Caribbean Environment Programme

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Regional Overview of Environmental Problems and Priorities Affecting the Coastal and Marine Resources of the Wider Caribbean Region

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Regional Overview of Environmental Problems and Priorities Affecting the Coastal and Marine Resources of the Wider Caribbean

1. INTRODUCTION

1. BACKGROUND

In accordance with decisions taken at the Fourth Intergovernmental Meeting (Guadeloupe. 26-28 October 1987), the Regional Co-ordinating Unit (RCU) undertook a re-assessment of environmental problems affecting marine and coastal resources of the region. To aid the RCU in identifying priority issues, national reports were requested from each of the country participants. The resulting draft was reviewed by the Meeting of Experts on the Caribbean Environment Programme, held in Mexico City, 7-9 September 1988. The recommendations and comments of the meeting have been incorporated in this document.

2. SCOPE AND PURPOSE OF THE OVERVIEW

Scope

The Wider Caribbean region encompasses an area of 4.31×10^6 km^2. It includes twelve continental countries bordering this basin, as well as fourteen island nations and seven dependent territories. Within this region is found a variety of people, cultures and political systems representing countries with different types and stages of economic development. Apart from the geomorphological and socio-political diversity within the Caribbean basin is the diversity of its living species and habitats. Furthermore, in the case of the islands, there is also a high degree of endemism, particularly floral, induced by their geographical separation.

The overview focuses primarily on the problems affecting coastal and marine resources of the Wider Caribbean region. This focus, however, is not narrowly defined. The region's environmental well-being is strongly linked, not only to social, cultural and political conditions, but also to economic realities and financial constraints prevailing in most of the States and territories of the region. The overview, therefore, recognizes and emphasizes various interrelationships between the environment and socio-economic development with respect to the coastal and marine resources of the region.

To cite just one example of linkage between ecology and economics, one has simply to look at changes that are now occurring in the region's agricultural structure. In response to mounting external debt, governments have pursued policies that encourage the cultivation of export crops to generate foreign exchange earnings. Such policies have led to a significant increase in the use of pesticides, artificial fertilizers and other agrochemicals. The result has been the introduction of a large number of new chemical additives into the aquatic food chain, undoubtedly an unforseen and unintended consequence of economic policy, but one nevertheless, with potentially serious ecological impacts.

The cumulative effects of numerous development initiatives have yet to be evaluated with any degree of precision. Despite the absence of definitive scientific findings, however, the potential impacts of various development policies cannot be ignored by those charged by their governments with the responsibility for environmental protection and natural resources management. Suffice it to say that while resource managers have no particular mandate to shape economic or fiscal policy, they are responsible for pointing out the dangers inherent in the single-minded pursuit of narrow sectoral programmes, whether for the promotion of tourism, the restructuring of agriculture, or the exploitation of mineral resources, all of which can have profound and irreversible impacts on aspects of the region's terrestrial and marine ecology.

Hence, while the Caribbean Environment Programme focuses on the region's marine and coastal resource base, the perspective of those guiding the programme must transcend the strict confines of marine and coastal ecology if those resources are to be effectively protected and enhanced for the benefit of succeeding generations. Indeed, a major challenge facing environmental planners and resource managers in today's world, is the need to devise strategies in which the objectives of environmental conservation are harmonized and integrated with programmes for economic development.

Purpose

The purpose of this regional overview is to highlight problems and issues of regional concern in order that they will be considered in the preparation of a long-term strategy for the development of the Caribbean Environment Programme. In addition, the overview has endeavoured to reflect a consensual view of the relationships between environmental and development issues that confront the States and territories of the Wider Caribbean region.

3. PRINCIPAL SOURCES USED IN DOCUMENT PREPARATION

The document has been prepared utilizing a variety of sources. Background material on resource management issues was obtained from national re orts and a number of Country Environmental Profiles, including those for Jamaica, Costa Rica, the Dominican Republic, Haiti, Belize, and one regional profile for Central America. National and sub-national coastal zone management programmes were also consulted. Of particular assistance was the IOC/UNEP draft report on the State of Marine Pollution in the Wider Caribbean Region", (1987), and the U.S. AID/NOAA report on "Caribbean Marine Resources", (1987).

The RCUs, office files on environmental problems and issues in the Wider Caribbean region and numerous UNEP Regional Seas reports, studies and evaluations were also examined. "Development and Environment in the Wider Caribbean Region: A Synthesis", (1982), was used as a point of departure.

Figure 1. Map of the Wider Caribbean Region

II. MANAGEMENT OF COASTAL AND MARINE RESOURCES

Coastal areas are the interface between the land, sea and air. They are the sites of very productive ecosystems such as wetlands, mangrove swamps, seagrass beds and coral reefs. They are also the primary sites for human settlements, providing immediate access to fisheries and other biolocical resources, as well as the locations of ports, harbours and recreational sites. In the case of islands, the great majority of their populations live at or near the coast. Thus, the depredation of ecological systems have been particularly acute in coastal areas. The peculiar nature of coastal areas and their connection *with* the sea underlie their economic and social value and their specific need for management and protection.

Over the past two decades, several terms have developed with respect to an integrated approach to the planning and management of coastal lands and adjacent marine resources. Terms such as “coastal zone management”, "coastal area planning and management", "coastal resources manaeement", "integrated rural development", etc. are concepts which implicitly recognize the value and interdependent nature of coastal systems, upland areas and the open sea, and the need to ensure that policies and activities in one area do not reduce the viability of other components of the whole ecosystem. It is important to note that the concept of the coastal zone was developed in a continental context where there was a significant geographical separation between activities in the interior which impacted downstream on the coast and the coastal area itself. In the case of small islands, the idea of a coastal area incorporates the whole island insofar as activities taking place inland are concerned as they are relatively close to the coast and may impact the coast directly and quickly. Furthermore, the new challenges put forward by the Law of the Sea require the inclusion of all the resources of the sea in the development planning

process. The concept of sea-use planning has become essential to sustainable development of the Wider Caribbean.

An integrated approach to the planning and management of coastal and marine resources requires the co-operation and collaboration of all resource users, institutions and decisionmakers. It needs a basic understanding of the economic value function and interrelated nature of the coastal systems. It needs the common resolve to manage these systems in terms of maintaining the long-term benefits that can be derived from them.

1. LAND MANAGEMENT AND THE MARINE ENVIRONMENT

A comprehensive strategy for the protection, management and sustainable use of the region's coastal and marine environment cannot afford to ignore the impacts of land clearing and deforestation, coastal construction, sand extraction and the management of upland watersheds on near-shore reef systems and fisheries. All of these activities are significantly impacting on the ecology, particularly near-shore ecosystems.

Deforestation

As the nations of the Wider Caribbean pursue programmes of economic development by encouraging export agriculture, industrial expansion and tourism, the clearance of forest lands has accelerated. In many of the region's States and territories deforestation is causing serious environmental degradation and impairing the long-term productive capacity of the resource base.

More than 2 million hectares of Caribbean tropical forests are destroyed annually, while a mere 70,000 hectares are replanted.

Deforestation in the region follows a pattern that generally proceeds in three successive stages. The first stage usually occurs when logging interests cut roads to gain access to select valuable hardwoods. Agricultural settlers follow, attracted by the availability of arable land.

Using slash and burn techniques, agriculture settlers initially clear enough land for subsistence. However, since forest soils tend to be shallow and of low fertility more land is cleared to compensate for declining yields. As areas are successively cleared and abandoned, cattle ranchers move in replacing subsistence farmers and the land is converted to pasture. This cyclical process results in the creation of large deforested areas with soils that are heavily compacted, organically weak and ill protected from rain, grazing livestock and sunlight, all contributing to the land degradation process.

Erosion and sedimentation

Many of the major watersheds in the Wider Caribbean region are suffering from serious devegetation and erosion as a result of shifting cultivation, seasonal burning, fuelwood collection and roadbuilding. Locally in Central American countries, annual soil erosion rates have been found to be as much as 500 metric tons per hectare. Water cycles are being disrupted and extremely high sediment loads have been recorded in streams, rivers, coastal bays and estuaries

(Table 1 and 2). Water borne sediments pose serious problems in regulating and harnessing stream flow with resulting adverse impacts on agricultural development, hydro power generation and urban water supply.

