Haiti and the Dominican Republic. The topography of the Dominican Republic is dominated by four principal mountain ranges which run northwest to southeast and parallel to each other. The northern most one is the Cordillera Septentrional; the Cordillera Central extends into Haiti and it is in this range that the highest point in the Antilles, Pico Duarte at 3087 m, is found. The ranges in the southern part of the country are the Sierra de Neiba and Sierra de Bahoruco, both reaching more than 2000 m. There is also one minor range, the Cordillera Oriental, in the northeast with an altitude of about 600 m. Much of the island is over 1000 m. The three valleys between the principal ranges are major agricultural regions. A low area, Llanura Costera, in the east of the country is also agricultural land where rice and sugar cane are grown and cattle are pastured.

The deep valley between the mountain ranges of Sierra de Neiba and Sierra de Bahoruco was once a marine channel dividing the area into a large northern and a small southern island. A relic of this is left as Lago Enriquillo, a large saltwater lake 40 m below sea level.

Haiti is also dominated by mountain chains. The Massif de la Hotte in the southwest, the Massif de la Selle in the southeast (this range continues eastwards as the Sierra de Bahoruco), the Chaîne des Matheux and Montagnes du Trou-d'Eau in the centre, the Montagnes Noires in the north-centre and the Massif du Nord in the north. The highest point is Pic la Selle (2674 m) in the Massif de Selle. The major valleys are in the northeast and centre of the country. The northwestern peninsula, Presqu'île du Nord-Ouest, is a low ridge with arid areas associated with it (Zanoni, 1989).

Hispaniola's climate is influenced mainly by humid northeast trade winds and as a result, annual precipitation is very variable. In the Dominican Republic, only 350 mm fall in the Neiba

Valley while 2750 mm fall at Laguna Limon. In Haiti, rainfall varies from less than 300 mm in the northwest to over 2800 mm, the greatest precipitation falls on the highest mountain summits in the southwest (Ehrlich *et al.*, 1985). There are two rainy and two dry seasons. October and November are usually the wettest months, January and February the driest. Mean annual temperature is around 26°C. A major hurricane occurs every ten to 20 years, causing tremendous damage both environmentally and economically.

Columbus landed on Hispaniola in 1492 and was followed by Spanish colonists who more or less wiped out the Amerindian population (Cook and Borah, 1971; Deagan, 1985; Keagan, 1992). In the late 17th century, French colonists began to establish themselves in the western half of the island, then in 1697, the Treaty of Ryswick divided the island between France and Spain. Both countries became independent in the early 19th century, though Haiti in particular has been plagued by uprisings and coups right up to the present.

Sixty per cent of the Dominican Republic's population are urban dwellers in comparison to 31 per cent in Haiti. The population of the Dominican Republic is multiracial with 68 per cent mulattos, 20 per cent Europeans, 11 per cent Afroamericans and one per cent Asian (SEA/DVS, 1990). Overall population density in the Dominican Republic is 161 people per sq. km; the country's most densely populated regions are the southern coast around the capital city of Santo Domingo and the Cibao Valley in the north. In Haiti, most of the population is of African origin. Overall density, at 254 inhabitants per sq. km, is higher than in the Dominican Republic. Around half a million Haitians are earning a meagre wage working in the Dominican Republic, mainly in the agricultural sector.

The socioeconomic trends in the Dominican Republic have been changing over the last twenty years. The society has

shifted from being rural and agriculture-dependent to become urban and services orientated. Sugar was the backbone of the economy and the main export in the 1970s, but with the drop in demand many areas were converted to grow fruit and vegetables. The tourist industry is now an important source of income for the country. In Haiti, the most important crop is coffee, followed by sugar.

The Forests

The vegetation of Hispaniola is usually described in terms of Holdridge's Life Zone System (Holdridge, 1947). Hartshorn *et al.* (1981) and Ehrlich *et al.* (1985) use this classification in their descriptions of the forests of the Dominican Republic and Haiti respectively. However, Hager and Zanoni (1993) have recently published a description of the natural vegetation of the Dominican Republic based on data from botanical field work. They distinguish between dry, semi-deciduous, broadleaved evergreen, pine, gallery and mangrove forests, as well as describing several non-forest formations. Their forest descriptions are used in this chapter.

The dry forests in the Dominican Republic are generally found between elevations of 40 m and 500 m, in areas with rainfall of between 500 and 1000 mm. They are mostly very disturbed. This forest type is now found in the country's south-western lowlands around Azua, in the Neiba valley and on the Barahona Peninsula and in the northwest in the Ciabo Valley between Monte Cristi and Santiago. It is only on the Barahona Peninsula that large areas of relatively undisturbed dry forest remain.

The dry forests have a canopy at around 10 m with little in the way of a shrub or herb layer. Among the characteristic trees and shrubs are *Guaiacum sanctum*, *G. officinale*, *Phyllostylon rhamnoides*, *Ziziphus rignoni*, *Maytenus buxifolia*, *Capparis* spp. and *Acacia skleroxyla*. On very dry, rocky or sandy ground, arborescent species of Cactaceae such as *Opuntia moniliformis*, *Lemaireocereus hystrix* and *Pilosocereus polygonus* are very frequent. Cactus species are also common in disturbed dry forests where the dominant tree species are the spiny *Prosopis juliflora* and *Acacia macracantha*.

