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Caribbean Sea large marine ecosystem

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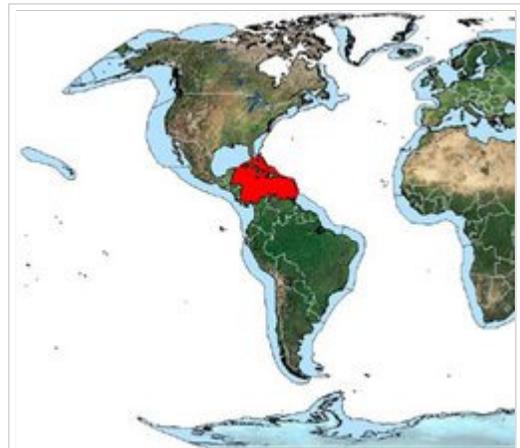
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Introduction

The Caribbean Sea Large Marine Ecosystem (LME) is a semi-enclosed sea located in the Western Hemisphere between North and South America, and bounded by Central America to the west. It encompasses an area of 2,515,900 square kilometers and is the second largest sea in the world. It is noted for its many islands, including the Leeward and Windward Islands situated on its eastern boundary, Cuba, Hispaniola, Puerto Rico, Jamaica and the Cayman Islands. There are numerous banks and breaking shoals. The LME is comprised of four deep basins: the Venezuelan Basin in the east, the Colombian Basin in the west (from which it is separated by a ridge), the Cayman Trough in the northwest, and the Yucatan Basin in the north. For information about water depths, see Richards and Bohnsack, 1990. There is little seasonal variation in surface water temperatures. Temperatures range from 25.5 degrees Celsius in the winter to 28 degrees Celsius in the summer.

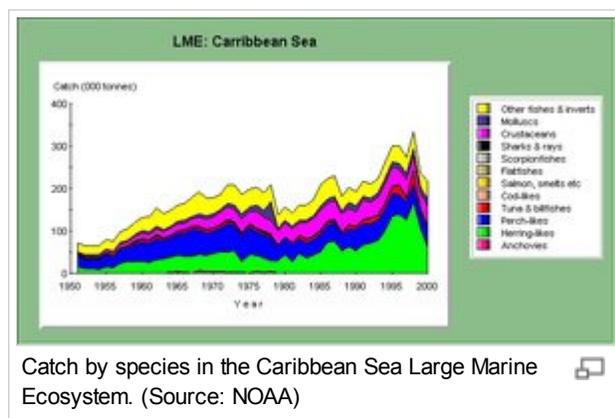


Location of the Caribbean Large Marine Ecosystem. (Source: NOAA)

Productivity

The Caribbean Sea LME is considered a Class III, low ($<150 \text{ gC/m}^2\text{-yr}$) productivity ecosystem, according to SeaWiFS global primary productivity estimates, although upwelling along the northern coast of Venezuela contributes to relatively high productivity in that area. Other factors contributing to the greater productivity of South America's northern coast are the nutrient input from rivers and estuaries. The remaining area of the LME is mostly comprised of clear, nutrient-poor waters (see Richards and Bohnsack, 1990). A key component of the shallow water ecosystem are the coral reefs of the Caribbean Sea (for a description, see Milliman, 1976, and Glynn, 1976). Living corals are made mostly by calcium-secreting corals and thrive in clear, oceanic, shallow, low-nutrient waters, with plenty of sunlight and warm temperatures. Coral growth can be limited by high turbidity, exposure to fresh water or air, extreme temperatures, pollution, and excess nutrients. There is some background information available on this area thanks to a multidisciplinary study called the Cooperative Investigations in the Caribbean Sea and Adjacent Areas (CICAR), which was completed during the 1970's (see Richards and Bohnsack, 1990). There is still a need for better understanding of the role of physical and biological offshore processes.

Fish and Fisheries



The Caribbean Sea LME produces an estimated catch of ½ million metric tons (1987 FAO report for 1985). Venezuela accounts for 53.5%, Cuba for 16%, Guyana for 8%, and the Dominican Republic for 3%. The remaining 34 countries account for 2% or less. Since most of the fishing is artisanal, it is likely that a substantial proportion of the catch is unreported. The principal modes of fishing are traps and handlines, with some netting and spear fishing. Over 170 species are caught for commercial purposes, but most of the catch is comprised of less than 50 species. Venezuela has the higher catch due to higher productivity in that area (see productivity paragraph), the size of its shelf and a

