Chapter 6

North and Central America

VEGETATION AND SPECIES COMPOSITION

In North and Central America mangroves are quite widespread along the coasts of 34 countries and areas, ranging from Barbados in the north to Panama in the south, and including several Caribbean islands. The low-island mangroves growing in the territory of Bermuda are among the northernmost communities in the world (32°20′N).

In this region, mangroves constitute a wide range of community types. In the Caribbean they are found growing along the margins of brackish and saline ponds, as fringe communities along the coasts or even inland. 'Overwash' mangrove communities (i.e. communities subject to tidal inundation, exposed to open waters and living on small islands that are entirely inundated with each tidal cycle) are found in Puerto Rico and on offshore cays of Belize and Jamaica. Estuarine mangroves are found only in countries with a rich riverine system, such as the Dominican Republic, Saint Lucia and Trinidad and Tobago. In these countries, mangrove trees may reach considerable heights. Surprisingly, in Anguilla, a low-lying limestone island where mangroves occur on the margin of saline ponds, *Rhizophora mangle* and *Avicennia germinans* may reach heights of up to 25 and 20 m respectively; mangrove trees of such height are not common in similar conditions elsewhere. An area of significant importance within this subregion is the Central Mangrove Wetland found in Grand Cayman, which extends for some 4 000 ha and is still almost entirely pristine and protected, in some areas, under the Marine Parks Law. It represents the largest area of inland mangroves in the Caribbean.

The considerable freshwater input from upstream and the high number of tidal flats found in the mainland countries of this region permit a more extensive development of estuarine mangroves. In this subregion, mangroves grow along both the Atlantic and Pacific coasts. Generally the richest and most complex forests are found on the Pacific coast (Costa Rica, for example), while only small and stunted trees, not exceeding 5 m, grow along the Atlantic coast. Some of the best developed mangrove forests in the subregion are the communities growing in the deltas of the Grijalva and Usumacinta Rivers, in Tabasco Province (Mexico), where trees may reach up to 30 m in height; in the Terraba-Sierpe National Park (Costa Rica); in the Bocas del Toro, San Miguel and Chiriqui Gulfs (Panama); and in Belize, where the forest canopy may reach 40 m.

Other mature mangrove forests are found in the Zapata peninsula (Cuba), and in Guatemala (in the estuaries of the Acomé and Paz Rivers and in the Monterrico lagoon). Extensive mangrove forests also cover the southern tip of Florida, where the freshwater coming from Everglades National Park meets the saltwater from the tidal flats, creating a major mangrove estuary system.

Interesting examples of dwarf mangrove communities may be found in a few Central American countries as a response to the high salinity and/or extremely dry conditions; these trees grow to less than 2–3 m (Turks and Caicos Islands) or even to less than 50 cm (Nicoya Gulf, Costa Rica).

Mangrove biodiversity in this region (Table 9), as well as in South America, is quite low compared with that of Asia (only 10 native mangrove species against more than 50 in Asia). The species are more or less evenly distributed over the region, apart from some exceptions such as *Avicennia bicolor, Pelliciera rhizophorae, Rhizophora harrisonii* and *Rhizophora racemosa,* which are found in a few countries only. A distinct element of Asian mangroves, *Nypa fruticans*, has been introduced in Panama.

TABLE 9
Mangrove species composition in North and Central American countries

Species	Anguilla	Antigua and Barbuda	Aruba	Bahamas	Barbados	Belize	Bermuda	British Virgin Islands	Cayman Islands	Costa Rica	Cuba	Dominica	Dominican Republic	El Salvador	Grenada	Guadeloupe	Guatemala	Haiti	Honduras	Jamaica	Martinique	Mexico	Montserrat	Netherlands Antilles	Nicaragua	Panama	Puerto Rico	Saint Kitts and Nevis	Saint Lucia	Saint Vincent and the Grenadines	Trinidad and Tobago	Turks and Caicos Islands	United States	US Virgin Islands
Acrostichum aureum	√	√			√[a]			√		√		√			√	√				√	√	√	√	√	√	√		√	√	√			√	√
Avicennia bicolor										√				√					√						√	√								
Avicennia germinans	√	√	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Avicennia schaueriana	√	√						√				√			√	√					√		√	√			√	√	√	√	√	√	√	√
Conocarpus erectus	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Laguncularia racemosa	√	√		√	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Nypa fruticans																										√[b]									
Pelliciera rhizophorae										√															√	√									
Rhizophora harrisonii										√												√[a]			√	√					√				
Rhizophora mangle	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Rhizophora racemosa										√															√	√					√				
Total no. of species	**6**	**6**	**2**	**4**	**4**	**4**	**3**	**6**	**4**	**9**	**4**	**6**	**4**	**5**	**6**	**6**	**3**	**4**	**5**	**5**	**6**	**6**	**6**	**6**	**9**	**10**	**4**	**6**	**6**	**6**	**7**	**5**	**6**	**6**

[a] Uncertain.
[b] Introduced.