The semi-deciduous forests are transitional between the dry forests and the broadleaved evergreen forests. They are found in the coastal plains and in mountainous regions at elevations between 400 and 900 m. They occur in areas with a distinct arid period and an annual precipitation of 1000 to 1800 mm. In the coastal plains, two different formations can be distinguished—those on rocky ground and those in swampy areas. The characteristic rocky ground formation can be found in Del Este National Park and in the eastern coastal zone between Macao and Cape San Rafael. This forest type has a canopy only 3–10 m high and contains trees such as *Krugiodendron ferreum*, *Coccoloba diversifolia*, *Bursera simaruba*, *Sideroxylon* spp. and *Ateramnus lucidus*. The herb layer is poorly developed and nearly always dominated by *Zamia pumila*. The semi-deciduous forest on swampy ground is characterised by two canopy layers. Generally the upper canopy reaches 20 m and is dominated by *Bucida buceras*. The lower canopy is around 5 m in height and commonly contains *Annona glabra* and *Calophyllum calaba*. Representative formations of this forest are found near the southern part of Bávaro Lagoon and by Hoyo Claro Lagoon. The mountainous semi-deciduous forests are found on the southern slopes of the Sierra de Neiba, the northern slopes of the Cordillera Central and in large areas of the Sierra de Bahoruco. In the Sierra de Neiba,

these forests are dominated by *Swietenia mahagoni* and *Coccoloba diversifolia*.

Two types of broadleaved evergreen forests are distinguished in the Dominican Republic—the rain forests and the cloud forests. The former are mostly found below 500 m; patches occur between Puerto Plata and Miches on the slopes of the Cordillera Septentrional and Cordillera Oriental, on Samaná Peninsula and in the basin of Río Yuma. However, in the Cordillera Central, they may be found as high as 1500 m. Annual precipitation exceeds 2000 mm in the areas where rain forests occur. The upper canopy of this forest type is usually about 25 m high, but in those forests dominated by *Sloanea ilicifolia* (such as in Armando Bermúdez National Park) it can reach 40 m.

The evergreen rain forest formations are quite variable. For instance, in Los Haitises National Park the rain forest occurs on a limestone karst and two associations occur: the *mogote* association of *Coccoloba* spp., *Leptogonum molle* and *Sapium daphnoides* amongst others; and the valley association including *Oxandra laurifolia*, *Tetragastris balsamifera* and *Dendropanax arboreus*. In other areas, the rain forests are dominated by *Mora abbottii*. This species occurs on the northeastern slopes of the Cordillera Septentrional between Moca and Nagua, in places on the eastern Cordillera Central and particularly in the forests of Loma Quita Espuela and Loma Guaconejo. In Loma La Herradura in the Cordillera Oriental another formation is found; it includes *Buchenavia* spp., *Didymopanax morototoni* and *Omosia krugii*.

Cloud forests are found in the high mountains, between 600 m and 2300 m. They are characterised by an abundance of epiphytes. In areas between 600 and 1250 m in elevation, on steep northern slopes and in mountain valleys, the palm cloud forest, or *manaclar*, is common. This forest type is dominated by *Prestoea montana* and tree ferns *Cyathea* spp. In areas of the eastern Sierra Bahoruco and in parts of the Cordillera Central above 1200 m the cloud forests are dominated by *Didymopanax tremulus*, often in association with species of *Magnolia*. In the western part of the Sierra de Neiba and in the Valle Nuevo Scientific Reserve at altitudes between 1800 and 2200 m the cloud forest is dominated by *Podocarpus aristulatus*.

Elfin woodlands are known only from the top of Loma Nalga de Maco between 1800 and 1900 m. They have a canopy at only 5 m and are characterised by an association of *Coccoloba pauciflora* and *Podocarpus hispaniolensis*.

Pine forests of the native *Pinus occidentalis* are the natural vegetation in high altitude zones of the Cordillera Central, Sierra de Bahoruco and, to a lesser degree, in the Sierra de Neiba.

In Haiti, the subtropical moist forest life zone is the most extensive zone. The natural vegetation of this zone is a well developed heterogenous forest of broadleaved trees, but clearing for agriculture has reduced the forest to mere remnants. *Catalpa longisiliqua* and mahogany *Swietenia* sp. are characteristic tree species, while the royal palm *Roystonea regia* is very common on limestone soils (Ehrlich *et al.*, 1985).

In Haiti, the dry forest zone is the second largest life zone. It is characterised by *Phyllostylon brasiliense*, *Prosopis juliflora* and *Guaiacum officinalis* (Ehrlich *et al.*, 1985).

The subtropical lower montane rain forest includes most of the remaining pine (*Pinus occidentalis*) forest in Haiti.

The natural vegetation of the other zones has not been described by Ehrlich *et al.* (1985), little if any of the forest remains.