Although desertification is not a phenomenon usually associated with the Wider Caribbean region, Mexico, Guatemala, Belize, Nicaragua, Haiti, Panama and Costa Rica all report conditions of soil degradation characteristically leading to desertification. The process is caused, in part by the clearance of vegetative cover and accompanying soil erosion. The impacts of wide-scale land clearance are similar to those caused by drought. Soils do not retain the moisture necessary for plant growth. The volume of stream flow is reduced to a fraction of normal. Combined with exposure to intense sun, soils age rapidly with soil constituents, such as humus, breaking down at a faster rate than can be absorbed by vegetation.

Table 1: Partial list of sediments discharged by rivers into the Gulf of Mexico and the Caribbean Sea

River	Drainage area (10^3 km^2)	Sediment discharge (10^6 tons per year)	Specific transport (t/km^2 per year)	Mean turbidity (mg/l)
USA				
Mississippi	2923	222	76	380
Apalachicola	44	0.16	6.8	15
Mobile	95	4.5	42	95
Brazos (Texas)	114	15.9	.139	3200
Colorado (Texas)	106	1.9[1]	17.9	
Rio Grande	467	very low[1]		
COLOMBIA				
Magdalena	235	234	1000	1000
VENEZUELA				
Orinoco	950	85.0	91	90

[1] Low values due to dams.
SOURCE: Ref.2.

Table 2: Surface Drainage in Central America

	Caribbean		Pacific	
	Area (10^3 km^2)	Percent	Area (10^3 km^2)	Percent
Nicaragua	117	90%	13	10%
Honduras	92	82%	20	18%
Guatemala[1]	86	79%	23	21%
Panama	24	31%	53	69%
Costa Rica	24	47%	27	53%
Belize	23	100%	-	-
El Salvador	-	-	21	100%
TOTAL	**366**	**70%**	**157**	**30%**

[1] Includes Gulf of Mexico
SOURCE: Ref.2 1.

Beach and dune destruction

Beaches and dunes perform vital functions in protecting uplands from the effects of hurricane-induced storm surge and coastal flooding. They provide the habitats for a wide range of flora and fauna and are particularly important as nesting sites for sea turtles. Threats to beach and dune stability come from a number of sources.

Sand mining is a predominant cause of beach and dune destruction throughout much of the insular Caribbean[15]. The mined sand is generally used in the construction industry for mixing with cement. Coastal construction works also threaten beach and dune stability. The importance of studying and understanding the dynamics of localized ocean currents before the construction of breakwaters and other coastal engineering works cannot be overstated. As has been the case in many coastal areas, the construction of groins, sea walls and jetties is often more detrimental than beneficial for beach replenishment. When humans intervene in the dynamics of beach and dune generation, it is often with disastrous effects, both to habitat and to the value of the resource for flood and shoreline protection. Shore and beach erosion has been identified as a significant problem along the north coasts of Puerto Rico and Jamaica, the east coast of Trinidad and the Gulf coast states of Florida and Mississippi.

2. COASTAL ECOSYSTEMS

Biologically productive coastal and marine habitats are coming under increasing stress throughout the Caribbean. Coral reefs, mangrove wetlands and seagrass beds, prime nursery areas for a wide variety of marine and terrestrial wildlife, are being threatened by a combination of pollution, sedimentation, dredging and coastal land reclamation. The cumulative effects of these activities can effectively sterilize the productive capacity of near-shore coastal areas.

Seagrasses are very productive, generating plant materials that are consumed by grazers - fish, turtles and sea urchins. This plant material is a component of a complex food cycle that includes small organisms and bacteria living among the grasses. The grass beds also serve as nurseries for the juveniles of commercially important fish (snappers, grunts) and invertebrates (lobsters, conchs)[5]. Chemical wastes (mainly oil and fertilizers), dredge and fill operations, thermal discharges and sedimentation, are degrading seagrass beds at an alarming rate. This will have a negative impact on coral reefs since grass beds retain and stabilize sediments preventing reef abrasion or burial during storm conditions.

In addition to their biological importance, sea grasses promote the physical stability of the coast, providing protection to inland areas from wave action and storm surge. Seagrass beds, through their root-like rhizomes, bind sand particles, giving the substrate a stability that inhibits sand transport during periods of ocean turbulence. By absorbing the energy of wave action, coral reefs and mangroves also mitigate the impact of coastal storms and hurricanes, affording natural protection to exposed coastal locations.

Mangrove wetlands and coastal forests

Coastal forests in the Wider Caribbean have been decimated. Thousands of square miles of biologically rich bayou in southern Louisiana have been devastated by oil and gas exploration and drilling. About 65 percent of all mangrove swamps in Tabasco State, Mexico, have been eliminated by petroleum related activities, threatening the continued existence of the shrimp fishery, in that area[28 29].

Mangrove swamps, are often regarded as marginal land and are being systematically degraded and destroyed despite their critically important role as nursery areas to commercially important fisheries. Mangrove thickets and tidal channels are also home for a variety of birds, reptiles and mammals. Additionally, coastal wetlands are important habitats for migratory waterfowls[6].

Often selected as sites for dump or landfills, these areas are, with few exceptions, devoid of meaningful protection. Trinidad's 15,000 acre Caroni Swamp supports the principal landfill for Port-of-Spain and is the disposal site for dredged materials from the harbour. The Portmore area of Metropolitan Kingston, once a productive marine wetland fringed by mangrove forests, has been filled to house some 80,000 people, but at an elevation that exposes residences to the risk of flooding both from the sea and from upland runoff. The indiscriminate filling of wetlands for housing and other urban activities not only causes environmental damage, but often results in poor urban development because of subsoil and drainage conditions. It is also at risk from liquifaction induced by earthquakes.

Coral reefs

Coral reefs are among the most biologically productive marine ecosystems. Their productivity stems from the nutrients, detritus and zooplankton which are retained almost entirely within the reef community and which provide a food source for reef dwelling plants and animals. Because of the importance of photosynthetic processes in coral reefs, their destruction is often attributed to turbidity from suspended sediments generated by upland runoff and channel dredging. Suspended sediments interfere with photosynthesis by blocking the sunlight and sediment deposition can result in the smothering of reef communities. Other causes of coral reef degradation include chronic oil pollution, a condition which exists off the coasts of Puerto Rico and Mexico. Reef damage is also caused by recreational boating, particularly from the anchoring of small boats on coral reefs.

3. HABITAT LOSS AND SPECIES REDUCTION

Wildlife in the Wider Caribbean region is a victim of divergent forces. Both poverty and development are taking their toll on the region's rare and endangered species (Table 3). Loss of wildlife often results from inappropriate development and harvesting practices and the elimination or modification of habitats.

Ultimately, the protection of endangered and threatened species can only be effective when the local community is supportive of, and actively involved in the management process. Once this participation is achieved, voluntary compliance with management activities increases and the need for law enforcement declines considerably. This approach is particularly important in the relatively poorer rural areas where there is greater dependence on the harvesting of wildlife and few government services are available.

Threatened species

The West Indian manatee, although legally protected in the Dominican Republic and Jamaica, continues to be hunted for food and is now close to extinction. Until a recent hunting moratorium, the scarlet ibis was illegally hunted for food and feathers[18]. In addition to being sought as a food source, turtles are killed for their shells, which are used in crafting jewellery and ornaments for the tourist trade. Flamingos and spoonbills are hunted for eggs and feathers in the Dominican Republic[7]. These depredations are a reflection of the region's poverty and, in some instances, ignorance of the danger of species extinction.

Table 3: Distribution and Status of Threatened Caribbean Coastal and Marine Animal Species

Species (Common Names)	**Status**	**Country**
Monachus tropicalis (Caribbean Monk Seal, West Indian Seal)	E	Mexico, Bahamas
Trichechus inunguis (Amazonian Manatee, S. American Manatee)	V	Colombia, Venezuela
Trichechus manatus (Caribbean Manatee, N. American Manatee)	V	Mexico, Bahamas, Cuba, Dom. Republic, Haiti, Jamaica, Puerto Rico, Trinidad & Tobago, Belize Costa Rica, Guatemala, Honduras, Panama, Colombia, Venezuela
Pterdroma hasitata (Black-caped Petrel, Diablotin)	V	Haiti
Caretta caretta (Loggerhead Turtle, Tortuga de mar, Cares, Tartaruga domar, Uruana, Suruana)	V	Mexico, Antigua/Barbuda, Bahamas, Cuba, Dom. Republic, Trinidad & Tobago, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, Colombia, Venezuela
Chelonia mydas (Green Sea Turtle, Tortuga Verde del Atlantico and Pacifico,Tortuga Blanca)	E	Mexico, Antigua/Barbuda, Bahamas, Cayman Islands, Dom. Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Netherlands Antilles, Puerto Rico, St. Lucia, St. Vincent, Trinidad & Tobago, USVI, Belize, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, Colombia, Venezuela
Eretmochelys imbricata (Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdaderia and de Pente)	E	Mexico, Antigua/Barbuda, Bahamas, Cayman Islands, Cuba, Dom. Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Netherlands Antilles, Puerto Rico, St. Lucia, St. Vincent, Trinidad & Tobago, USVI, Belize, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, Colombia, Venezuela

Status Key: E = Endangered; V = Vulnerable; CT = Commercially Threatened
SOURCE: Ref.20.