MANGROVE RESOURCES: STATUS AND TRENDS 1980–2005

More than 2 million hectares of mangroves are currently growing along the coasts of North and Central American countries (Table 10). In the majority of countries and areas, mangroves cover less than 10 000 ha (representing only about 2 percent of the total regional mangrove area) and only eight countries have more than 50 000 ha.

The most extensive mangrove cover in the region is found in Mexico and Cuba (Figure 9), which have more than one-third and about one-quarter of the regional mangrove area, respectively. These two countries have the fifth and the seventh largest extent of mangroves worldwide (see Figure 3). Together with the United States, Panama and the Bahamas, they account for 82 percent of total mangrove area in North and Central America. The remaining 17 percent is spread among 29 countries and areas.

Cuba and Puerto Rico are exceptions to the serious losses and degradations in mangrove area that have taken place over the past two decades in the region. The major plantation programme currently under way in Cuba helped increase the area from 537 400 ha in 1980 to 547 500 ha in 2000. Here mangrove protection legislation has been in force for more than a decade and has recently been enforced more effectively.

A substantive loss of mangrove area (almost 700 000 ha, or about 23 percent of the area present in 1980) occurred in this region over the last 25 years (Figure 10). When this decrease is compared with area changes in other regions, it is second only to that of Asia.

TABLE 10
Status and trends in mangrove area – North and Central America (1980–2005)

Country/ area	Most recent reliable estimate		1980	1990	Annual change 1980–1990		2000	Annual change 1990–2000		2005	Annual change 2000–2005	
	ha	Ref. year	ha	ha	ha	%	ha	ha	%	ha	ha	%
Anguilla	90	1991	90	90	0	0	90	0	0	90	0	0
Antigua and Barbuda	1 175	1991	1 570	1 200	–37	–2.6	850	–35	–3.4	700	–30	–3.8
Aruba	420	1986	420	420	0	0	420	0	0	420	0	0
Bahamas	141 957	1991	180 000	145 000	–3 500	–2.1	140 000	–500	–0.3	140 000	0	0
Barbados	4	2004	30	16	–1	–6.1	7	–1	–7.9	4	–1	–10.6
Belize	78 511	1990	78 500	78 500	0	0	76 500	–200	–0.3	76 000	–100	–0.1
Bermuda	16	1992	17	16	n.s.	–0.6	15	n.s.	–0.6	15	0	0
British Virgin Islands	587	2001	660	630	–3	–0.5	590	–4	–0.6	570	–4	–0.7
Cayman Islands	7 830	1998	8 500	8 000	–50	–0.6	7 700	–30	–0.4	7 600	–20	–0.3
Costa Rica	41 840	2000	63 400	53 400	–1 000	–1.7	41 800	–1 160	–2.4	41 000	–160	–0.4
Cuba	545 805	2003	537 400	541 400	400	0.1	545 500	410	0.1	547 500	400	0.1
Dominica	10	1991	12	10	n.s.	–1.8	10	0	0	9	n.s.	–2.1
Dominican Republic	21 215	1998	34 400	25 800	–860	–2.8	19 400	–640	–2.8	16 800	–520	–2.8
El Salvador	28 000	2004	46 700	35 300	–1 140	–2.8	28 500	–680	–2.1	28 000	–100	–0.3
Grenada	255	1992	295	260	–4	–1.2	230	–3	–1.2	215	–3	–1.3
Guadeloupe	2 950	1997	3 000	2 990	–1	n.s.	2 960	–3	–0.1	2 950	–2	–0.1
Guatemala	17 727	1999	18 600	17 400	–120	–0.7	17 500	10	0.1	17 500	0	0
Haiti	15 000	1988	17 800	15 000	–280	–1.7	14 300	–70	–0.5	13 700	–120	–0.8
Honduras	78 668	2000	152 500	118 400	–3 410	–2.5	78 700	–3 970	–4	67 200	–2 300	–3.1
Jamaica	9 731	1997	12 000	10 700	–130	–1.1	9 700	–100	–1	9 600	–20	–0.2
Martinique	1 840	1998	1 900	1 900	0	0	1 800	–10	–0.5	1 800	0	0
Mexico	882 032	2002	1 124 000	985 600	–13 840	–1.3	885 000	–10 060	–1.1	820 000	–13 000	–1.5
Montserrat	5	1991	5	5	0	0	5	0	0	5	0	0
Netherlands Antilles	1 138	1980	1 140	1 100	–4	–0.4	1 000	–10	–0.9	1 000	0	0
Nicaragua	69 050	1998	103 400	79 300	–2 410	–2.6	65 000	–1 430	–2	65 000	0	0
Panama	174 435	2000	250 000	190 000	–6 000	–2.7	174 400	–1 560	–0.8	170 000	–880	–0.5
Puerto Rico	8 870	2000	7 650	8 300	65	0.8	8 900	60	0.7	9 000	20	0.2
Saint Kitts and Nevis	79	1991	85	80	–1	–0.6	75	–1	–0.6	70	–1	–1.4
Saint Lucia	200	2002	200	200	0	0	200	0	0	200	0	0
Saint Vincent and the Grenadines	51	1991	55	51	n.s.	–0.7	50	n.s.	–0.2	50	0	0
Trinidad and Tobago	7 150	1991	7 500	7 170	–33	–0.4	7 000	–17	–0.2	7 000	0	0
Turks and Caicos Islands	23 600	1988	23 600	23 600	0	0	23 600	0	0	23 600	0	0
United States	197 648	2001	275 000	240 000	–3 500	–1.3	200 000	–4 000	–1.8	195 000	–1 000	–0.5
US Virgin Islands	216	1999	350	320	–3	–0.9	200	–12	–4.6	150	–10	–5.6
North and Central America	**2 358 105**	**2000**	**2 950 779**	**2 592 158**	**–35 862**	**–1.29**	**2 352 002**	**–24 015**	**–0.97**	**2 262 748**	**–17 851**	**–0.77**