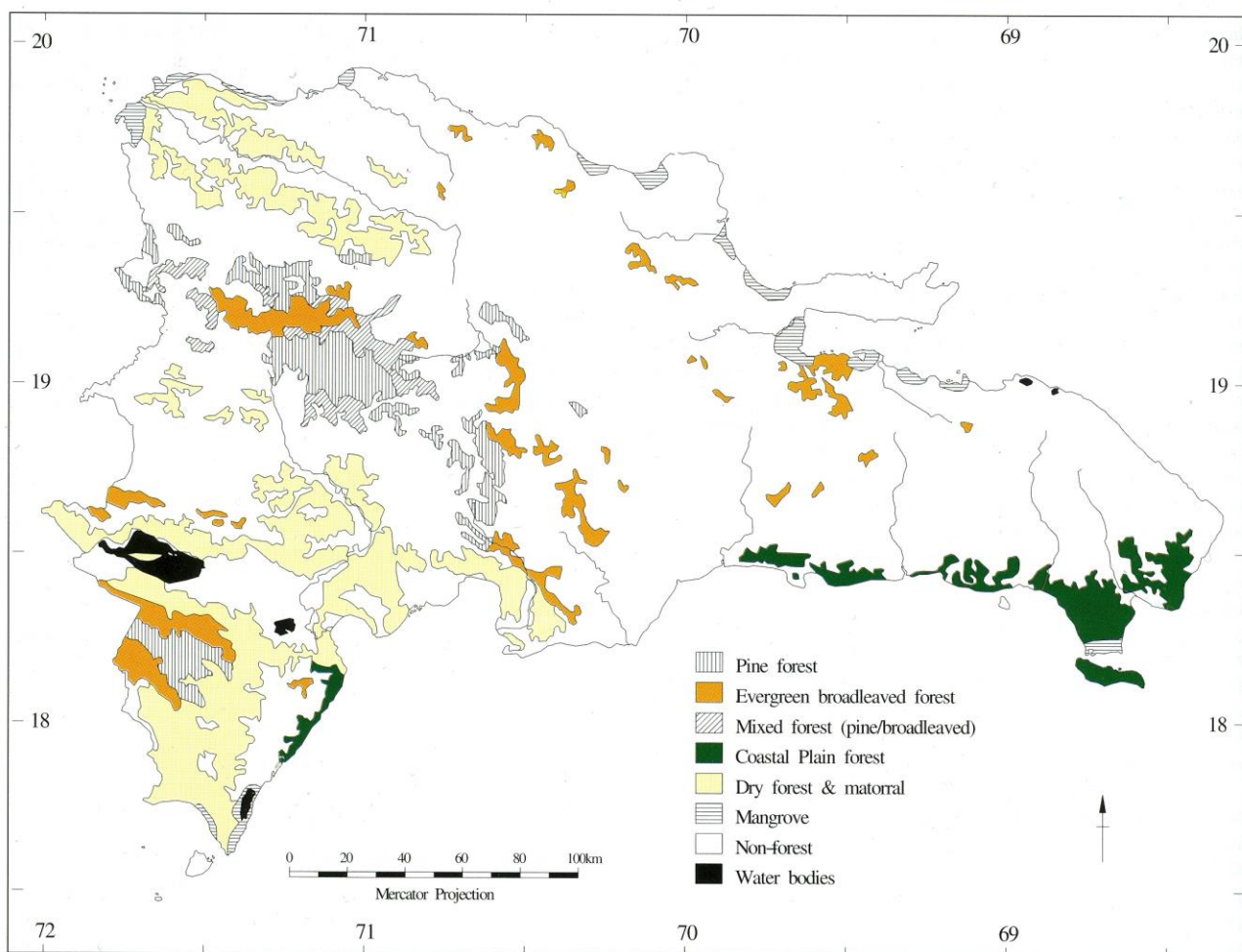


Figure 11.1 The forest ecosystems in the Dominican Republic, based on 1984 aerial photographs.

Source: after Schubert (1993)

Mangroves

The largest areas of mangrove are found in the northeast of the Dominican Republic at Manzanillo, Montecristi and Samaná Bay. Analysis of aerial photographs taken between 1983 and 1984 indicated that approximately 325 sq. km of mangroves remained in the Dominican Republic (SEA/DVS, 1990). Common species include *Conocarpus erectus*, *Rhizophora mangle*, *Laguncularia racemosa* and *Avicennia germinans*.

Mangrove forests in the Dominican Republic are particularly threatened by development for the tourist trade. Extensive areas are being devastated in Punta Cana, one of the largest resorts in the eastern portion of the country, between Puerto Plata and Samaná in the north and northeast and between La Romana and Boca de Yuma in the southeast. The development of Montecristi and the Barahona Peninsula is expected to cause further devastation on the northwest and southwest coasts.

Ehrlich *et al.* (1985) reported that there were a total of 224 sq. km of mangrove in Haiti, with major areas in the Bay of Caracol and L'Estère. In later papers (Thorbjarnarson, 1988; Paryski *et al.*, 1989), it was estimated that there were about 180 sq. km of mangroves. Mangroves are used for charcoal and

polewood, but this does not yet have a significant impact. It is forbidden by law to cut these forests, but this is not enforced. Nevertheless, the mangrove forests are one of the least threatened ecosystems in Haiti (Paryski *et al.*, 1989).

Forest Resources and Management

When Columbus arrived in Hispaniola, the island was almost entirely forested. Today, about 90 per cent of the forests in the Dominican Republic have vanished due to human activities (SEA/DVS, 1990). At the beginning of this century, 40,000 sq. km or 85 per cent of the country was forested, this was reduced to 34,000 sq. km by 1940, to 11,000 sq. km in 1973 and to only 5000 sq. km or 10 per cent of the Dominican Republic by 1986 (SEA/DVS, 1990). FAO (1993) gives the considerably higher estimate of 10,770 sq. km remaining in 1990, of which 8540 sq. km was closed broadleaved forest.

DIRENA, using aerial photographs from 1983–84, detailed the land use in the Dominican Republic as shown in Table 11.1 (Republica Dominicana, 1992). According to this report, there were approximately 3000 sq. km each of both pine and broadleaved forests remaining in the country at that time. No recent, accurate map of the forests in the country has been found for this Atlas, therefore a sketch map based on 1984 aer-

ial photographs (Schubert, 1993) has been reproduced here as Figure 11.1.

The first documented attempt to regulate clearing of forests in the Dominican Republic was in 1884, when all clearing near river beds and springs was banned and farmers were ordered to keep five per cent of their property in forest (Reynoso *et al.*, 1988). Since then, a total of 63 laws, two executive orders, three resolutions and several decrees have been legislated for the protection of forests (J. Ottenwalder, in litt. 1993).

While about 26 government agencies are involved in the management of natural resources in the Dominican Republic, in an administrative and/or advisory capacity, two institutions — the General Directorate of Forests (DGF) and the National Forestry Technical Commission (CONATEF) — are directly invested with management authority for the administration and management of the forests. A third institution, the Directorate of National Parks (DPN), is involved when the forests occur in conservation areas.

