Marine and coastal areas

The oceans are the largest ecosystems on the planet. They are as rich and diverse as any land ecosystem, but remain practically unexplored. Although the deep seas are still, in general terms, unpolluted, there is already evidence of environmental degradation in some areas as well as deterioration of many marine species.

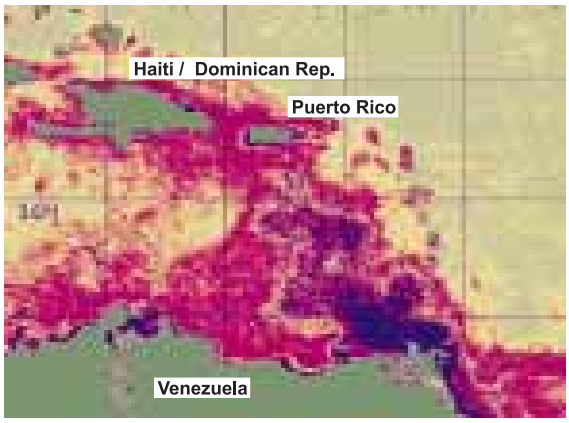
The marine coastal environment, by contrast, has clearly been significantly affected by habitat transformation and destruction, by over-fishing, and by pollution, mostly resulting from land-based activities far away from the sea.

More than one-third of the world population lives less than 100 kilometres from the coast (Cohen *et al.* 1997). In Latin America and the Caribbean, where 60 of the 77 largest cities are on the coast, that figure jumps to 60 per cent.

Marine and coastal systems in the region support the complex interactions of diverse ecosystems, with great biodiversity, and are among the most productive in the world: they are the breeding grounds for commercial species, they generate revenue from tourism, and they act as protectors. Several of the largest and most productive estuaries in the world are located in this region, namely the Amazon and Plate rivers on the Atlantic coast and the Guayaquil and Fonseca on the Pacific coast. The coast of Belize has the second-largest coral reef in the world. The waters off the coasts of Chile and Peru contain one of the five largest fisheries in the world, and the fastest-growing fisheries in the world can be found near the coast of Argentina and Uruguay (IDB 1995).

The region's coast is 64 000 kilometres long and includes 16 million square kilometres of maritime territory. This area plays a key role in the diverse sub-regional and intra-regional dynamics. The coastal areas of the Greater Caribbean, for example, receive sediment from, in order of importance, the Mississippi River (United States of America), the Magdalena River (Colombia), the Orinoco River (Venezuela) and other rivers in Mexico, Central America, the Antilles, Colombia and Venezuela (PNUMA 1999b). The Gulf of Fonseca, in Central America, is the setting for productive relations in the fishing activities of Guatemala, El Salvador and Nicaragua. Significant sedimentation has been detected in the Caribbean Basin and in the Orinoco and Amazon River basins. Also relevant are the climatic relations that exist between the coasts of the Eastern and Western Pacific, such as those seen in the *El Niño* condition (see section 'Climate change' below). Lastly, it is important to stress that for countries like the island states of the Caribbean, Panama and Costa Rica, territorial waters represent more than 50 per cent of their total area.