Species (Common Names)	**Status**	**Country**
Lepidochelys kempii (Kemp's Ridley, Atl. Ridley Sea Turtle, Tortuga Lora)	E	Mexico
Lepidochelys olivacea (Olive Ridley Turtle, Pacific Ridley Turtle, Tortuga verde, Parlama)	E	Mexico, Cuba, Puerto Rico, Costa Rica, Honduras, Nicaragua, Panama, Colombia, Venezuela
Dermatemys mawii (Central American River Turtle)	V	Mexico, Belize, Guatemala, Honduras, Panama, Colombia, Venezuela
Dermochelys coriacea (Leatherback, leathery Turtle, Luth, Tortuga Tora, Barriguda, Tartaruga)	E	Haiti
Caiman crocodilus crocodilus (Spectacled Caiman)	V	Trinidad & Tobago, Colombia, Venezuela
Caiman crocodilus fuscus (Brown caiman)	V	Mexico, Cuba, Nicaragua, Panama, Colombia, Venezuela
Crocodylus acutus (Amer. Crocodile, cocodrilo, Lagarto Negro)	E	Mexico, Bahamas, Cayman Islands, Cuba, Dom. Republic, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, Colombia, Venezuela
Ameiva polops St. Croix Ground Lizard	E	USVI
Family Anthipathidae (Black Corals)	CT	Caribbean Region
Strombus gigas (Queen Conch)	CT	Caribbean Region
Panilurus argus, P. guttatus (Spotted Spiny Lobster)	CT	Caribbean Region

Poverty is both a cause and an effect of environmental degradation. For those whose livelihoods are linked to an aquatic resource base, unproductive and degraded coastal and marine habitats impede the possibility of rising beyond a meagre subsistence existence. Conversely, poverty itself poses one of the greatest threats to the natural environment, for day-to-day survival is the highest priority of the poor and destitute. Programmes for marine and terrestrial resource conservation could be viewed as a threat to material existence of the poor.

At the other extreme, the region is also witnessing wildlife destruction that results from large-scale development due to the elimination or modification of habitat. As secluded, sandy beaches give way to tourism or other forms of development, the turtle nesting habitat is reduced[11]. As mud flats, salt ponds and coastal lagoons are filled to provide sites for urban development, wintering areas for migratory waterfowl are eliminated[7].

In Trinidad's Caroni Swamp, for example, the scarlet ibis nesting behaviour was disturbed by the noise of low-flying jet aircraft whose flight path was directly above their nesting areas (altitude requirements on aircraft take-off and approach have subsequently been modified).

Floating oil residues such as pelagic tar have been reported to impact on marine turtles, particularly in the eastern Gulf of Mexico. Despite the fact that all turtles are presently classified as either threatened or endangered, turtle meat continues to be a popular delicacy sold in many parts of the region.

Caught between the pressures of poverty on the one hand and development on the other, governments have generally been ineffective in implementing programmes for resource enhancement and wildlife protection. Though some park and protected areas have been declared, active management that includes monitoring and enforcement is insufficient. Public awareness of the issues remains limited to rather narrow circles of professionals and academics. There is a pressing need for skillfully designed and executed public education campaigns throughout the Wider Caribbean. Without public support, penalties against violators will go unenforced, and there is every likelihood that the export of turtle shell and feather products will continue when no alternative means of livelihood are available to generate incomes for local populations.

4. FISHERIES

Because of significant regional differences in physical oceanographic conditions, the distribution of fishery resources varies from relative abundance along the continental shelves of Central America and northern South America, to relative scarcity offshore the islands in the Antillean chain. Commercial fisheries utilizing trawlers and purse seiners tend to be concentrated along, the coasts of Venezuela, Mexico and the U.S. Gulf coast states. Puerto Rico has major fish processing facilities, but the catch is largely from the Pacific. Among the islands of the Antilles, only Cuba possesses a mechanized fishery industry.

It is noteworthy that there is growing conflict in the region between artisanal and industrial fishing, activities. There appears to be a rising number of incidents in which industrial trawlers have completely wiped out artisanal fisheries in a very short time. Access to marine resources

and the vulnerability of traditional rights in the face of industrial technology is a difficult policy issue that needs to be addressed.

The resource base

Jamaica's fishery resource is characteristic of those found elsewhere in the insular Caribbean. As in most island States and territories, the marine capture fishery is primarily artisanal in nature, conducted mainly by fishermen operating, in canoes[8]. In Jamaica, approximately 95 percent of these fishermen confine their activities to the island's coastal shelf and associated banks, rather than venturing further offshore.

Commercially harvested species comprise bottom-dwelling (demersal) coral reef species, including finfish and shellfish, and free-swimming (pelagic) species of finfish. The demersal fishery includes more than 200 species of coral reef fish that include grouper, snapper, grunt, goatfish and parrot fish. The pelagic fishery comprises far-ranging oceanic species such as yellowfin tuna, blue marlin, dolphin and various sharks, as well as coastal dwelling or in-shore species such as herring, anchovy, mullet and jack. Oceanic species are taken by line fishing, while coastal species are taken mainly by gill and seine nets. Fish traps or pots account for well over half of all fish catches in the insular Caribbean[2]. The average catch per landing in Jamaica, using traps is 59 pounds, a figure that has remained fairly stable since 1971. This yield conforms to figures on average catch for artisanal landings in Haiti, which, as reported by FAO for a 3-month period, September-November 1984, varied between 30-73 pounds.

Other commercially valuable fishery resources of the insular Caribbean include marine shrimp, conch and lobster (Table 4). These resources, particularly conch and lobster, are often caught without regard for regulations regarding size and restrictions on harvesting egg-bearing females. In the case of Haiti, the tonnage yield of lobsters, molluscs and other shellfish is about half of the total pelagic catch. Despite Haiti's 1500 km of coastline, it is a net importer of dried and salted fish to meet domestic demand.

Reliable, region-wide information on fishery yields are non-existent. FAO estimated that in 1984, 484,000 tons were landed. But some years earlier the agency estimated that actual tonnage figures might be anywhere from 2-10 times higher than reported figures. Few inspectors, inconsistent reporting procedures, the lack of formal record keeping and the large number of geographically dispersed artisanal operators defy efforts to apply statistically valid procedures in estimating catches. Because of these factors, regional generalizations are usually derived from country experience, which are also subject to some of the same problems that impede regional estimating efforts.

It is estimated that between 1983 and 1986 fish production in Venezuela increased by 55 based on an increase in the number of trawlers by 32% and the float of artisanal fishing boats by 20% in the same period (Table 5).

Table 4. Declines in Lobster and Conch

	Average for 1977-79 (metric tons)	Average for 1980-82 (metric tons)	% Decline 77-78-79 to 80-81-82
Caribbean spiny Lobster[1]	6,347	3,746	-41%
Queen Conch[2]	568	415	-27%

[1] Belize, Costa Rica, Honduras, Nicaragua, Panama
[2] Belize, Honduras

SOURCE: Ref.22.

Table 5: The artisanal and industrial fish production in Venezuela (in metric tons)

	ARTISANAL			INDUSTRIAL		
Year	Sardines	Others	%	Tuna	Others	%
1981	27,974	91,108	68.0	34,807	21,150	32.0
1982	52,521	99,072	77.5	22,700	21,400	22.5
1983	41,078	106,651	68.1	44,400	24,872	31.9
1984	48,455	121,470	66.8	58,600	25,18	33.2
1985	53,797	114,797	60.1	82,800	29,819	39.9
1986	79,433	110,836	62.6	83,551	30,263	37.4

SOURCE: Ref.38.

Even where fish stocks are now only capable of supporting artisanal activities, intensive programmes for the conservation of depleted stocks, as well as new initiatives in mariculture may hold out opportunities that have yet to be grasped.