DGF was created in 1962 both to enforce legislation prohibiting tree cutting and to preserve national security in forest

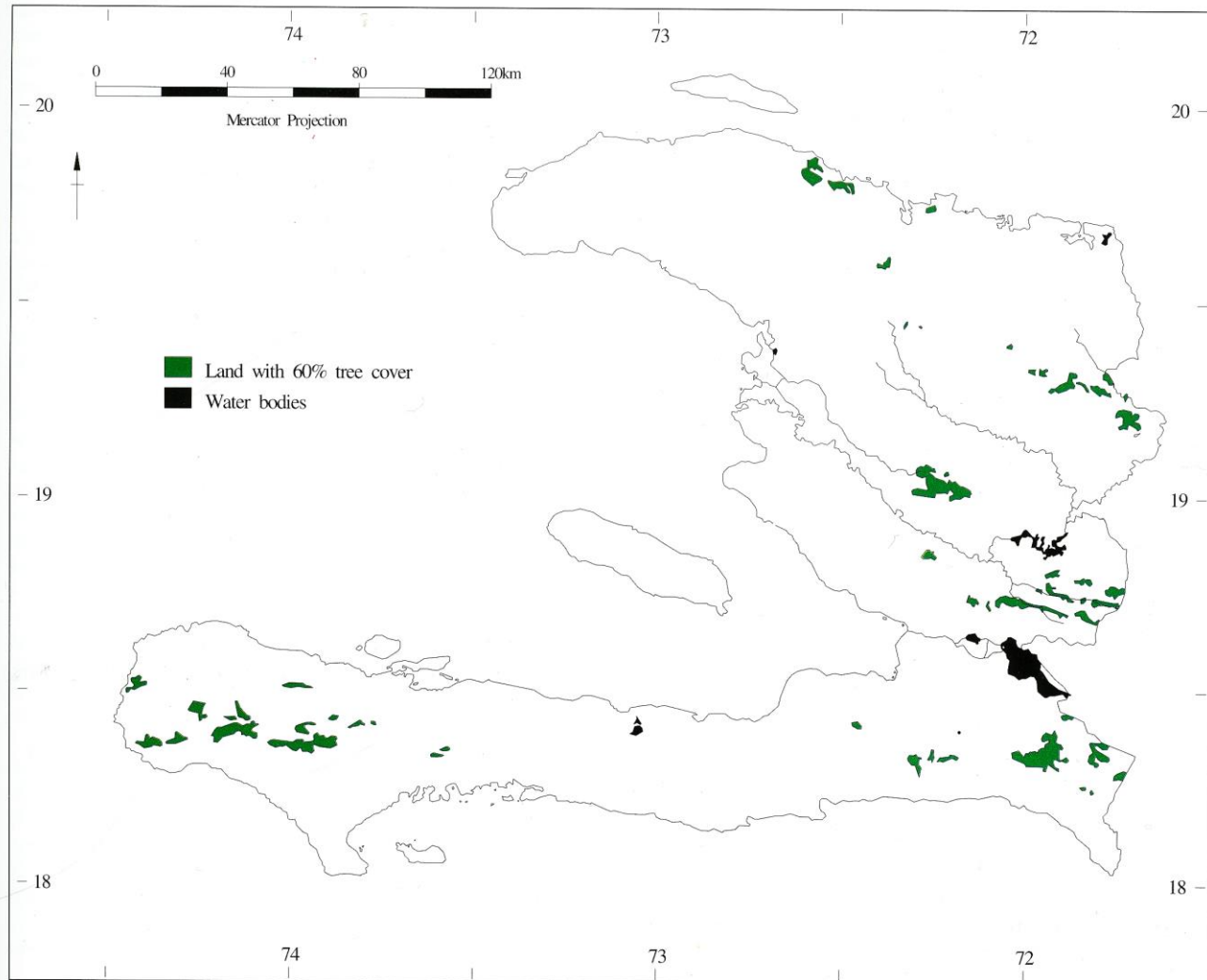
areas. The DGF is also responsible for Government reafforestation projects and controls the production and distribution of charcoal. It, however, lacks an adequate budget and trained personnel.

The National Technical Forestry Commission (CONATEF) was established in 1982 to develop a national plan for the organisation of the forestry sector. In 1985, the role of CONATEF was expanded to include forest preservation, development and policy and it thereby became the primary institution for the administration of forest resources, while DGF became the agency for implementing forest policy.

In 1967, in an attempt to enforce forestry regulations, all sawmills were closed and the cutting of trees was declared illegal throughout the country. In 1986, Operación Selva Negra was launched by the government of the Dominican Republic to enforce these regulations (Ottenwalder, 1989). It was intended to stop illegal, indiscriminate deforestation and to give CONATEF time to develop a programme for the sustainable utilisation of dry forests. It lasted for several months and, although cosmetic in nature and achievements, it was highly

Figure 11.2 Land in Haiti covered with forest having at least 60% tree coverage.

Source: Ehrlich *et al.* (1985)



HISPANIOLA

Table 11.1 Land use in the Dominican Republic

Land Use	Area (sq. km)	% of land
Urban zone	361	0.8
Sugar cane	4,074	8.4
Other agriculture	12,883	26.6
Pastures	13,736	28.4
Pine forests	2,950	6.1
Broadleaved forests	2,893	6.0
Dry forests	8,055	16.7
Matorral/Brushland	2,094	4.3
Wetlands	210	0.4
Others	1,124	2.3
Total	48,380	100

Source: Republica Dominica (1992)

successful as an extension and public relations exercise (J. Ottenwalder, in litt, 1993).