Large-scale sediment flows into the Caribbean



Source: University of South Florida (USF) http://usfweb.esf.edu/

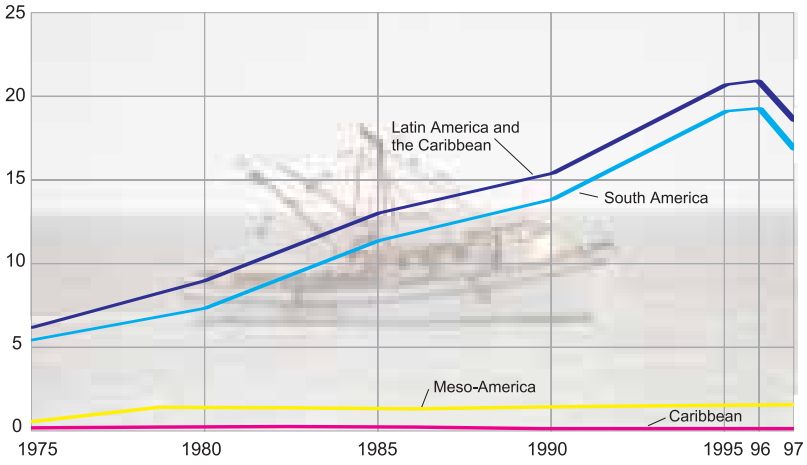
Marine fisheries

The total marine catch in the region reached a peak of 21 million tonnes in 1995 (about 20 per cent of the world catch). From 1985 to 1995, many South American countries doubled or tripled their catch, while Colombia increased its catch fivefold. However, the catch in later years has dropped considerably. For 1997, the decrease was around 14 per cent (FAO 2000).

The biggest decreases in catch occurred in Peru and Chile: for 1993 this represented around 80 per cent of the total catch and around 30 per cent of the total income, which was US$4.5 billion that year (Lemay 1998). Two important reasons for this are the *El Niño*

The marine fishery catch grew four-fold between 1975 and 1995, but has decreased since then because of over-exploitation and the El Niño phenomenon.

Marine fish catch, 1975-1997 (million tonnes/year)



Source: United Nations Food and Agriculture Organization (FAO): FAOSTAT (http://apps.fao.org/fishery/fprod1-s.htm, downloaded February 18, 2000).

phenomenon and the over-exploitation of the fisheries resource.

Between 1970 and 1983, the catch in Peru plummeted from 12 million to 2 million tonnes due to the *El Niño* events. Although in the following decade the catch volume increased significantly, reaching 8.9 million tonnes in 1995, it then dropped again to 7.8 million tonnes in 1997 (IDB 1995; FAO 2000). It is likely that this latest decrease was caused by the 1997–1998 *El Niño*.

The other key factor is over-exploitation of fishery resources: 80 per cent of the commercially exploitable stocks in the south-western Atlantic and 40 per cent of those in the south-eastern Pacific are now fully exploited, over-exploited or depleted (FAO 1997c).

The Chilean case is a good example of this. The country witnessed a steady increase in its catch over the past few decades. In the period from 1990 to 1998, the GDP of the Chilean fishing industry grew at an average annual rate of 10.7 per cent, while exports grew 5.5 per cent from 1990 to 1996 (Chile, Central Bank 1998). However, the average catch in 1998 decreased more than 43 per cent compared with 1997, reaching its lowest point in the decade at 3.6 million tonnes. Fish product exports dropped 31 per cent compared with 1997, and the returns decreased 10.6 per cent (Chile, Ministerio de Economía, Subsecretaría de Pesca 1998).

The dramatic fall in the Chilean catch is directly related to a decrease in landings of yellow tail jack (*Trachurus simmetricus murphy*) and anchovy (*Engraulis ringens*), the major components of the