5. NATURAL AND TECHNOLOGICAL HAZARDS

The combination of natural and technological hazards poses a serious and ever-resent threat to the economy and the ecology of many of the States and territories of the Wider Caribbean region.

Natural Hazards

The region is subject to a range of natural disasters that include earthquakes, riverine flooding, volcanic eruptions, landslides and subsidence, hurricane induced storm surge and high velocity winds and drought. Volcanic eruptions of Mont Pelee in Martinique (twice in 1902) claimed more than 30,000 lives. The Soufrière of St. Vincent erupted in 1902 and again in 1979.

A volcanic eruption in Colombia melted mountain snows, generating floods and mudflows that killed 20,000 persons in 1985. Disastrous earthquakes have occurred in Jamaica, Colombia, Nicaragua, Venezuela, Mexico and Guatemala. Hurricanes regularly devastate the islands of the Caribbean, the Gulf coasts of Mexico and the United States.

Technological Hazards

Vulnerability to technological hazards is also on the increase in the Wider Caribbean region. The combination of high volume tanker traffic, major oil and gas extraction and exploratory drilling makes the region particularly vulnerable to oil spills and related hydrocarbon releases that pollute the waters and threaten fragile marine and coastal ecosystems. Chemical, petrochemical and pharmaceutical plants, many of which are located at the land-sea interface, all pose potential risks[12].

The destructive impact of any major event, whether natural or industry-related, could have region-wide consequences. Thus, it is essential that the States and territories of the region develop the institutional capabilities for joint response in cases of environmental disasters. In December 1987, the UN General Assembly adopted a resolution designating the 1990's as the International Decade for Natural Disaster Reduction, "... in which the international community, under the auspices of the United Nations, will pay special attention to fostering international co-operation in the field of natural disaster reduction...". Although intergovernmental co-operation has been strengthened through organizations such as the Pan Caribbean Disaster Preparedness and Prevention Project, some governments maintain closer ties with North America and Europe than they do with their Caribbean neighbours. The need for strengthening regional ties also exists in the scientific/academic world. Divisions among national and/or language groupings need to be bridged, particularly in the fields of seismology, meteorology and vulcanology.

6. CLIMATIC CHANGES AND SEA LEVEL RISE

The phenomenon of sea level and temperature rise, and changes in wind and precipitation patterns, as a result of the "greenhouse effect", has found broad acceptance in the scientific community. In addition, it has been determined that the "EI Niño" phenomenon, occurring in the Pacific Ocean influences global weather patterns as well as affecting hurricane activity in the Caribbean. These regional and planetary phenomena could have serious consequences for many of the States and territories of the Wider Caribbean.

While it may be premature to recommend specific actions, serious study and evaluation from a regional perspective is warranted. Based upon available evidence, some of the consequences of the "greenhouse effect" can be summarized as follows: (1) a rise in global temperatures, which will be greater in the temperate and polar regions than in the tropics; (2) an increase in average worldwide precipitation; (3) higher globally-averaged evaporation; and (4) a widespread reduction in the annual temperature range with longer warm seasons and shorter cold seasons.

Sea level rise, due to melting of the polar ice caps and thermal expansion of the oceans, could also account for the loss of productive agricultural lowlands. In addition, there could be far reaching impacts upon vital wetland resources, prime beach front property, and one-third of the world's population that live within 60 km of a coastline. It is estimated that the impacts on parts of the Wider Caribbean region could exceed those for other areas because of the simultaneous occurrence of land subsidence. Some Caribbean nations (Costa Rica, Guatemala and Grenada) are already instituting building and development controls in anticipation of rising sea level elevations.

As a response to the concern expressed about the possible implications of climatic changes for the marine and coastal environment, UNEP in co-operation with the Intergovernmental Oceanographic Commission (IOC), has initiated the preparation of regional studies which will review the situation in several regions of the world. Such a study for the Caribbean will assume a 20 cm sea level rise and a 1.5^{o}C temperature rise by the year 2025 as was hypothesized in the 1985 WMO/ICSU/UNEP global scenario.

Table 6: Implications of Climatic Changes in the Wider Caribbean Region

Terms of reference	**Sea level rise of 20 cm**	**Temperature rise of 1.5^{o}C**
Ecosystems	*Level of Vulnerability*	
Deltas	High	Low
Estuaries	Moderate	Moderate
Wetlands	Moderate	Moderate
Coastal Plains	Moderate	Low
Coral Reefs	Moderate	Moderate
Mangroves	Moderate	Low
Seagrass Beds	Moderate	Low
Fisheries	Low	Moderate
Agriculture	Low	Low
Forests	Low	Moderate
Socio-Economic	*Level of Vulnerability*	
Coastal Zones	Low	Moderate
Tourism	Moderate	Low
Settlements & Structures	Moderate	Low
Public Health	Low	Moderate
Tropical Storms	Low	High

An important conclusion of the Wider Caribbean Task Team on the Implications of Climatic Changes is that expected sea level and temperature rise will increase the vulnerability of society to other types of environmental change. The results are summarized in Table 6.

The Team found that the sea level in the region has been rising on an average of approximately 0.36 cms per year, over the past 30 years. However, this varies extensively throughout the Caribbean, such that not all areas of the region are experiencing sea-level rise. The Team concluded that "case studies" were the most effective method of quantifying the effects of climatic change, and that several sites that are deemed to be at high risk from sea level change and/or temperature rise should be selected for extensive and intensive study. Further research will be undertaken in five key areas: coastal erosion; groundwater/petroleum extraction; tropical storm frequency/intensity; wind stress and ocean transport; and riverine discharge. The case studies will be designed to address physical processes, ecological aspects and socio-economic issues.

7. ENVIRONMENTAL HEALTH

Increasing urbanization and industrialization, more widespread use of pesticides (Table 7), growing dependence on agrochemicals, higher concentrations of pollutants in air and water - all of these factors increase public exposure to disease. A recent study of one country in the region found that potable water is bacterially contaminated periodically or continuously across the nation. Drinking water reservoirs near several major cities of the region show unacceptably high levels of fecal coliform contamination.

Table7: Pesticide Poisonings in Five Central American Countries, 1971-1976

Country	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**Total**
Costa Rica	196	235	259	326	216	NR	1,232
El Salvador	586	2,860	1,301	1,331	1,454	1,385	8,917
Guatemala	1,134	2,313	1,621	1,010	1,044	1,144	8,266
Honduras	NR	30	48	37	NR	NR	115
Nicaragua	NR	557	243	NR	NR	NR	800
Total	**1,916**	**5,995**	**3,472**	**2,704**	**2,714**	**2,529**	**19,330**

NR – Not Reported.
SOURCE: Ref.3.

Water borne disease

Commercial oystering in the Mississippi Sound was periodically suspended when state inspectors discovered high levels of water contamination in shellfish areas. Heavy metal concentrations in mangrove oysters off the coast of Campeche, Mexico, are higher now than ten years ago. There is a considerable bacterial pollution in the internal channels of Cartagena Bay, Colombia. Urban areas, close to the Cienaga de la Virgen, are inundated with waters containing,

high levels of coliform bacteria during floods. Havana Bay, Veracruz Harbour, San Juan, Guadeloupe and Curacao are reported to be under great stress from urban sewage and there are no prohibitions against the taking of fish and shellfish from these contaminated waters for individual consumption or for sale to the public.

Illness and death are linked to poor environmental conditions. Diarrhoeal diseases and typhoid fever continue to be major health problems in the region, transmitted by contaminated food and water. Other parasitic and communicable diseases that are environmentally related include malaria, schistosomiasis, infectious hepatitis, dengue and yellow fever.

There is an urgent need to identify the environmental conditions giving rise to these diseases in order to establish public investment priorities in the areas of water supply, liquid waste disposal and solid waste management. Closely related is the issue of training and recruitment of environmental health officers. Based on recent studies a critical need exists for improved training and recruiting of public health personnel throughout the region.

Mounting infrastructure needs

As rural populations migrate to urban centres, investments in basic services -water supply, sewage facilities, solid waste disposal- have lagged far behind minimum requirements for decent and productive urban living. Soaring vehicular traffic gives rise to high levels of air pollution that are pandemic in their reach, and heavy metal concentrations in urban runoff drain into bays and estuaries once rich in marine life.