Interest and efforts to develop a national programme for forest management rose during the late 1960s. Inventories of forest resources were conducted between 1967 and 1974 by OEA and FAO, while integrated conservation-development projects, targeting important watersheds and rural areas and often including reforestation plans, began in 1970.

From its inception to 1985, DGF has reforested about 79 sq. km, mostly with the exotic *Pinus caribea* rather than the indigenous *P. occidentalis*. Few follow-up evaluations of the plantations occur, but it is estimated that about 65 per cent of them survive (Peña, 1988). The reforestation programme has been hampered by a scarcity of trained professionals, a lack of financial and technical support and inadequate institutional support.

FAO (1994) reported that production of fuelwood and charcoal in the Dominican Republic was less than one million cubic metres in 1992. However, the government (Republica Dominica, 1992) has calculated that yearly consumption is 3.9 million cu. m and that it will increase at an annual rate of 1.4 per cent. Forests with a potential for fuelwood production are estimated to cover between 2000 and 3000 sq. km, but average yields are so low (about 2 cu. m/ha/year) that, even if the forests were managed, they could not satisfy the projected demand. In the year 2000, the annual demand for firewood is expected to be 4,760,000 cu. m (Republica Dominica, 1992). Around 75 per cent of the energy for domestic use comes from the forests; they supply, overall, about 29 per cent of the country's total energy demands.

As from January 1987, a five year ban was passed on the capture, killing or exploitation of all native wild vertebrates in the Dominican Republic (Ottenwalder, 1989). This was extended in February 1992 for another ten years. Excluded from the decree are species considered to be agriculture pests and exotic predators. Enforcement of these regulations is poor.

In Haiti, Holdridge (1947) calculated that forests, in the absence of humans, could potentially occupy 55 per cent of the land area. However, very little of this remains. Even as early as 1954, it was reported that only eight or nine per cent of the land surface was forested (Burns, 1954). In 1978, it was estimated that 6.7 per cent of the land was covered with forest having at least 60 per cent tree coverage (Figure 11.2); 659 sq. km (36 per cent) had a canopy cover of 80–100 per cent; while 1188 sq. km had a canopy cover between 60 and 80 per cent (Ehrlich *et al.*,

1985). The single largest stretch of forest remaining in the mid-1980s was the 264 sq. km stand of pine forest in the southeast of the country. Paryski *et al.*, (1989) reported that forest cover in the country was less than 1.5 per cent, while FAO (1993) estimates that only 230 sq. km of forest (0.8 per cent of the country's land area) remained in 1990.

In Haiti it is the Division of Natural Resources (DNR) within the Ministry of Agriculture (MARND — Ministère de L'Agriculture, des Ressources Naturelles et du Développement Rural) which is responsible for the protection of forests, watersheds, coastal resources and other natural resources. Most of its efforts so far have been restricted to regulating hunting and fishing and to very limited reforestation projects (Paryski *et al.*, 1989). Low budgets, a lack of trained personnel, no clear policies and changing government priorities have prevented any serious conservation efforts.

Deforestation

The earliest Amerindian settlers on Hispaniola were primarily hunter gatherers who had little impact on the forest. Even though the Tainos, who arrived later, were practising intensive agriculture by the time they were discovered, they were concentrated along the coast and their population density was low so that they too had a minimal effect on the forests (Lugo *et al.*, 1981).

The forests have diminished only since European colonisation. Between 1630 and 1880s, as in many of the Caribbean islands, the lowland forests were gradually converted to plantations of sugar cane and African slaves were brought in to work on the land. After this period, following the abolition of slavery and the economic collapse of monocultures, some destruction of montane forests took place as many of the freed slaves moved to the mountains (Lugo *et al.*, 1981). The scarcity of lowlands and valleys in Haiti meant that the upland forests there were exploited early on. In both countries, the temporary rise in the price of sugar cane at the end of the First World War meant that some plantations were extended considerably (J. Ottenwalder, in litt, 1993).

In the Dominican Republic, devastation of pine and broadleaved forests is mostly caused by clearing for agriculture and pasture and by the demand for forest products. Deterioration of the dry forests is due mainly to collecting of wood for charcoal and fuel, for both domestic and industrial purposes (Ottenwalder, 1989). If the government's estimates (Republica Dominica, 1992) of annual consumption of firewood are correct, the outlook for the dry forests in particular is extremely bleak. FAO (1993) estimates deforestation in the Dominican Republic to be 351 sq. km each year, an annual rate of 2.8 per cent.

Table 11.2 Status of locally threatened species within the Dominican Republic

	Endangered	Vulnerable	Rare	Unknown
Fish	—	—	—	2
Amphibians	—	—	—	—
Reptiles	8	13	6	—
Birds	4	24	6	21
Mammals	3	—	1	1
Total	15	37	13	24

