

## THEMATIC REPORT FOR THE CENTRAL/SOUTH AMERICAN SUB-REGION

Prepared for the CLME Project

by

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# 1 INTRODUCTION

The Caribbean Sea Large Marine Ecosystem is a semi-enclosed tropical sea bounded by North America (South Florida), Central and South America and the Lesser Antilles island chain (Figure 1). The region includes 26 countries and 19 dependent territories of the USA, UK, France and the Netherlands, from the largest (e.g. Brazil and the USA) to the smallest (e.g. Barbados, St. Kitts and Nevis) in the world, and from the most to the least developed. Throughout the region, there is high dependence on living marine resources for food and livelihoods, particularly from fishing and tourism. As such, the sustainability of its living marine resources is of considerable socio-economic importance to most of the countries in the region.

The ocean circulation patterns in the Caribbean Sea and the transboundary nature of its living marine resources give rise to significant linkages among the region's coastal and marine areas and living marine resources. This requires a collaborative approach among the countries for addressing the problems facing the region's living marine resources. The countries, in collaboration with IOCARIBE and the Centre for Resource Management and Environmental Studies of the University of the West Indies, have obtained the support of the Global Environment Fund (GEF) to develop a project that will provide the opportunity for the implementation of management reforms that will permit sustainable development and management of the shared living marine resources of the CLME and adjacent regions. Since most of the living marine resources of the CLME are shared in some way, these reforms can be expected to lead to improved food security and enhanced livelihoods, especially in coastal communities that rely on fisheries and tourism (CLME Project Coordinating Office, 2006).

This Thematic Report outlines the key transboundary living marine resources issues for the Central/South American sub-region, their environmental impacts, socio-economic consequences, major causes, knowledge gaps, and proposes options for addressing these problems. For the purposes of this report, the Central/South American sub-region is considered as the marine area bounded by Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Mexico (Quintana Roo), Colombia and Venezuela (Figure 1).

The report provides information on productivity, fishes and fisheries, pollution and ecosystem health, socio-economics and governance. It focuses on shared living marine resources, in relation to the following:

- Migratory resources – coastal and oceanic pelagic species;
- Resources with transboundary distribution as adults (some demersal species);
- Resources with transboundary larval stages (such as lobster, conch);
- Dispersion of pollutants and exotic species;
- Resources with trans-boundary trophic linkages.

## **2 DESCRIPTION OF THE CENTRAL/SOUTH AMERICAN SUB-REGION**

This section provides an overview of the Central/South American sub-region, including its geographical characteristics, ecological status, and socio-economic situation.

### ***2.1 Physical and Geographical Characteristics***

The Central/South American sub-region borders the western part of the CLME, and extends from the shoreline to the 200 mile Exclusive Economic Zone (EEZ) of the countries. The coastal and marine areas as well as the distribution of the pelagic and demersal fisheries resources show very similar characteristics.

Like the rest of the LME, the sub-region has a tropical climate. The marine areas are influenced by the Caribbean Current, which transports water northwestwards through the Caribbean Sea. The flow turns sharply westward as it crosses the Cayman Basin and enters the Gulf of Mexico as a narrow boundary current, the Yucatan Current, which hugs the Yucatan Peninsula (Fratantoni, 2001). The circulation in the Caribbean experiences much variation in both space and time, some of it in the form of mesoscale eddies and meanders. In the southwestern Caribbean, there are no geographical limitations to the Caribbean Current, so it is wide and with large eddies in this area. On meeting the Mosquitos Bank off Nicaragua, the Caribbean Current turns towards the coast and downwards, producing a continuous counterclockwise circulation (Anisimov *et al.*, 1986). This current is stronger in the latter part of the year (Carleton *et al.*, 1979).

The strongest flow in the Caribbean Sea is found across the southern third of the sea (Gordon 1967; Kinder 1983). In this area, the highest surface velocities can reach 70 cm s<sup>-1</sup> along the coasts of Venezuela and the Netherland Antilles (Fratantoni 2001). There are also strong (60 cm s<sup>-1</sup>) currents along the Panamanian and Colombian coasts, but there is little flow over the Central American Rise, since most of the northwestward flow gets channeled through a trough southwest of Jamaica. The winds in the Caribbean Sea region generate a circulation cell where deep waters upwell along the north coast of South America and surface waters (enriched by upwelling and by discharges from the Orinoco River) are advected northwards into the region, especially during the rainy season.

The river basins of Colombia and Venezuela (Magdalena, Orinoco and Catatumbo rivers) have a significant influence on the Caribbean Sea (Sierra-Correa, 2001; INVEMAR, 2003).

### ***2.2 Ecological status***

#### **2.2.1 Productivity**

The Caribbean Sea LME is considered a Class III, low productivity ecosystem (<150 gCm<sup>-2</sup>yr<sup>-1</sup>), based on SeaWiFs global primary productivity estimates (NOAA, 2007). Exceptions are the plumes of the continental rivers, the localized upwelling zone

off northwestern Venezuela, and nearshore habitats such as coral reefs, mangroves, and seagrass beds.

Most of the coastal and marine environments and ecosystems of the tropical Western Atlantic are represented in the Central/South American sub-region. The principal aquatic ecosystems are coral reefs, seagrass beds, mangrove and coastal lagoons, beaches, rock reefs, cliffs, and estuaries. Coral reefs are scattered over the Colombian continental platform, forming atolls and wide chasms in the San Andres and Providencia archipelago. Along the continental coast, there are small fringing and patch reefs, while around the Rosario and San Bernardo archipelagoes and around Isla Fuerte there are extensive coral reefs (Diaz *et al.*, 2000; Penchaszadeh *et al.*, 2000). The Colombian coral reefs have a low density of economically valuable marine species.