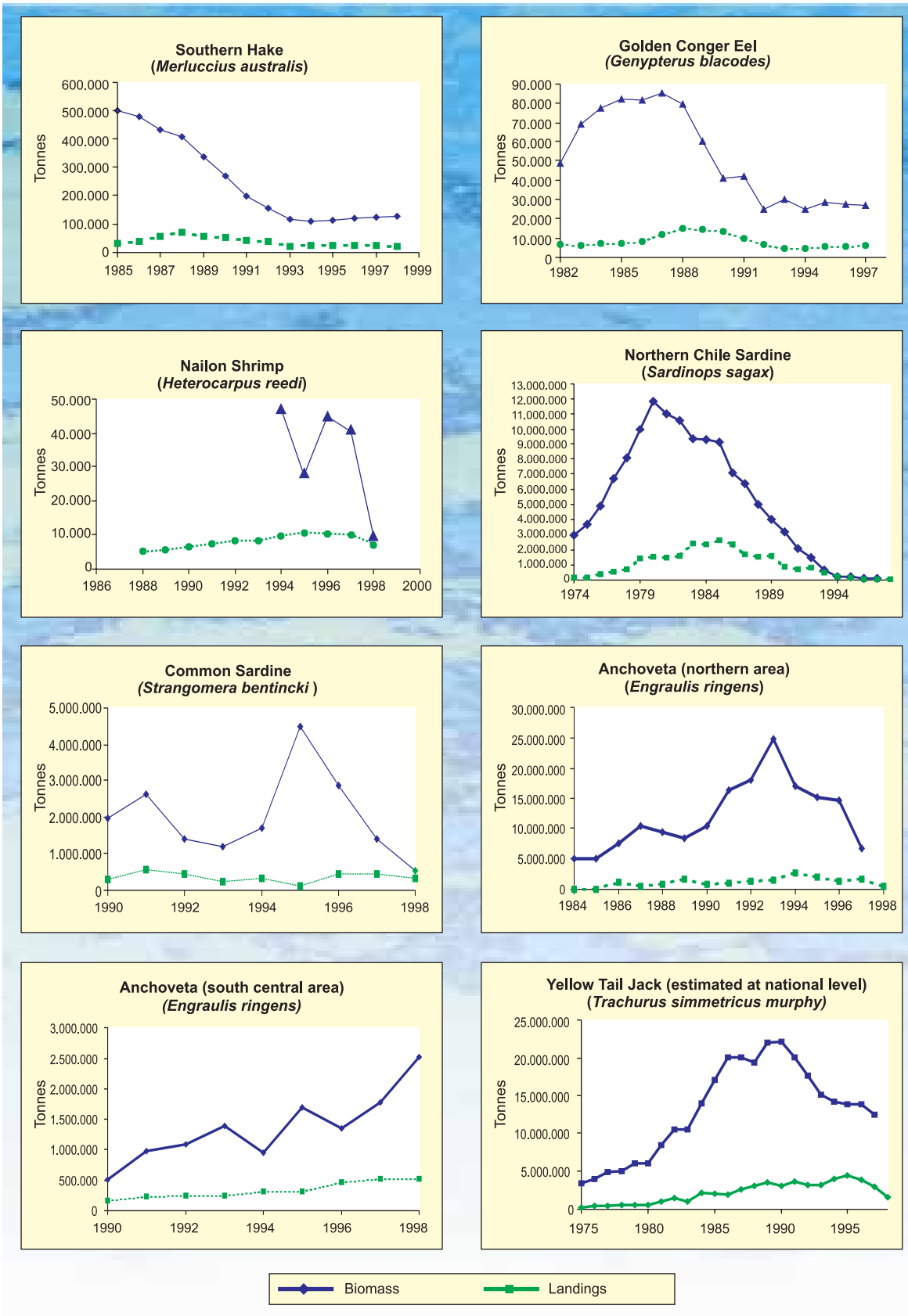
The impact of Chilean fisheries on exploited species*

Species	Abundance (1)		Total biomass (1)	Exploitation rate (2)	Over-exploitation
	Juveniles	Adults			
Groundfish species (from deep waters)					
Southern Hake (*Merluccius australis*)	19 %	24 %	29 %	—	Severe
Golden Conger Eel (*Genypterus blacodes*)	—	40 % (females)	30 %	—	Severe
Nailon Shrimp (*Heterocarpus reedi*)	—	—	—	—	Catch smaller than authorized
Pelagic species (feeding in surface waters)					
Sardine (*Sardinops sagax*)	—	—	—	80% (1994)	Extensive depletion
Common Sardine (*Clupea Strangomera benticki*)	—	—	—	58 % (1998)	Significant biomass and recruitment decrease since 1996
Anchoveta (*Engraulis ringens*)	30 %	—	—	—	Over-exploitation because of recruitment (southern Peru and northern Chile, possibly also central and southern Chile)
Yellow Tail Jack (*Trachurus simmetricus murphy*)	—	—	—	22 to 32 % (1993-1996)	Severe crisis: total allowable catch has not been reached

** Expressed in terms of the original stock percentage reduction (groundfishes) or in exploitation rates (pelagic species)*
(1) Relative to the level existing before the commercial exploitation of the species.
(2) As a proportion of the estimated stocks to the last reference year (see graphs below).