Source: SEA/DVS, 1990

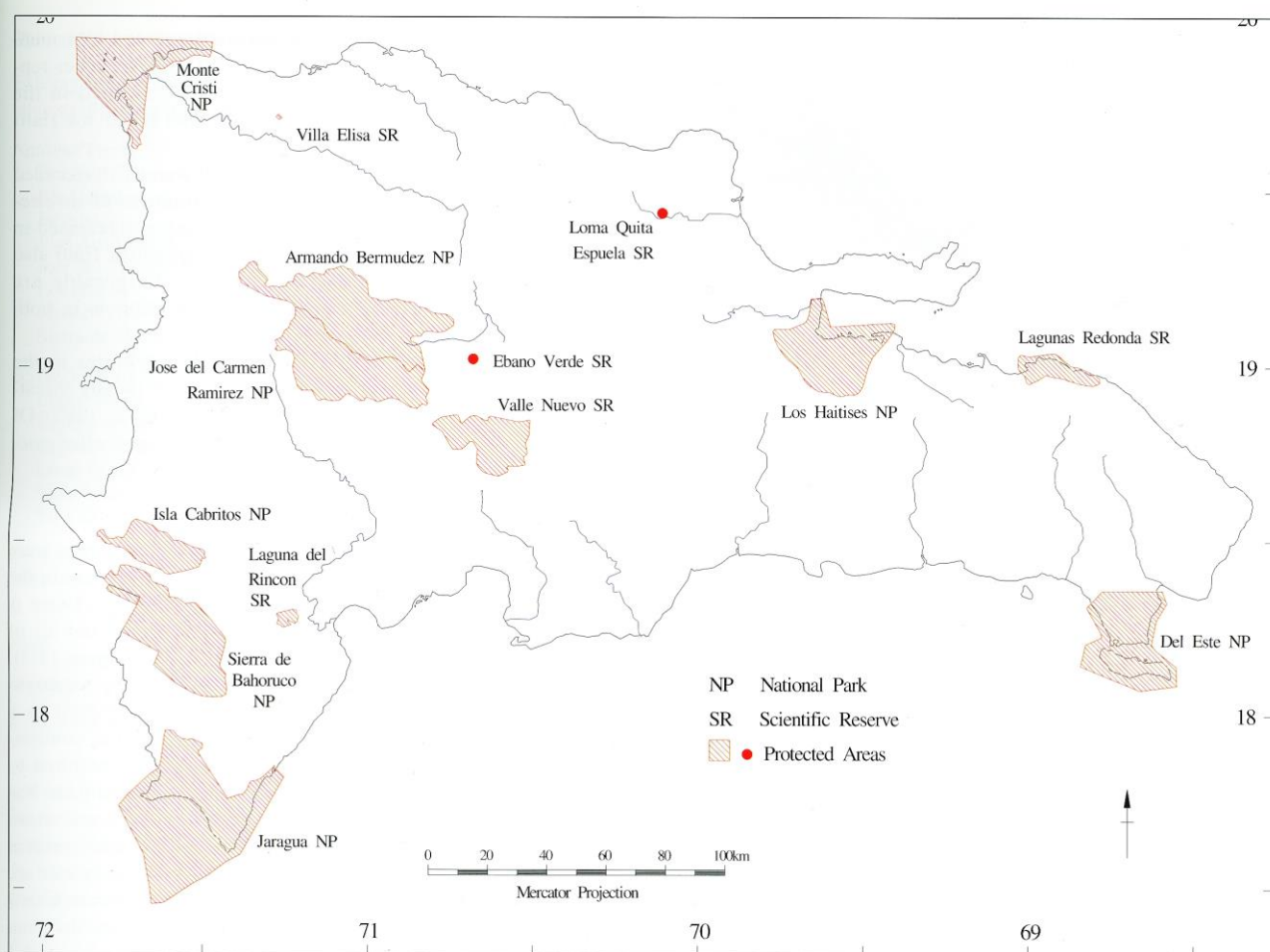


Figure 11.3 Protected areas in the Dominican Republic in IUCN's categories I-IV

Russell (1988) attempted to measure the rate of deforestation in the western half of the Dominican Republic by comparing satellite photographs taken in 1972, 1979 and 1986. He calculated that 2115 sq. km of hardwood and pine forests disappeared between 1972 and 1986, giving an annual deforestation of 141 sq. km per year. During the same period, annual deforestation of the subtropical dry and thorn forests was calculated to be 106 sq. km. Most of the forested land was cleared for agriculture and pasture.

The same problems occur in Haiti where, after many generations of land abuse, there is now a tradition of land stewardship in the country by which most peasants expect to exploit the land. Indeed, peasant life is almost totally dependent on cutting trees for construction, fuelwood and charcoal and for clearing new agricultural land to replace that rendered unproductive by overuse and erosion (Paryski *et al.*, 1989).

In addition, large quantities of timber were cut and exported from Haiti as early as the 19th century, for instance in 1845, 18,600 cu. m of mahogany alone were exported (Paryski *et al.*, 1989). It is estimated that by 2008 only one of Haiti's river basins will have any forest cover remaining. Paul Paryski (in litt., 1993) working for UNDP in Haiti, estimates annual deforestation rate in the country to be 3.8 per cent. However FAO (1993) give the higher figure of 4.8 per cent; this, though, is only 15 sq. km each year.

Biodiversity

The flora of the island of Hispaniola is the second most diverse for the Caribbean islands. Of the estimated 5000 flowering plants and conifers, 30–33 per cent are considered endemic (Zanoni, 1989). The areas with highest rainfall are the most diverse with the highest number of endemics.

There is little monitoring of the status of the plants on Hispaniola, but a considerable number are threatened. For instance, on the Dominican Republic the endemic *Cryptorhiza haitiensis* and the palm cacheo *Pseudophoenix ekmanii* are being eliminated by commercial use.

Hispaniola has the highest faunal diversity and levels of endemism of the West Indies, with the Dominican Republic having the highest diversity and endemism in vertebrate groups of all the Caribbean islands. As on the other islands, most (18 of 20) of the native mammals remaining on Hispaniola are bats. Haiti used to have at least 28 species of native terrestrial mammals, but now only two survive (Woods, 1983; Paryski *et al.*, 1989). These are the endangered Haitian solenodon *Solenodon paradoxus* and the rare Hispaniolan huito *Plagiodontia aedium*. A species recovery plan has been completed for *S. paradoxus* and a major reserve on the north side of Pic Macaya has been proposed to protect it; this species is considered to be the highest priority for con-



Montane rain forests in the Ebano Verde Area, Central Dominican Republic. (WWF/Mauri Rautkari)

servation in Haiti (Ottenwalder, 1992a; Woods *et al.*, 1992; Woods and Ottenwalder, 1992). The other species on the island listed as threatened by IUCN (Groombridge, 1983) is the Cuban flower bat *Phyllonycteris poeyi*. There are 12 introduced species of mammal (Woods and Ottenwalder, 1992) of which the mongoose *Herpestes auropunctatus* and rat *Rattus norvegicus* have a considerable adverse impact on the native fauna.