pelagic fishery that includes yellowfin tuna and swordfish. The principal species harvested in the Caribbean Sea LME are spiny lobster (*Panulirus argus*), coralline reef fishes, and conch. Spiny lobster is one of the most valuable species of the Caribbean. There is concern over the long-term sustainability of spiny lobster due an increase in fishing effort. In some areas the minimum legal size is well below the size of reproductive maturity (see Richards and Bohnsack, 1990). Coralline reef fish are a major fishery. Reef fish while centered in the Caribbean range as far as southern Florida and the Bahamas. The U.S. Caribbean Fishery Management Council recognizes 65 shallow-water species with economic importance (see Richards and Bohnsack, 1990). Traps are the primary means for catching reef fishes and crustaceans. The conch fishery has collapsed in many Caribbean areas and it is unlikely this catch can be sustained. Richards and Bohnsack (1990) report a decline of catch per unit effort. Several species of sea turtles are threatened or endangered in many areas in the Caribbean as a result of overexploitation. The University of British Columbia Fisheries Center have detailed fish catch statistics for this LME.

Pollution and Ecosystem Health

The Caribbean Sea Large Marine Ecosystem is showing signs of stress, particularly in the shallow waters of coral reef systems. There have been unexplained episodes of massive coral bleaching and coral deaths. Coral growth can be limited by high turbidity, exposure to fresh water or air, extreme temperatures, pollution, and excess nutrients. Corals are essential to reef growth and help prevent erosion. Large sections of reefs are smothered by macroalgae (see Richards and Bohnsack, 1990). Bleaching may be due to an increase in water temperatures. Bleaching occurs when the coral expels its resident symbiotic algae. Two other diseases affecting coral are white band disease, which killed 90% of *Acropora palmata* off Buck Island, St. Croix, U.S. Virgin Islands, and black-ring disease. Coral reef degradation is caused by increased sedimentation, anchor damage, excess nutrients, ship groundings, storms, hurricanes, and diver contact (see Richards and Bohnsack, 1990). Massive reef fish mortalities occurred in August 1980, following Hurricane Allen. The cause of death was not determined. The mass mortality of the sea urchin *Diadema* spp. in 1983 also remains unexplained. Land development, as well as an increase in population and tourism, are contributing to the area's environmental degradation. There are signs of overfishing of the reef resources. Fish kills, oil pollution, and land erosion resulting from deforestation are other forms of pollution (see Richards and Bohnsack, 1990). For information on biological diversity and pollution issues in this LME, see UNEP's Caribbean Environment Program site.



Socioeconomic conditions



The Caribbean Sea Large Marine Ecosystem. (Source: NOAA)

Many of the countries of this LME are poor and overcrowded. Because the Caribbean climate is so suitable for year-round tourism, many locals are pursuing it as a means of earning their living. The importance of the tourism industry is attested by the number of cruise ships in the area. The cruise industry has expanded tremendously in the last couple of decades. While tourism is expected to increase, it is not always reliable and consistent from year to year, especially since the Caribbean region is prone to hurricanes. The increase in tourism is also expected to contribute to more environmental degradation. Caribbean economies need to diversify. For information on tourism, see UNEP's Caribbean Environment Program site.

Governance

As many as 38 countries and dependencies border the Caribbean Sea Large Marine Ecosystem, and need to address the numerous transboundary issues existing in this LME. The fragmented nature of coastal and marine resource management is a legacy of the colonial past. The languages and cultures of the foreign occupiers (Spain, Great-Britain, France, the Netherlands, and the USA) were different, as were the management systems and laws they bequeathed to these territories, most of which are now independent and democratic. There is presently a lack of coordinated support among the 38 Caribbean nations for ecosystem monitoring and management. Efforts of individual countries will not be as effective as a holistic approach by all countries. These countries vary in their levels of education and economic development. One proposed solution to the fisheries overexploitation problem is the creation of marine fishery reserves (see Richards and Bohnsack, 1990). A study (see Roberts et. al., 2001) provides two key pieces of new evidence that fully protected marine reserves can replenish fisheries beyond their boundaries. Marine experts are developing a project for the sustained management of shared marine resources. There is a need in this region to share a knowledge base, harmonize legislation and effectively enforce regulations. It will be necessary to improve public awareness and involve the resource users in the management process. Institutional reform will help bridge the gap between national and regional efforts. Regional organizations exist, such as IOCARIBE, whose members are the Bahamas, Barbados, Belize, Colombia, Costa Rica, Cuba, the Dominican Republic, France, Guatemala, Haiti, Jamaica, Mexico, Nicaragua, Panama, St. Lucia, the Netherlands, Trinidad and Tobago, the United Kingdom, and the USA.

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