Source: Compiled from Moreno, 1999.

Biomass and landings of the main species exploited in Chilean waters



Source: Moreno, 1999.

Over-fishing and the 1997-1998 El Niño *phenomenon have caused a dramatic decline in Chilean fish catch.*

country's catch. The quantity of yellow tail jack began to decline in 1997 as a result of over-fishing in 1994, 1995 and 1996, when landings exceeded the average of previous years, while the anchovy catch was affected in 1998 by the *El Niño* conditions (Chile, Ministerio de Economía, Subsecretaría de Pesca 1999a).

Aquaculture

Many fishing activities – industrial, artisanal and recreational – co-exist in the Caribbean sub-region. Total catches by the principal fisheries increased from approximately 189 000 tonnes in 1975 to a maximum of 268 000 tonnes in 1985, before declining to around 146 000 tonnes in 1995. In 1996 and 1997 the volume remained at a similar level, with minor oscillations. According to an FAO assessment, around 35 per cent of the Caribbean stocks are over-exploited (FAO 1997c). This sub-region also has the highest percentage of waste, mainly as a result of shrimp trawling.

Fish farming is less important in Latin America and the Caribbean than it is in some other tropical regions, although it is growing, as are its environmental impacts (Lemay 1998; PNUMA 1999b). In Ecuador, Colombia and the Dominican Republic, shrimp farming has developed significantly, and in 1995 the region as a whole produced 21.6 per cent of the global harvest of this species.

Aquaculture in Chile is growing at more than 30 per cent per annum compared with a global increase of only 9.5 per cent. These activities are focused on salmon farming, induced by favourable export markets, and they generate some US$450 million per year in export revenue. Salmon exports in 1997 reached 145 000 tonnes (Chile, Ministerio de Economía, Subsecretaría de Pesca 1998). During 1998, various forms of salmon exports represented 43.7 per cent of total fish exports; the returns resulting from salmonid exports grew 6.9 per cent; and the volume shipped grew 13.5 per cent (Chile, Ministerio de Economía, Subsecretaría de Pesca 1999b).

The conversion of mangroves affects several important ecological functions. Mangroves are the habitat of diverse organisms, including birds, crabs and oysters; they provide spawning and nursery areas for fish, shrimp, prawns and lobsters; and they protect the coastline against wave erosion (PNUMA 1999c). Other important impacts include the enrichment of habitats with nitrogen and phosphorus; interaction with the food chain; oxygen consumption; interaction between native and planted species; the introduction of exotic species; and the release of biotic compounds (including pesticides and antibiotics), chemicals, hormones and growth enhancers (PNUMA 1999c).

Tourism

Tourism represents about 12 per cent of the gross domestic product of Latin America and the Caribbean, and is concentrated mainly along the coasts. Some 100 million tourists visit the Caribbean each year, contributing 43 per cent of the combined gross domestic product of the Caribbean and one-third of its export revenues (WTTC 1993). It is expected that for the year 2005, and just in the Caribbean, scuba-diving tourism alone could generate some US$1.2 billion in income (OMT 1994). Aside from generating employment (10 million people were employed in tourism-related jobs in 1993), investments in tourism have led to important changes in land use and life-styles along the coasts, with many rural coastal areas experiencing a gradual shift from reliance on local agriculture and fishing to the provision of tourism services and related activities (WTTC 1993).

Trade

The region's ports are the second most important destination for containerized goods exported from the United States, and the Panama Canal is a focal point for maritime trade. The overall tonnage going through the ports in the region increased from 3.2 per cent to 3.9 per cent of the world total between 1980 and 1990, and a significant increase is expected as a result of trade liberalization and the privatization of regional ports (UNCTAD 1995). Port expansion and maritime trade usually go hand in hand with expansion of trade routes along the coastline, as is already happening in Argentina, Brazil, Ecuador and Uruguay.

All these activities cause a rapid and often drastic transformation of the marine coastal zones (see map below for the case of Central America).