A total of 136 resident and 118 migratory birds have been recorded in the Dominican Republic, 22 of these are endemic to the island (SEA/DVS, 1990). The same eight bird species (five endemics) are listed as threatened in Haiti as in the Dominican Republic; four are at risk mainly as a result of deforestation. (Collar *et al.*, 1992). The Hispaniolan hawk *Buteo ridgwayi* and white-winged warbler *Xenoligea montana* have all but vanished from Haiti as most of their forest habitat has been cut down; the latter is, however, found in some protected areas. La Selle thrush *Turdus swalesi* and the chat tanager *Calyptophilus frugivorus* are in protected areas in both countries, but neither species is considered safe (Woods and Ottenwalder, 1992). The fifth endemic species, the rufous-breasted cuckoo *Hyetornis ruficularis* is found in many habitat types and over a wide range of altitudes. It is hunted, as medicinal food, and its scarcity may be due to the impact of pesticides and fertilizers as well as to the general degradation of the island's natural vegetation (Collar *et al.*, 1992). The ground warbler *Microligea montana* and the Hispaniolan parrot *Amazona ventralis* are also considered to be threatened in Haiti (P. Paryski, in litt.), although they are not listed by Collar *et al.* (1992) as globally threatened. Species recovery plans have been completed for the black-capped petrel *Pterodroma hasitata*, the white-winged warbler and the Hispaniolan crossbill *Loxia megaplaga* (Ottenwalder, 1992b, 1992c, 1992d; Woods *et al.*, 1992; Woods and Ottenwalder, 1992).

Sixty species of amphibian have been recorded on the island, all belong to the order Anura, while 43 belong to the genus *Eleutherodactylus* (Schubert, 1993). *Hyla vasta* is threatened in both countries, while *E. semipalmatus* is threatened in Haiti (Groombridge, 1993). The cane toad *Bufo marinus* and the frog *Rana catesbeiana* have been introduced.

There are 141 reptiles on the island, 117 of which are endemic and two lizards are introduced (Schubert, 1993). There is still a significant number of the threatened American crocodile *Crocodylus acutus* on the island. However, numbers in Lake Enriquillo, which was considered to be one of the largest concentrations of the species, have declined from an estimated 500 in 1980 to only 100 in 1992 (J. Ottenwalder, in

litt. 1993). A recovery plan is being implemented by a consortium of government institutions and NGOs. Six other reptiles (excluding the marine turtles) are threatened in the Dominican Republic, three of these are also listed for Haiti (Groombridge, 1993).

There are 70 species of fresh or brackish water fish recorded on the island of which 22 are endemic. Numbers of invertebrates are not known. Eight species are listed as threatened in the Dominican Republic, with six of these given for Haiti also (Groombridge, 1993). The two listed as vulnerable are *Phylolestes ethelae* and *Battus zetides*, the latter is in both countries.

There are 89 species or subspecies of vertebrates in the Dominican Republic that are considered to be locally threatened, their status is shown in Table 11.2 (SEA/DVS, 1990). Of these, 13 reptiles and one bird, the spotted rail *Pardirallus maculatus*, are not found in a protected area.

Conservation Areas

The first of the Dominican Republic's conservation areas were set up in the 1950s when two stretches of montane forest in the Cordillera Central were gazetted as national parks. There is now a network of 24 conservation areas, although not all of these are in IUCN's categories I–IV (Table 11.3, Figure 11.3), and they protect representative areas of the country's ecosystems. Nevertheless, these protected areas do not exist as a structured national system at present. A systematic, comprehensive evaluation of them and their legislation is required to achieve national conservation objectives. The government has failed to allocate the financial and administrative resources necessary to implement the laws adequately and truly protect the conservation areas (Reynoso *et al.*, 1988). Park guards are generally underpaid and inadequately trained. Monte Cristi National Park is considered to be the most threatened of the conservation areas.

Fifteen new conservation areas have been proposed (SEA/DVS, 1990). These areas were selected for their potential contribution to national biodiversity conservation and include habitat types that are not under protection in the existing network. There are also proposals to expand some of the present protected areas, and to manage others as Biosphere Reserves.

The National Park Directorate (DNP) in the Dominican Republic was created in 1974. It is responsible for developing, managing, regulating and protecting the country's conservation areas. The institution has been affected by budget limitations, political influences and its role overlapping with that of DGF.

In various protected areas, a co-management strategy has been developed with local or national NGOs cooperating with DNP to protect natural resources, develop and implement management plans for the conservation areas or work in surrounding buffer zones. For instance, Fundación Quito Espuela works in Loma Quita Espuela Scientific Reserve, Progreso in Ebano Verde Scientific Reserve and Grupo Jaragua in Jaragua National Park.

Management plans have been written for three of the national parks (Jaragua, Los Haitises and Del Este) and there are draft plans for two others: José del Carmen Ramírez and Armando Bermudez. The management plan for Jaragua has, since 1991, been successfully implemented; the plan for Del Este was scheduled for implementation beginning in 1993/1994. All the conservation areas have suffered some form of exploitation (Reynoso *et al.*, 1988) and, in addition, government agencies

Table 11.3 Conservation areas of the Dominican Republic

Existing conservation areas in IUCN's categories I-IV are listed. The large wildlife sanctuary (for whales) is not listed.