Social infrastructure costs are high. Inability to meet these costs is resulting in a continuously deteriorating urban environment and an unrelenting build-up of unmet needs whose cumulative costs are staggering when measured against modern standards of environmental health, public safety and urban amenities. Severe shortages of affordable housing have resulted in overcrowding, uncontrolled growth of squatter settlements and inner city deterioration.

Industrial port development

On a more positive note, many of the States and territories of the region have been modernizing and developing their ports in response to market requirements and changes in the technology of marine transport such as containerization and roll-on-roll-off. Unfortunately, much of the port development has destroyed valuable marine habitat, polluted the marine environment and physically (as well as visually) cut off the city from the sea. The disposal of dredged materials from the cutting of new channels and from channel maintenance has become an almost universal problem.

Urban waterfront potentials

Without minimizing the enormity of the problems, many of the capital cities within the Wider Caribbean have an exceptional attribute - their seaside location. Urban waterfronts, often neglected, deteriorating and decaying, represent a great potential asset. By taking advantage of

the land-sea interface, the urban waterfront, when creatively redeveloped and refurbished, becomes a magnet, attracting tourists and residents alike and revitalizing the city centre.

This interface is a locational asset which could be enhanced to bring excitement, vitality and variety to the urban landscape generating economic, aesthetic and recreational values. Bridgetown, Barbados, is a good example of how the interpenetration of the sea into the city centres can enhance the physical setting and generate new sources of economic activity.

Preserving, and restoring historic sites further enhances the waterfront setting. Experience with such development in the metropolitan centres of North America and Europe has demonstrated that urban waterfronts have a potential for attracting local and international tourism, which. in turn, can stimulate the growth of small retail businesses and increase the market for indigenous products and crafts iii.

8. TOURISM IMPACTS AND OPPORTUNITIES

The past several years have witnessed explosive growth in the region's tourism, an industry that is acutely dependent on a high quality natural environment. This is one industry in which the linkage between economics and environmental quality is beyond dispute. Most visitors come to the Caribbean for sun, sea, surf and sand and the argument for habitat protection from an economic perspective is overwhelming, since habitat destruction can threaten the resource base upon which tourism depends.

In 1988, the tourism industry was the largest source of Jamaica's foreign exchange earnings, accounting for 23 percent of the country's hard currency receipts[42]. Seventy percent of the Cayman Islands' economy is dependent on tourism. Antigua and Barbuda's economy is almost totally dependent on tourism and tourism agencies, once buried in government bureaucracies, are now being elevated to ministerial status.

Barbados, whose economy is heavily dependent on tourism, is projecting a more than 10 per cent increase in visitor arrivals by 1990 compared with 1988. The island welcomed 450,000 tourists in 1988. The industry had netted Barbados some US$459.1 million dollars in 1988, US$84 million dollars more than in the previous year.

Accelerating hotel construction

Many countries have embarked on massive hotel construction programmes. Tobago is undertaking an ambitious programme of tourism development that includes new hotel construction, a new international airport and major harbour improvements to accommodate cruise vessels. The newest and largest Club Med has been constructed in Providenciales in the Turks and Caicos Islands, an area with extensive coastal habitat in almost pristine condition.

However, with thousands of rooms currently under construction in the region, the pitfalls, as well as the opportunities offered by tourism must be seriously evaluated, particularly since loans and grants are now being provided by international donors to stimulate such development.

Tourism impacts on the coastal and marine environment

The overwhelming bulk of tourism development is taking place without environmental assessments having been prepared. As a result:

- Hotels are being constructed in areas of valued natural habitat; coral reefs are being blasted to provide channels for the passage of small craft into marinas and boat basins;
- Canals cut into residential subdivisions and poorly designed marinas become septic sinks due to poor water circulation, often induced by shoaling which impedes tidal flushing;
- Tourist facilities are constructed without adequate sewage treatment facilities or with package plants that are frequently inoperative - as a result of inadequate maintenance. There are numerous examples of modern hotels being constructed without provisions for sewage treatment, based on assumptions that municipal systems, now or in the near future, will accomodate the waste loads. As a result, raw sewage is often disposed of in ocean waters adjacent to swimming beaches that quickly become polluted with fecal coliforms and other pathogenic bacteria. For years, signs at beaches along San Juan's Condado area were posted to alert swimmers to pollution levels which exceeded safe standards.
- The use of beach buggies and off-the-road vehicles by hotel guests often destroys dunes and dune vegetation contributing to beach erosion; organized recreational outings to offshore islands and cays disturb wildlife and can destroy fragile habitat; the taking of corals and spear fishing can also deplete the marine resource when unregulated

Additionally, development of tourism facilities often contributes to sand mining and coastal deforestation with the resultant adverse effects mentioned previously.

Symbiosis of tourism with marine resource protection

Tourism is now the largest single source of foreign exchange earnings in much of the Wider Caribbean, and is inextricably associated with attributes of natural -beauty, diversity of flora and fauna, and opportunities to experience the sights and sounds of a tropical and sub-tropical environment. The majority of tourists are particularly intrigued by coral reef communities and marine , wildlife sanctuaries.

If thoughtfully advised, tourists will respect environmental controls and regulations. The primary danger to the environment comes not from tourists, but from a flawed development process that must be accepted as the responsibility of the region's governments and private sector to correct. Institutional weaknesses with respect to comprehensive planning, project review, impact assessment and capital programming for supporting infrastructure need to be addressed as a priority concern of both Governments, donor agencies and lending institutions.

Given the new recognition by the World Bank and other funding agencies of the symbiosis between environment and development, a sounder and more responsible approach to tourism development may be forthcoming. An indication of this increased environmental awareness is the extensive environmental planning programme now underway in St. Kitts as part of a $12.5

million U.S. AID development programme providing road access to the Southeast Peninsula, a 4,000 acre area of hill, salt ponds. sandy beaches and forests previously accessible only by boat or jeep trail.

Linking tourism with the designation of parks and protected areas

The importance of protecting the physical resource base and promoting biodiversity has won increasing acceptance in the Wider Caribbean as the economic importance of preserving environmental quality has assumed sharper focus. Sustained, long-term development has struck a responsive chord throughout the region. This concept is now part of mainstream thinking with respect to strategic planning for regional growth and development (see the Langkawi Declaration on Environment, October 1989; and note the newly established Commission of Latin America and the Caribbean on Development and the Environment, October 1989).

In response to these conditions, the Caribbean nations have begun to seek ways of protecting their limited and rapidly shrinking marine resource base. The emergence of a region-wide programme for parks and protected areas is the logical extension of an evolutionary process that has been unfolding throughout the region.

The designation of parks and protected areas is an important first step. Without monitoring and enforcement, however, old patterns of exploitation are likely to continue. While some marine and terrestrial protected areas have been established (Table 8), many others remain unprotected from the depredations of poachers, and mineral extraction. Even when officially designated, numerous resource conflicts occur in the day-to-day management of marine reserves. The marine reserve in Barbados, for example, is being polluted by sewage and the disposal of swimming pool effluents from nearby hotels; fishermen are pressuring the authorities to allow fishing in the reserve; the coral (especially black coral) continues to be harvested for souvenirs and water sports operators (e.g. jet ski) continue to ply the area

Table 8: Existing Marine Parks and Coastal Protected Areas in the Caribbean Region

Country	Protected Area Name	Year of Estab.	Hectares	(Marine %)
Antigua and Barbuda	Diamond Reef Marine Park	1973	2,000	(100)
	Nelson's Dockyard National Park	1984	3,108	--
	Palater Reef Marine Park	1973	500	(100)
Bahamas	Black Sand Cay Reserve	1988	0.5	--
	Conception Island Land and Sea Park	1971	850	(20)
	Exurna Cays Land and Sea Park	1958	45,564	(80)
	Inagua National Park	1963	74,333	(10)
	Lucayan National Park	1982	16	--
	Pelican Cays Land & Sea Park	1981	850	(80)
	Peterson Cays and and and Sea Park	1968	0.6	--
	Union Creek	1963	1,813	--
Barbados	Barbados Marine Reserve	1980	250	(100)
Belize	Crown Reserves (7 sites)	1977	5.6	--
	Half Moon Cay Natural Monument	1982	4,144	(95)
	Hol. Chan Marine Reserve	1987	1,300	(90)
British Virgin Islands	Flamingo Pond Bird Sanctuary	1977	449	--
	The Baths National Park	1987	3,250	--
	West Dog Island Forestry Park	1974	12	--
	Wreck of the Phone Marine Park	1980	323	(96)
Cayman Islands	Colliers Bay Pond	1976	32	--
	Meagre Bay Pond	1976	38	--
	National Marine Park System (with 24 non-contiguous units)	1986	10,000	--
	Westerly Ponds/Salt Water Ponds	1980	24	--
Colombia	Cienaga Grande de Santa Marta Wildlife Sanctuary	1977	23,000	--
	Corales del Rosario National Park	1977	18,700	(90)
	Haina Cay to Cotton Cay Nature Reserve	1971	3,600	--
	Isla de Salamanca National Park	1964	21,000	(61)
	Los Flamencos Wildlife Sanctuary	1977	7,000	--
	Sierra Nevada de Santa Marta National Nature Park and Biosphere Reserve	1964	383,000	--
	Tayrona National Nature Park	1969	15,000	(25)