Note: n.s. = not significant.

In absolute terms, the biggest area changes took place in Mexico, Honduras, Panama, the United States and the Bahamas. In Mexico, several areas of mangroves have been clear-cut to convert land to aquaculture, agriculture and urban and tourism development. A significant additional area of mangrove forest, yet to be quantified, was lost during the three hurricanes that hit the Mexican coasts in 2005 (Emily, Wilma and Stan). Between 10 000 and 14 000 ha have been lost annually in this country since 1980. In Honduras, the shrimp and salt production industries have been the main cause

FIGURE 9
North and Central America – five countries with the largest mangrove area, 2005

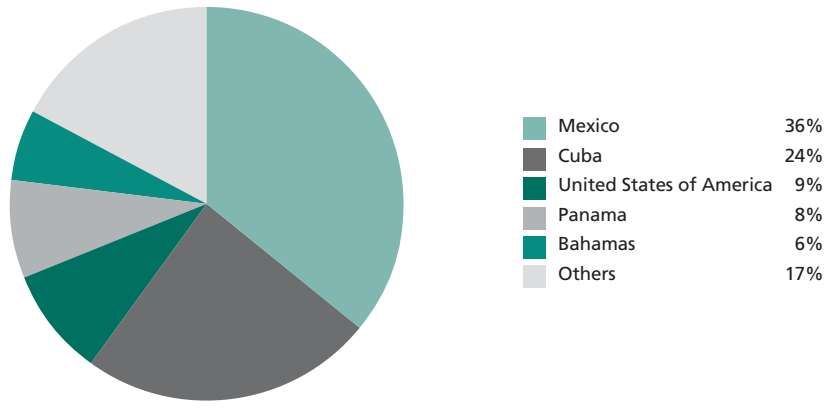
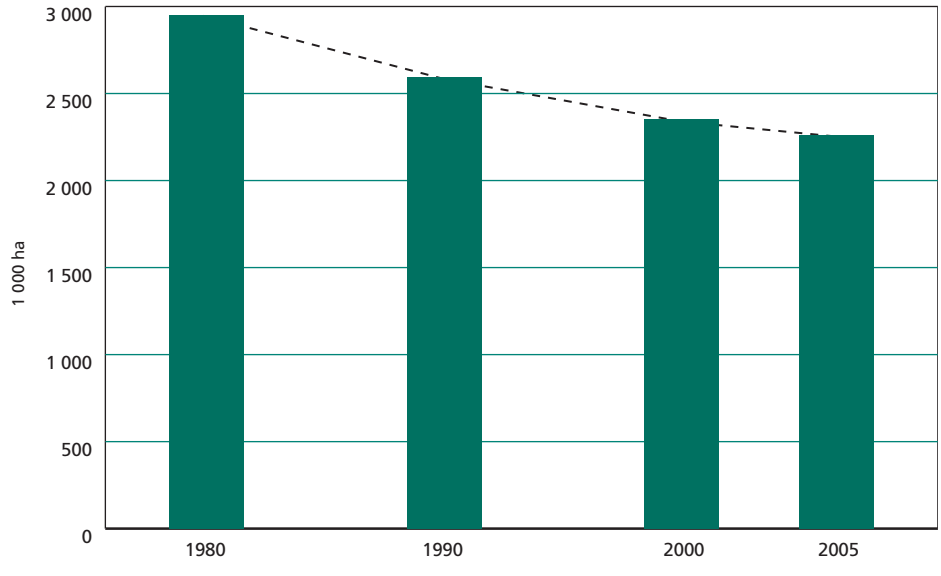