Sediment and pollution loads

In general, the main contributor to coastal marine habitat degradation – including mangroves, estuaries and coral reefs – is the conversion of land for agricultural use, housing or tourism. Also important are the impacts caused by surface transportation activities and by hydrocarbon production and processing.

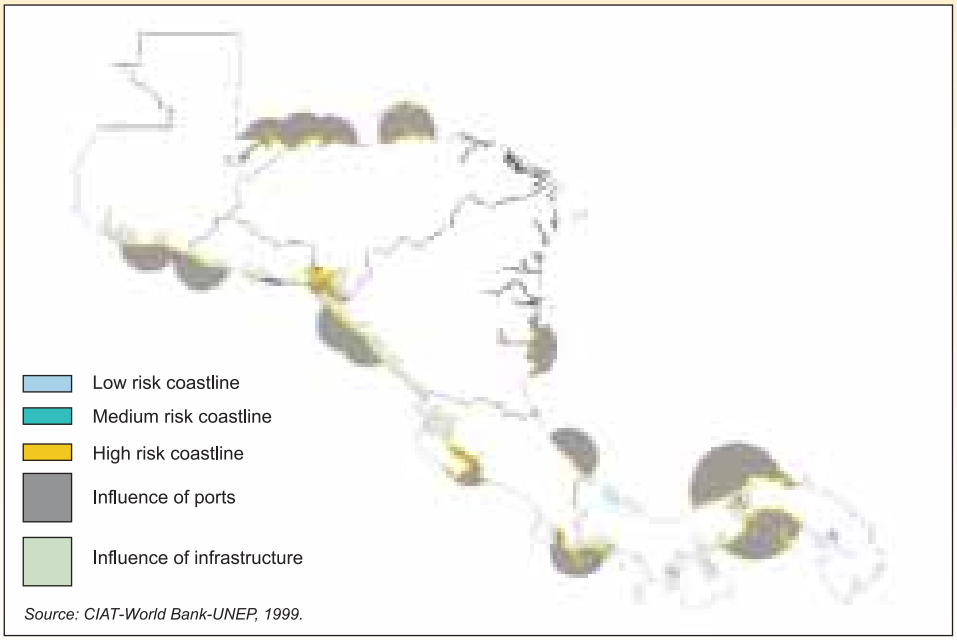
Erosion, caused by deforestation and poor management of agricultural land (see 'Land and food' section above) is one of the principal agents of coastal shallow water degradation. In the Greater Caribbean, for example, the sediment load deposited in coastal waters is estimated to be more than ten million tonnes per year (PNUMA 1999b). At the same time, the excessive use of fertilizers in agriculture has furthered algal population growth and eutrophication in coastal lagoons. There is little information on contamination of coastal waters from pesticides, but mean concentrations of heptachlorine of 10.12 nanograms per litre and 6.85 nanograms of dieldrin (PNUMA 1999b) have been detected in surface waters at the port of Bluefields, Nicaragua. In such countries as Brazil, Ecuador, Guyana and Honduras these factors are worsened by people migrating to coastal flood plains, not only increasing the pollution of the coast but also causing over-fishing and conflicts related to access to traditional fishing grounds (IDB 1995).

A Coastal Risk Index for Central America

Within the framework of the CIAT–World Bank–UNEP project for rural sustainability indices, a Coastal Risk Index has been prepared based on a similar index developed by the Global Resource Institute, with a geo-referenced example for Central America.

This Coastal Risk Index is based on a port's 'radius of influence'. Port influence is considered to be high risk for a radius of influence of 60 kilometres for medium-sized ports and 100 kilometres for large ports. The influence of the infrastructure and population centres serves as an approximate measure of coastal development, rating it in accordance with how close it is to the maritime area: if two hours or less, it is considered to be highly accessible, with a risk of intermediate impact. All other coastal areas are considered to be low risk.

The map shows that the influence of infrastructure is greater in the Central American Pacific coast, while port pressure is similar on both coasts. As a result of this, 40 per cent of the regional coastlines are at high risk, 10 per cent are at intermediate risk, and the remaining 50 per cent are at low risk.