Country	Protected Area Name	Year of Estab.	Hectares	(Marine %)
Costa Rica	Barra de Colorado Nat. Wildlife Reserve	1985	92,000	--
	Cahuita National Park	1970	1,700	(35)
	Gondoca Manzanillo Nat. Wild. Reserve	1987	9,449	--
	Tortuguero National Park	1975	18,947	(16)
Cuba	Bocanao Park	1986	19,700	--
	Cayao Caguanes	1986	12,500	--
	Cayao Cantiles	1986	6,800	--
	Cayao Coco – Cayo Guillermo	1986	27,188	--
	Cayao Guajaba	1986	10,445	--
	Cayao Largo	1986	37,500	--
	Cayao Romano	1986	82,554	--
	Cayao Rosario	1986	5,000	--
	Cayao Sabinal National Marine Park	1986	34,651	--
	Cuchillas del Toa	1986	--	--
	Desembarco del Granma National Park	1986	25,764	--
	Ensenada de Mora	1986	792	--
	Encambray Park	1986	187,400	--
	Habonica	1986	3,383	--
	Jibacoa-Bacunayagua	1986	30,000	--
	Peninsula de Hicacos	1986	107,704	--
	Peninsula de Saetia	1986	4,154	--
	Portillo	1986	448	--
	Punta Perdenales – Cabo Frances	1986	12,000	--
	Sierra Maestre National Park	1986	528,000	--
Dominica	Cabrits National Park	1987	360	(66)
Dominican Republic	Cabo Frances Viejo National Park	1974	--	--
	Ciudad de Puerto Plata National Park	1971	--	--
	East National Park	1975	43,400	--
	Jaragua National Park	1983	13,380	--
	La Caleta Sub-Marine National Park	1983	1,210	--
	Laguna Redonda y Laguna Limon Scientific Reserve	1983	1,210	--
	Litoral Sur de Sto. Domingo Nat. Park	1986	--	--
	Los Haitises National Park	1976	20,000	--
	Monte Cristi National Park	186	55,000	--
	Samana Bay – Silver Banks Mar. Sanct.	1986	--	--

Country	Protected Area Name	Year of Estab.	Hectares	(Marine %)
Guadeloupe	Grand Cul de Sac Marin	--	4,700	(100)
Guatemala	Biotopo Manambique	1986	35,000	--
	Rio Dulce National Park	1955	73,000	--
Honduras	Cuero y Salado Wildlife Sanctuary	1986	8,700	--
	Rio Platano Biosphere Reserve	1980	350,000	--
Jamaica	Montego Bay Marine Park	1974	59	(100)
	Morant Cays Managed Area	1907	12,000	--
	Ocho Rios Marine Park	1966	278	(100)
	Pedro Bank and Cays Managed Area	1907	1,000,000	(100)
Martinique	Reserve Naturelle de la Caravelle	1976	517	--
Mexico	El Garrafon Marine Park and Isla Mujeres	1980	--	--
	La Blanquilla Marine Park	1975	6,687	--
	Gancun-Nizuc-Isla Mujeres	--	--	--
	Arrecifes de Cozumel including Chankanaab Park	1980	76,800	--
	Isla Contoy Ecological Reserve	1970	700	--
	Ria Celestum	1979	59,130	--
	Rio Lagartos	1918	47,840	--
	Sian Ka'an Biosphere Reserve	1986	528,147	--
	Tulum National Park	1981	664	--
Montserrat	Fox's Bay Bird Sanctuary	1979	6	--
Netherlands Antilles	Bonaire Underwater Park	1979	2,600	(100)
	Curaçao Underwater Park	1983	1,036	(100)
	Flamingo Sanctuary	1969	55	--
	Saba Underwater Park	1987	--	(100)
	Simpson Bay Lagoon	--	1,250	--
	Spanish Lagoon	1980	70	--
	Washington-Slagbaai National Park	1969	5,900	--
Panama	Comarca Kuna Yala Biosphere Res.	1983	320,600	(12)
	Isla Bastimentos National Marine Park	1988	15,000	--
	Portobello National Park	1976	17,364	--

Country	Protected Area Name	Year of Estab.	Hectares	(Marine %)
Puerto Rico	Cabo Rojo National Wildlife Refuge	1974	237	--
	Culebra National Wildlife Refuge	1909	284	--
	Desecho National Wildlife Refuge	1968	145	--
	Estuarine Sanctuaries	1982	1,600	--
Saint Lucia	Maria Islands Reserve	1982	45	(0)
	Pigeon Island National Historic Park	1979	20	(0)
Suriname	Copie Nature Reserve	1986	28,000	--
	Coppename Mouth Nature Reserve	1966	10,000	--
	Galibi Nature Reserve	1969	4,000	--
	Peruvia Nature Reserve	1986	35,000	--
	Upper Coesewijne Nature Reserve	1986	37,000	--
	Wanekreek Nature Reserve	1986	43,860	--
	Wia-wia Nature Reserve	1961	36,000	--
	Reserve Naturelle de la Caravelle	1976	517	--
Trinidad & Tobago	Buccoo Reef & Bon Accord Lagoon	1970	650	(90)
	Caroni Swamp Wildlife Reserve	1982	7,900	--
	Kronstadt Island wildlife Sanctuary	1940	5	--
	Little Tobago Wildlife Sanctuary	1928	101	--
	Saut d'Eau Wildlife Sanctuary	1935	10	--
	Soldado Rock Wildlife Sanctuary	1934	6	--
	Southern Watershed Wildlife Sanctuary	1934	1,852	--
	St. Giles Islands Wildlife Sanctuary	1968	29	--
U.S.A. Southern Florida	Biscayne National Park	1968	41,120	--
	Everglades National Park	1947	566,796	--
	Florida Keys National Wildlife Refuge	--	60,066	--
	Fort Jefferson National Museum	1935	64,000	--
	J.N. "Ding" Darling National Wildlife Refuge	1945	20,000	--
	John Pennekamp Coral Reef State Park	1960	22,684	--
	Key Largo National Marine Sanctuary	1975	67,000	--
	Looe Key National Marine Park	1981	1,810	--
	Pine Islands, Matlacha Pass and Island Bay National Wildlife Refuges	1908	186	--
	Rookery Bay Nat. Estuarine Reserve	1978	38,000	--

Country	Protected Area Name	Year of Estab.	Hectares	(Marine %)
U.S. Virgin Islands	Buck Island National Wildlife Refuge	1969	20	--
	Buck Island Reef, St. Croix	1961	356	(80)
	Green Cay National Wildlife Refuge	1977	6	--
	Sandy Point National Wildlife Reguge	1974	149	--
	Virgin Islands National Park, St. John	1976	6,073	(33)
Venezuela	Archipielago Los Roques National Park	1972	225,153	--
	Cienaga de los Olivitos Wildlife Refuge	1987	24,200	--
	Cuare Wildlife Refuge	1972	11,825	--
	Henri Pittier National Park	1937	107,800	--
	Isla de Aves Wildlife Refuge	1974	4	--
	Juan Manuel de Aguas Blancas y Aguas Negras Wildlife Reserve	--	27,795	--
	Laguna de las Marites Nat. Monument	1974	3,674	(50)
	Laguna de Restinga National Park	1974	10,000	(15)
	Laguna de Tacarigua National Park	1974	18,400	(50)
	Las Tetas de María Guevara Nature Monument	1974	1,670	(20)
	Médanos de Coro National Park	1974	91,280	(54)
	Mochima National Park	1973	94,935	(52)
	Morrocoy National Park	1974	32,090	(60)
	Peninsula de Paria National Park	1978	37,500	--

III. MARINE POLLUTION: A THREAT TO SUSTAINABLE DEVELOPMENT

Building on the resource base

The marine and coastal ecosystems of the Caribbean Sea and Gulf of Mexico provide a major source of wealth that, directly or indirectly, supports millions of people. The region's near-shore coastal resources - beaches and coral reefs - are the basis for a thriving tourism industry, and the region's harvestable shell and finfish resources serve to support a spectrum of operators ranging from artisanal to highly mechanized, commercial enterprises catering to world market. New initiatives, such as the spider crab projects in the Dominican Republic and Turks and Caicos and while still in their pilot phases, could offer potentially rich rewards. Other innovative projects have been launched, including sea moss farming in St. Lucia, sea turtle aquaculwre in Suriname, a queen conch project in the Turks and Caicos Islands and a project at the Institute of Marine Affairs in Trinidad testing the feasibility of adapting the Malaysian prawn to the Caribbean environment. These projects share a common requirement for success: a physical environment that is relatively pollution-free and an institutional framework that is supportive of innovation and experimentation.