FIGURE 10
Mangrove area changes over time – North and Central America (1980-2005)



of some 85 000 ha of mangroves lost since 1980. Shrimp farms and salt production are also the main cause of the reduced area of mangroves in Panama, which lost a total of 80 000 ha from 1980 to 2005. The use of land for livestock grazing and conversion of mangroves for urban and tourism development are additional causes of mangrove losses. Proper conservation legislation is still lacking in the country, but efforts towards the rehabilitation of degraded areas are being undertaken in a few localities.

In the United States coastal ecosystems have been damaged mainly by drainage for agriculture, reclamation for urban development and canalization. Large mangrove areas now fall within the system of protected areas that forms much of the land and sea area of southern Florida, notably Everglades National Park, and strict laws have been enacted for the protection and/or sustainable utilization of mangroves. In the United States hurricanes also represent a serious threat to mangroves and cause significant losses.

Successful mangrove conservation can be found in the Bahamas, where increased awareness of the services and benefits of mangroves has led to a decline in the annual rate of loss. The 3 500 ha lost annually in the 1980s dropped to 500 ha in the 1990s and to no significant change from 2000 to 2005. Past losses in the country were mainly caused by the development of tourism infrastructure (resorts, marinas and residential areas), opening of access to the waterfront and mosquito control.

Analysing the results in relative terms, the biggest rates of loss (as a percentage of total mangrove area) were recorded from Barbados, the United States Virgin Islands, Honduras, Antigua and Barbuda, the Dominican Republic and El Salvador. The main cause of mangrove degradation and loss in the Caribbean islands has been the rapid and often unsustainable development of tourism industries – on which their economies largely depend – and of the related infrastructure (marinas, hotels and harbours). In Central American countries such as El Salvador, mangroves were lost mainly through uncontrolled urbanization, agricultural encroachment and conversion to shrimp and salt ponds.

As mentioned previously, Cuba and Puerto Rico are the only countries in the region to have experienced a net increase in mangrove area. Cuba has gained about 10 000 ha of mangroves since the 1980s, while Puerto Rico suffered considerable losses during the 1970s, but has recorded an increase in the area of mangroves since the 1980s, probably owing to increased legal protection, natural colonization of new areas and the reversion of agricultural land to its original state as mangrove area. In comparative terms, the increase in area in Puerto Rico (an average annual change of 0.65 percent from 1980 to 2005) is even higher than that in Cuba (0.07 percent).

According to available information, Anguilla, Aruba, Montserrat, Saint Lucia and the Turks and Caicos Islands have maintained their mangrove areas relatively constant over the past 25 years. As a result of increased awareness in the region, the annual rate of mangrove area loss has decreased in the last five years in 24 countries.

MAIN USES AND THREATS

Mangrove resources in North and Central America have traditionally been used for wood and non-wood products, with evidence of human use dating back 5 000 to 6 000 years. They have long been a source of timber for poles and other construction material, charcoal and fuelwood. The collection of crabs, oysters and other molluscs (e.g. *Anadara tuberculosa* and *Anadara similis*) is also a common activity, and in some countries it represents a significant percentage of local – and even national – income. In Cuba, for example, the export of oyster depends mainly on mangrove communities and their health. Villagers also use mangroves to extract tannins and, to a lesser extent, medicines. The nectar of mangrove flowers, particularly *Avicennia* spp., is exploited in the apiculture industry. Beehives are transported to the mangrove areas during flowering to produce honey and wax.