<i>National Parks</i>	<i>Area (sq. km)</i>
Del Este	420
Isla Cabritos	24
Jaragua	1,374
José Armando Bermúdez	766
José del Carmen Ramírez	738
Los Haitises	1,600
Monte Cristi ⁺	1,310
Sierra de Bahoruco	800
<i>Scientific Reserves</i>	
Ebano Verde	23
Laguna del Rincón	48
Lagunas Redonda y Limón	101
Loma Quita Espuela	73
Valle Nuevo	409
Villa Elisa/Dr Orlando Franco	0.2
<i>Historic National Parks</i>	
La Isabela [*]	0.3
La Vega Vieja [*]	nd
Total	11,435

⁺ includes Cayos Siete Hermanos Bird Sanctuary

^{*} not shown on Figure 11.3

Source: WCMC (unpublished data)

other than DNP often carry out programmes which foster the invasion of parks and reserves.

As well as the areas controlled by DNP, there are three *Zonas Vedadas*, two managed by the General Directorate of Forests and the third, the Rio Nizao watershed, managed jointly by DNP and DGF. The sizes and IUCN category of these are unknown.

In Haiti, a decree of 1968 declared eight sites as national parks or nature sites (IUCN, 1992), but these were mostly small areas of historic interest. They were all less than 50 hectares except for the 22 sq. km La Citadelle. In 1979, the Institut de Sauvegarde du Patrimoine National (ISPAN) was created to protect and conserve Haiti's natural and cultural heritage and in 1983 two new parks (La Visite and Pic Macaya) were gazetted by presidential decree, with financial help from USAID. However, the decree creating the new parks failed to assign final responsibility for them to a single government agency and there has been some conflict between ISPAN and MARNDR as a result. Neither organisation have the staff or budget to adequately protect the parks. Both areas suffer from invasion by peasants, who clear the forests to plant crops. The eight areas designated earlier are still protected, but they are not listed in Table 11.4 as they are not in IUCN's categories I-IV.

Management plans have been written for Haiti's three largest protected areas — La Citadelle (22 sq. km, category V), La Visite and Pic Macaya (Woods *et al.*, 1992 — shown on Figure 11.2). The World Bank's Forestry and Environmental project proposes to consolidate the management of all the parks in Haiti under the administrative control of the Service for the Protection of the Environment (SPE) of MARNDR.

A national marine park at Les Arcadins, about 30 km from Port-au-Prince, has been proposed as a conservation and eco-tourism site by WWF.

Conservation Initiatives

In 1991, a Forestry Code for the management and administration of the Dominican Republic's forest resources and a Strategy for the Conservation of Biological Diversity in the Dominican Republic were prepared; the former by CONATEF/SURENA and the latter by the NGO Grupo Jaragua. A Forestry Action Plan is currently under review. In addition, a Coastal Zone Management Plan for the entire coast of the country was prepared and released by the Oficina Nacional de Planificación (ONAPLAN) in 1993.

Participation of Dominican NGOs in environmental issues has increased considerably, particularly since the mid-1980s. Today about 50 of these organisations are directly or indirectly involved in the sector. About 20 are committed to the protection, conservation and promotion of natural resources and biological diversity, with programmes involving protected areas, endangered species, environmental education, community development, sustainable development and control of pollutants amongst other things.

Over the past 25 years there has been aid to the forestry sector from a variety of international organisations. This includes assistance with resource assessment, forest management, education, technical training, watershed management and institutional strengthening from organisations such as OAS, FAO, UNDP and IICA.

There are also other international governmental and non-governmental organisations involved in the promotion and support of biodiversity conservation and sustainable development in the Dominican Republic. The groups involved at present include USAID, TNC, WWF, World Bank, IUCN, OEA, the Center for Marine Conservation, GTZ and the Spanish Cooperation Agency.

USAID has financed a massive reforestation and agro-forestry project in Haiti through the Pan American Development Foundation. A number of private environmental lobby groups have been established in the last few years and they have helped the public become aware of Haiti's enormous environmental problems. The Haitian government also prepared an environmental plan which was presented to UNCED in 1992.

An environmental unit has been established recently by UNDP in Haiti. Its activities include: facilitating and coordinating the programmes, strategies and projects of the donor community, the NGOs and the private sector in Haiti, mainly through an inter-agency committee; monitoring and documenting the status of the environment in Haiti using databases, a GIS, satellite imagery and useful environmental indicators; fulfilling UNDP directives concerning the environment, especially those resulting from UNCED and Agenda 21; and facilitating the preparation and execution of environmental projects.

Table 11.4 Conservation areas of Haiti

Existing conservation areas in IUCN's categories I-IV are listed.

<i>Natural National Parks</i>	
La Visite	20
Pic Macaya	55
Total	75

Source: WCMC (unpublished data)

Unfortunately the September 1991 coup d'état and the consequent political crisis have resulted in the suspension of most of the local government and internationally funded programmes that were established to address conservation and environmental problems. For instance, in 1992, USAID terminated funding to the University of Florida Biosphere Reserve Project, which was set up to establish a functional biosphere reserve around Pic Macaya (2347 m) to protect its exceptional biodiversity, its last relictual cloud forests and the watercatchment zone for Haiti's southern

peninsula. However, after a major lobbying effort, USAID agreed to continue conservation activities in the Pic Macaya area by funding a local NGO, and the Haitian government has assigned soldiers to protect the reserve, a measure which has halted much of the destruction of the remaining forests there.

The situation in Haiti remains very difficult due to the continuing and unresolved political crisis and an OAS trade embargo which has further impoverished the peasant farmers, forcing them to destroy their environment and Haiti's forests merely to survive.

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