Pollution sources

Pollution from land-based and maritime activities, as well as from oil and gas extraction is impairing productive fisheries, as well as viable tourism areas and represent serious threats to sustainable economic development. Marine pollution stems from multiple sources within the territorial limits of the region. The different types of contaminants include petroleum and its derivates, mineral contaminants including those from plants for mineral processing, urban and industrial contaminants and agricultural contaminants.

Marine pollution prevails in many major ports - Havana, Kingston, San Juan, Veracruz, Cartagena, Puerto Cabello and Port-of-Spain[1]. Marine sediments in harbours retain substantial concentrations of heavy metals -copper, cadmium, chromium, lead, zinc and mercury- accumulated as a result of past waste disposal activities and discharge practices[43]. Dredging disturbs these contaminated sediments causing them to enter the water column where they are often ingested by marine organisms such as shellfish, thereby entering the food chain.

Some marine pollution stems from transboundary and extra-regional activities. The transboundary nature of marine pollution necessitates a common, regional approach for its assessment and control. The complexity of developing and implementing a regional assessment and control proce.ss requires an integrated approach at both the national and regional levels.

The assessment and control of marine pollution in the region calls for strong and substantial action. So far, the monitoring and research elements have received strong support. The CARIPOL programme for the research and monitoring of petroleum pollution in the Wider Caribbean region has been successfully operating for more than 10 years However, there is no similar data base for other pollutants, such as sewage, agrochemicals and industrial effluents.

1. LAND-BASED SOURCES OF POLLUTION

Throughout the region, land derived pollutants are degrading and destroying near-shore marine habitats, fouling recreational swimming areas and creating public health hazards. There is growing evidence that this type of pollution is accelerating as urbanization overtakes the capacity of existing municipal infrastructures. In general, the treatment of domestic sewage and industrial effluents is grossly inadequate. Only 36 percent of households within the Kingston Metropolitan Area are connected to municipal sewage systems. Similarly, sewage collection and treatment is available to only about 15 percent of the urban population in the Dominican Republic. Even where sewage infrastructures have been constructed, plant operation and maintenance are often inadequate, as are the monitoring of effluents and the enforcement of effluent standards.

Adding to pollution of the surface and ground water is leachate from the mounting volume of solid waste that is accumulating in poorly designed landfills that are frequently located in or near coastal swamps and lagoons. The Wider Caribbean receives waters and sediments from continental drainage systems including the Mississippi, Rio Grande, Magdalena and the Orinoco.

Adding to any impacts from these continental drainage systems are those stemming from the numerous watersheds of the insular Caribbean and of Central America, 70 percent of whose surface area drains into the Caribbean (Table 2). Conceivably, pollutants and sediments from as far distant as the Andes and the northern Great Plains of North America could reach the estuaries and embayments of the Wider Caribbean.

The potential for ecosystem contamination has been heightened by the increased use of agrochernicals in the region. As traditional agriculture gives way to farming practices that utilize large quantities of artificial fertilizers and a wide variety of pesticides, the dangers of ground and surface water contamination, as well as contamination of nearshore coastal waters from runoff increases accordingly.

Industrial effluents

A common source of pollution is effluent generated by the refining of sugar and the distillation of alcohol. These effluents contain a high amount of solid residues which cause an extreme oxygen demand and result in rapid environmental deterioration.

There are numerous examples of waste discharges resulting in massive fish kills. One such kill occurred during 1988 in the Gulf of Paria. A band of dead fish half a mile long and 1,000 feet wide was reported by Trinidad and Tobago's Institute of Marine Affairs. The fish kill was attributed to oxygen depletion associated with an outbreak of algal blooms in the Gulf.

In an effort to emulate industrialized economies and to diversify from dependence on commodity exports, some countries in the region have established heavy industries that are major point source generators of toxic pollutants. Whereas many of these same industries are subject to stringent emission controls in Europe or North America, such controls are not always applied in the region. Even when laws and regulations are enacted, there is often little capability to actively monitor and enforce air and water emission standards.

Overwhelmed by the need to treat domestic sewage, there is an almost total disregard of the dangers posed by industrial effluents. Chemical plants, automobile battery salvage operations, metal plating plants, petroleum refineries, printing plants, dry cleaning establishments, automobile filling stations and hospitals all, to some extent, produce highly toxic, non-biodegradable waste products that infiltrate into ground and surface waters or are directly discharged into the sea. Toxic chemicals (including chromates, zinc and cyanides) from the galvanizing operation near Belize City have caused extensive fish kills during the past several years. This example could be replicated throughout the region since programmes for the handling, storage and disposal of chemical, radioactive and toxic wastes are similarly inadequate.

With few exceptions, there is no effective enforcement of measures for the pretreatment of domestic sewage and industrial wastes before they are discharged into municipal sewers or directly into open water bodies. Among some of the worst polluters are industries which are owned or operated by the public sector, a circumstance which raises special problems for those governmental ministries or agencies charged with enforcing environmental standards. This is a

pressing problem for both the larger continental urban areas as well as for the governments of the insular Caribbean States and territories.

2. MARITIME ACTIVITIES

While land-based sources of pollution pose serious threats to the marine environment, shipping and maritime activities have also caused marine pollution problems. Oil spills, ballasting, tank washings and docking operations have contaminated marine and coastal ecosystems in many places throughout the region. In addition, the exploration and exploitation of sea-bed resources, raise particularly serious problems in hydrocarbon rich areas.

The Wider Caribbean region is potentially one of the largest oil producing areas in the world. The petroleum industry alone generates 70% of Venezuela's national income, and is critical to the economies of Trinidad and Tobago, Mexico, and the Gulf Coast States of the U.S.A. In addition to oil production, a steady stream of tanker traffic moves about 5 million barrels of petroleum through the area every day[12]. Ship traffic through the Panama Canal is among the world's heaviest. Tanker movements through narrow channels and in the vicinity of some ports increase the possibility of shipping accidents. About half of the oil pollution in the region is caused by local tanker traffic and ballast washings.

Impacts of marine pollution

Marine mammals, finfish, birds and shellfish are all severely impacted by hydrocarbon pollutants[46]. Floating tar from tanker ballast washings is ingested by the green, loggerhead, hawksbill and Kemps-Ridley turtles and remains in their digestive tracts for days. Mangroves exposed to chronic oil pollution show signs of defoliation and death. Aromatic and paraffin hydrocarbons are consumed and degraded by fish and crustaceans. Oysters, mussels and other benthic molluscs remove hydrocarbons from the water column by filtration but seem to lack the capacity to metabolize these compounds. Petroleum hydrocarbons have been detected in oysters from coastal Mexican lagoons and in birds from Galveston Bay, Texas. These are areas which are periodically affected by oil spills, as well as by oil discharges from terminal operations and tanker discharge.

Windward exposed coasts of islands and other land masses in the region have highly polluted beaches[4]. Many beaches in the Caribbean have average concentrations of tar in excess of 100 grams per metre of shore front making them virtually unusable for recreational purposes. Examples of heavy tar pollution occur in Curaçao, Bonaire and Grand Cayman. The situation in Grand Cayman is particularly poignant since this island's economy relies heavily on tourism and there is no local petroleum industry.

Figures 2, 3 and 4 show the geographic distribution of the most prominent forms of petroleum hydrocarbons found in the Wider Caribbean Region: dissolved/dispersed hydrocarbons (DDPH); beach tar; and floating tar balls that eventually could reach the coast.