Source: CIAT-World Bank-UNEP, 1999.

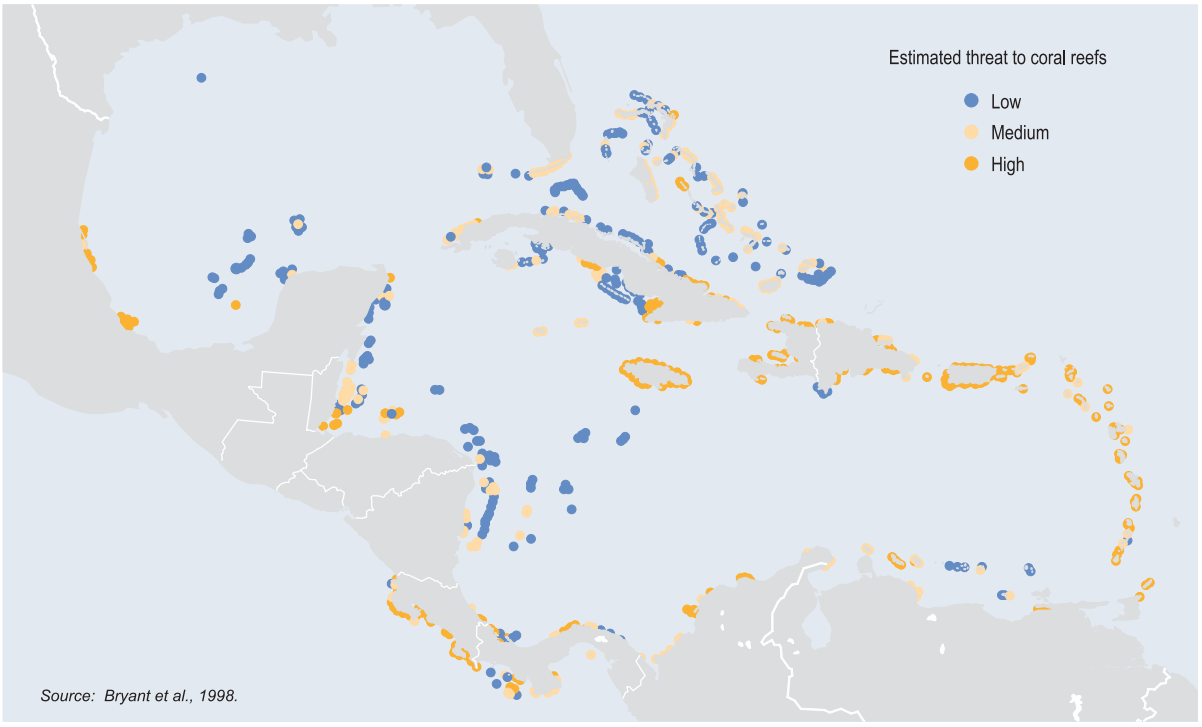
Coastal water quality has been declining region-wide because of an increase in untreated municipal waste discharges. For example, in the Greater Caribbean it is estimated that between 80 and 90 per cent of waste waters are discharged directly into coastal waters without having been adequately treated first (PNUMA 1999b).

Particularly badly affected are the region's mangrove ecosystems, which have been rapidly disappearing over the last 20 years. In Mexico, for example, up to 65 per cent of the mangroves have already been lost (Suman 1994). Moreover, important environmental functions are also being compromised, including coastline stability, fish breeding grounds, recreational uses and flood control.

Reef ecosystems provide another clear indicator of the severe damage being caused to the environment. The reefs in the Caribbean and adjacent waters represent about 12 per cent of the global total: today, 29 per cent of the reef areas of the sub-region (see map) are considered to be at significant risk from runoff and sedimentation caused by deforestation, from nutrients coming from hotel and vessel sewage, from construction projects along the coast, and from mining activities (Bryant *et al.* 1998) as well as from increases in sea surface temperatures (see box on page 57).