As in other parts of the world, mangroves have been exploited mainly for local use, and commercial exploitation has been practised only in a few cases. These coastal ecosystems provide shelter and breeding grounds for numerous commercial and non-commercial fish species and thus are often used as fishing areas. Panama, for example, has developed a valuable fishing industry that includes a number of fish species dependent on mangroves in at least one phase of their life. Damage to these coastal ecosystems may have significant negative impacts on the fisheries sector. A reduction in the fish catch subsequent to a loss of mangrove area was observed in Jamaica as well as in the United States, where estimated losses of 45–80 percent of mangrove areas south of Miami corresponded to a decline of about 20 percent in the catch of commercial fisheries (Spalding *et al.*, 1997).

Notwithstanding the significant benefits provided by these coastal forests, large areas of mangrove have been cleared over the past decades. Reclamation of land for

urban and tourism development has been the main regional cause of loss over the last 25 years. Drainage and canalization have resulted in an additional loss of mangrove area (e.g. in Barbados). In the Caribbean countries, which are dependent on tourism, a large proportion of the mangroves have been converted for marinas, hotels and residential areas. The severe site modifications undertaken in Barbados, for instance, led to local extinction of *Acrostichum aureum* and *Avicennia schaueriana*, which were originally found in two localities.

Other areas of mangrove forest have been converted to shrimp ponds in Costa Rica, El Salvador, Guatemala and Honduras, even though to a lesser extent than in Asia; to salt paddies; and, in several countries, to agricultural land for rice or pasture for livestock. The conversion of mangrove areas to other land uses was often promoted as a way of strengthening the national economy or improving sanitary conditions. It should be stressed, however, that in some countries (Costa Rica and El Salvador) the conversion of mangrove area to shrimp farming or salt production activities is no longer allowed, but it is still a severe threat to mangroves in others (e.g. Guatemala and Honduras).

In recent years the biggest regional threats to mangroves are the ever-increasing development of the tourism industry, pollution from runoff of fertilizers and pesticides, and improper disposal of wastes. Oil pollution is not a widespread problem for the region as a whole, but it is a serious threat in Panama owing to the extremely high maritime traffic in the Panama Canal (Spalding *et al.*, 1997).

Because of their location in the front line between ocean and land, mangroves also face natural threats such as the frequent hurricanes. In 1989, during hurricane Hugo, dense mangrove forests played a significant role in the protection of lives and resources in the British Virgin Islands, yet some mangrove trees on the ocean side were damaged. During the passage of hurricane Andrew in 1992, trees were uprooted in the Florida Everglades. More recently, the mangroves of the Cayman Islands were severely impacted in 2004 by hurricane Ivan, which caused some US$1.8 billion in damage and significant destruction to the coastal and central mangrove wetlands of Grand Cayman. Studies are under way to assess the impact of and possible damage caused by the recent passage of hurricane Katrina, which devastated the coasts of Alabama, Florida, Louisiana and Mississippi in August 2005 and was recorded as the one of the most destructive natural disasters in the history of the United States.

MANGROVE CONSERVATION AND MANAGEMENT

Local authorities are increasingly recognizing the importance of mangrove forests and the benefits of healthy mangroves, both for their aesthetic and ecological value and for the economic advantages provided by sustainable tourism and by their link with national fisheries, among others. A step forward in the protection of these ecosystems has been the decreased number of shrimp farm permissions issued and the restoration of mangrove forests in some abandoned ponds. Some countries have stressed that the conservation of coastal areas is critical to future socio-economic development, and a series of activities are being organized to increase awareness in the public and private sectors. 'Coastal Awareness Month' – launched in April 2005 in the Bahamas by the Ministries of Education and Tourism and a group of environmentalists drawn from the public and private sectors (the Green Team) – is a good example of such activities.

Mangroves are also increasingly appreciated for their protective role against coastal erosion and other natural hazards. Some governments have initiated activities to conserve and protect them. On the other hand, in some countries in the region the public still does not consider mangroves a resource to be actively protected.

Adequate legislation for the protection and conservation of mangroves is not very common in the region, and only very few countries have specific laws for the conservation of these ecosystems (Costa Rica and the United States are examples). In

some countries such as the Bahamas and Cuba, mangroves are protected under different habitat and/or forest laws, and in others they are often included in wildlife, wetland, coastal or maritime protected areas. Some areas are also included in the Ramsar list: Het Spaans Lagoen (Aruba), Terraba-Sierpe National Park (Costa Rica), Grand Cul-de-Sac Marin de la Guadeloupe (Guadeloupe), Jeanette Kawas National Park (Honduras) and Everglades National Park (United States). Unfortunately, where legislation exists, effective implementation is often lacking due to insufficient human resources. Plantation programmes in the region are generally undertaken as small reforestation or rehabilitation activities (mainly rehabilitation of shrimp farms), with the exception of Cuba, where a major plantation programme begun in 1980 continues.