Sea-bed drilling activities, whether exploratory or exploitative, often introduce foreign materials into the marine environment. Exploration for oil and gas and for mineral resources

inevitably requires the disposal of the sea-bed materials removed during drilling operations. The exploitation of petroleum and its by-products is often accompanied by leaks and spillage which occur during extraction, loading onto ships or feeding into pipelines.

Figure 2. Average Beach Tar Concentration/Location (glm)

Average concentrations of beach tar in grams per metre of beach front for each site sampled in the CARIPOL petroleum pollution monitoring programme. 77ze average concentration of each sample site is shown as shaded circle. SOURCE: Ref 19

Non-biodegradable materials, such as plastics and fishing nets made of synthetic materials also contribute to marine pollution in the region[10]. This marine debris, which stems primarily from waste disposal practices on ships, but also from land disposal, poses a threat to valuable marine species and to tourism. Marine mammals and fish may become entangled in marine debris or swallow it and can suffer injury or death as a result. With respect to tourism, visitors are often confronted by debris washed ashore on beaches or floating over coral reefs and in swimming areas.

Figure 3. Average Floating Tar Concentration/Location (mg/m)

Average concentration of floating tar in milligrams per square metre for each 1-degree square for which CARIPOL data exist. The average concentration of each square is shown as a shaded circle in the middle of that square (thus, some circles appear on land).
SOURCE: Ref. 19

Figure 4. Average DDPH Concentration/Location (ug/l)

Average concentration of dissolved/dispersed petroleum hydrocarbons (DDPH) in micrograms per litre for each 1-degree square for which CARIPOL data exist. The average concentration for each square is shown as a shaded circle in the centre of that square (thus, some circles appear printed on land). SOURCE: Ref. 19

3. TRANSBOUNDARY MOVEMENT AND DUMPING OF HAZARDOUS MATERIALS

Increasingly stringent regulations governing the disposal of hazardous wastes in industrialized countries could result in an increased movement of such materials to disposal sites within the Wider Caribbean region[44]. One recent incident was reported by the Government of Haiti when a vessel of international registry off-loaded ash near the seaside city of Gonaïves. Such wastes often contain heavy metals and other toxic substances which not only impair the quality of the resource base, but also accumulate in organisms consumed by humans, thereby posing a health hazard.

Evidence of transboundary shipments of toxic wastes for disposal within the Wider Caribbean region has given renewed urgency to the need for regional legislation dealing with this new and highly charged issue. In approaching the subject, care must be taken to distinguish between the movement of waste materials - such as waste paper, salvageable metals, other re-cyclable materials or waste fuel sources - and known toxic and/or radiological materials.

A number of Governments in the region have been approached by private disposers seeking to establish disposal sites within their territorial borders, often for considerable sums of money. This situation is being monitored by the Organization of American States (OAS), the Pan-American Health Organization (PAHO) and the Caribbean Conservation Association (CCA) and is receiving the co-operation of the signatory States to the Cartagena Convention. The seriousness of this issue gives added incentive to early consideration of a draft protocol under the Cartagena Convention on waste disposal as it affects marine and coastal environments.

In a joint effort, IOC, IMO and UNEP are co-operating on technical aspects in order to strengthen the original institutional capabilities in response to waste managements requirements. A seminar convened in Mexico in September 1987 produced specific recommendations in that regard.

It must be frankly acknowledged that many countries throughout the world dump some of their wastes at sea, including dredged materials and hazardous substances. With respect to the Wider Caribbean, very little information is available on intentional ocean disposal of wastes, the nature of these wastes and the frequency and location of disposal.

IV. CO-ORDINATION, INFORMATION AND INSTITUTIONAL DEVELOPMENT

1. SOCIO-ECONOMIC SUPPORT

The States and territories of the region face an overwhelming array of environmental problems resulting from intensive exploitation of coastal and marine resources coupled with ineffective and often, inappropriate approaches to development planning.

Beset by economic problems and financial pressures, many of the States and territories of the Wider Caribbean, while frequently paying homage to the spirit of environmental protection, have done very little to implement effective resource management programmes. Admittedly, the constraints to putting such programmes into place are formidable. Among those constraints are the following:

- weak political support from the aeneral populace;
- inadequate budgets for environmental agencies;
- lack of trained personnel and equipment;
- uncertainty as to the appropriateness of standards to be adopted;
- judicial systems that are unsupportive of environmental policies and programmes; and
- reluctance in many of the States and territories to confront powerful economic interests.

The extent of effort that will be required to overcome these constraints should not be minimized. Those agencies currently responsible for environmental protection are generally subordinate to other agencies whose mandates focus on development. It is unfortunate, but it must be acknowledged that environmental protection has often been associated with "no growth" rather than with sustained economic development. When the efforts of government are directed to increasing production, raising crop yields or generating more tourism, environmental considerations are relegated to secondary status. It is not until the occurrence of an “event”, such as a fish kill or the contamination of a ground water source, that urgent calls go out to the environmental agency to "do something" to correct the situation.

The "panic reaction" by governments to environmental problems is no longer justifiable. Warnings and admonitions have been sounded for decades. Serious attempts to deal with environmental problems may require institutional restructuring and a financial commitment to meaningful action by national and regional organizations, particularly with respect to speeding scientific applications in agriculture, adapting waste management technologies to local conditions and by searching out and publicizing successful examples of environmental mitigation.

In this process, key conceptual issues will have to be resolved, especially the need to clarify, in programmatic terms, what long-term sustainable economic growth entails. Does economic transformation without environmental degradation mean slower overall development? Is this politically viable? What are the trade-offs between rapid, short-term economic gain and sustained long-term development? Who benefits, and to what extent? Which resource components should receive priority attention and infusions of research and development funds? Above all, how can the economic benefits of restoring degraded ecosystems be convincingly demonstrated to political directorates?

2. LEGISLATION

Increasingly international law is being enacted in matters of environmental protection and natural resource conservation. This is particularly true when one country's actions (or in actions) impact on the resources of neighbouring States and territories. Because of the great commonality of problems, it is imperative that the Governments of the Wider Caribbean harmonize environmental and resource conservation legislation so as to promote sustainable development within a regional perspective without ignoring local or country specific needs. Some of the subject areas which merit attention with respect to regional legislative initiatives are oil, pollution, marine dumping of hazardous or noxious pollutants, sewage disposal, habitat, wildlife conservation and the control of marine waste.

Meaningful environmental legislation should be based on sound research and must be accompanied by practical mechanisms for enforcement. Institutional capacity to administer the regulations and a public commitment to enforce the laws are essential if those laws are to be effective.

Coastal land use planning needs to be strengthened as do the institutional arrangements for land use management. Natural resource conservation and environmental protection objectives need to be more effectively integrated into the planning and permitting processes. Existing practices have to be brought into line with state-of-the-art professional and technical knowledge.

3. TRAINING, EDUCATION AND PUBLIC AWARENESS

Despite an enormous need for environmental trainina and education, there is little sharing of information and experience on problems and issues of common concern among the institutions of the region. While many of the region's institutions of higher education offer numerous science-oriented courses, very few offer the training in resource management which is desperately needed to cope with the region's environmental problems. For the islands particularly, much of the professional training takes place in continental countries with very different institutional, climatic and cultural conditions. There is an untapped potential for regional institutions to pool their resources in the natural resources area, thereby reducing the dependence on extra-regional institutions. The work of the Consortium of Universities for Natural Resources Management represents an important new initiative in this area, bringing together the various universities of the English, French, Spanish and Dutch speaking Caribbean.

Inadequate sharing of environmental information also occurs among development banks, aid agencies, environmental ministries and agencies. The result is an all too frequent duplication of effort and needless expenditure of funds. Exchange of information and data produced by environmentally-oriented projects can focus regional sensitivities on environmental problems, helping to reduce costs and creating a larger pool of information that might otherwise be available in any one country.

General public awareness of regional environmental issues remains limited to rather narrow circles of professionals and academics. The successful implementation of environmental programmes requires a strong public constituency. However, despite the efforts of the Caribbean Conservation Association and other organizations focusing on public awareness, there is still little sustained support for environmental policies and programmes on the part of the general electorate in many countries of the region. There is a pressing, need for a multiplicity of skillfully designed and executed public educational campaigns throughout the region. Without popular localized support, the ability of Governments to respond to the myriad of problems highlighted in this overview will be severely hampered.

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