The infrastructure required for the tourism industry and for coastal settlements is a major source of coastal water contamination (UNEP 1999b). In addition to locally produced waste, it is estimated that more than 700 000 tonnes of waste are generated by the 35 million tourists who visit the Greater Caribbean each year (PNUMA 1999b). The growing popularity of the Greater Caribbean as a yacht and cruise ship destination has resulted in yet more waste being disposed of directly into the environment. Port facilities in general have inadequate collection systems to deal with the solid waste produced by visiting vessels. In extensively developed coastal areas there is high risk of sewage pollution due to the high water table and to the soil's high absorption capacity. In places like Barbados, Jamaica and Haiti, protective reef systems have been degraded by eutrophication caused by faecal material in the water, contributing to soil erosion and to beach destruction. Existing measurements for Havana Bay have found concentrations of 70 micromoles per litre of nitrogen from ammonia and between 0.7 and 2.5

The threat to coral reefs



Source: Bryant et al., 1998.

Many of the region's coral reefs are under threat: the Caribbean sub-region is the most affected, with 29 per cent of its reefs at high risk.

micromoles per litre of phosphorus, causing the eutrophication of certain areas (PNUMA 1999b).

Another significant source of water pollution and coastal sedimentation is the extraction, processing, storage and transportation of natural gas and oil, as well as the cross-boundary transfer of hazardous and toxic wastes, including radioactive materials and chemicals. Although there is little up-to-date information about this, several studies carried out in the Greater Caribbean show hydrocarbon concentrations in surface waters ranging from 1.0 to 5.98 micrograms per litre in Bluefields (Nicaragua) and 1.0 to 1.85 micrograms per litre in Puerto Limón (Costa Rica) to 0.36 to 1.27 milligrams per litre in Havana Bay (Cuba) (PNUMA 1999b). Concerning sediments, hydrocarbon concentrations found in Bluefields (Nicaragua), Cartagena (Colombia), Yucatan and Veracruz (Mexico) and Havana (Cuba) range between 6 and 1 240 micrograms per gram, with averages varying between 26.6 and 994 micrograms per litre, the lowest values being found in Bluefields and the highest in Havana, according to data published in 1996 and 1997 (PNUMA 1999b).

Hazardous substance spills in maritime accidents involving oil tankers, freighters and other vessels are only one risk factor in this field. Most such incidents are caused by accidents or human errors, although a few have been of a criminal nature, such as discharging ballast waters near the coast. Between 1975 and 1997 thirteen oil spills were recorded, ranging from 50 tonnes to 6 000 tonnes, with an annual mean of 2 000 tonnes. In 1999 (to October) eight cases were reported, showing a marked reduction in magnitude, ranging between 10 and 4 000 litres, with a total of some 16 tonnes (Bezerra 1999). However, a 1 300 tonne oil spill occurred in January 2000 in the Guanabara Bay, next to Rio de Janeiro, affecting hundreds of square kilometres of sea waters and mangroves (including a 14 000-hectare protected area), and all the beaches in the bay area. The state-owned oil company was fined US$28 million (the highest fine to date for ecological damage) in compliance with the new Environmental Crime Law (see Chapter Three). Estimates are that one-third of the oil spilled from 1983 to 1999 went into the ocean since the spills were caused by accidents at port terminals or in refineries built along the coast.

Integrated management

Successful marine coastal resource management implies thoroughly understanding how ecosystems work, including habitat distribution and species composition. Species' interactions and their responses to human interventions are extremely relevant to coastal resource management. The conservation of these resources demands an integrated and comprehensive framework for policy-making, planning and management.

The current situation and importance of coastal marine resources demand urgent action, as well as international co-operation and agreements. For these agreements to be successful, institutional capacity-building is needed among the regional governments, in addition to efforts to promote the design, monitoring and assessment of marine coastal activities.

Careful, co-ordinated, simultaneous planning and management of all sectoral activities will bring much greater overall benefits than the separate implementation of individual sectoral development plans. The integrated coastal management approach is necessary, bringing together into one single administrative framework all the human, physical and biological aspects of coastal areas.