The Central American States and Mexico's Quintana Roo State are characterized by diverse environmental features, including low-lying terrain, highly permeable rocks (Mexico), barrier reefs, and coastal wetlands (Gobierno de Quintana Roo, 2002). Their biodiversity represents the confluence of the flora and fauna from two biogeographical regions, the Nearctic of North America and the Neotropical of South and Central America, including the Caribbean. In the Central American area, the Meso-American Barrier Reef off Belize is the second largest in the world after the Great Barrier Reef of Australia. The wide zone of Cayos Miskitos in Nicaragua and the Honduras platform are also some prominent features of the sub-region. However, these have not been adequately described in the scientific literature (Colin, 1988).

Oceanic fronts in the sub-region are generated by coastal wind-induced upwelling off Venezuela and Colombia (Belkin *et al.*, 2005). A front of about 100 km long dissects the Gulf of Venezuela along 70°40'W, likely caused by the brackish outflow from Lake Maracaibo combined with coastal upwelling. A 200 km-long front in the Gulf of Honduras peaks in winter, likely related to a salinity differential between the Gulf's apex and offshore waters caused by high precipitation in southern Belize (Heyman and Kjerfve, 1999).

### **2.2.2 Fish and fisheries**

Fishing is of economic, social, and cultural importance to the populations of the Central/South American Sub-Region. Most of the coastal communities practice some type of fishing, capture or collection of marine species, both for food and for commercial purposes. Because of the high energy coast, where the Northeast Trade Winds blow year round, fishing in the open sea is carried out mainly by industrial fleets for high value species. Artisanal fishing is mainly carried out in the coastal lagoons and in coral reef areas. Among the wide diversity of commercially valuable species in the sub-region are penaeid shrimps, lobsters, conchs, snappers, sea basses, and pelagic species (of lesser importance).

Due to their biological cycles, their population dynamics, and their dispersion throughout the Central/South American sub-region, the major fisheries species have some degree of

transboundary linkage, include trophic linkages, either in their larval or adult stage. For instance, the lobster larvae initially feed on plankton as they drift in the ocean for almost one year, then consume another type of food when they settle, and finally consume carrion as adults. This trophic shift is not exclusive of lobster. The large pelagic fishes travel over greater spaces than the lobster, during which they switch food types not only by zones, but also by trophic link and, even though they could consume multiple food types, they could obtain most of their nutrition from only one source (Borer *et al.*, 2005). Some studies suggest that sea bass associated with coral patches have a significant predatory impact on the night fodder crabs of adjacent seaweed beds, indicating an important trophic link between tropical coral patches and the marine seaweed habitats (Eggleston *et al.*, 1998).

Although there is greater information availability in the Central American countries (ANNEX I), available landing statistics show that the majority of the countries have maintained very productive fisheries (Table 1). Due to the fact that the problems and pressures on the different species are very specific, information on these fisheries is presented separately for each one:

Shrimp: The industrial shrimp fishery is the most important fishery in the sub-region. With the exception of Mexico, Belize, Costa Rica, and Panama, all the countries have important industrial shrimp fisheries in the Caribbean Sea. The main species captured in the sub-region are: *Farfantepenaeus brasiliensis*, *Farfantepenaeus notialis*, *Farfantepenaeus subtilis*, *Litopenaeus schmitti*, and *Xiphopenaeus kroyer* (Carpenter, 2002). The biology of these species has been widely described (Gulland and Rothschild, 1984; Garcia and Le Reste, 1986).

Venezuela, Nicaragua, and Honduras are the major shrimp producers in the sub-region (Table 1), as a result of the greater expanses of trawlable areas on their continental platforms. Guatemala, Costa Rica, and Panama do not have important shrimp fisheries in the Caribbean Sea, and in Colombia available information indicates a capture of 650,000 kg in the Atlantic, even though the majority of the captures take place in the Pacific Ocean (Espinal *et al.*, 2005).

Trawling for demersal species is having a great impact on the benthic habitats and non-target species, such as in the case of shrimp fishing, in which shrimps represent less than 10% of the total catch. Also of concern is post-harvest loss caused by the shrimp boats' limited carrying capacity, which is a reflection of the design, size, operational system, and operation costs (FAO, 1982). Despite their low mobility, there is evidence that shrimps have a transboundary migratory pattern, which implies the need for joint management in the countries sharing these stocks. Measures to address the overfishing of shrimp include spatial or temporal prohibition of fishing, and improving the socio-economic situation of the fishers and the personnel involved in processing.

Lobster: The spiny lobster fishery is one of the most valuable fisheries in the sub-region. In Central America, the first export records are from the 1950s, but it was not until the 1960s that the capture and exportation of this crustacean was done in a systematic way,

especially for USA markets. At the end of the 1960s, a Fisheries Development Project was conducted by the United Nations Development Programme (UNDP) and the Food and Agriculture Organization (FAO), in which exploratory cruises were carried out to determine with greater precision the relative abundance and distribution of the lobster in the Central American Caribbean region (Giudicelli, 1971). This led to the development of the commercial fishery for lobster, exclusively by divers and with nets.

Both artisanal and commercial methods (traps – wooden bag nets and ‘casitas’, and use of ‘hookah’ and SCUBA) are employed sequentially in the lobster fishery, with the artisanal fishers targeting the younger lobsters and the industrial fishers targeting the adult population. The most important species captured in the Central/South American sub-region is *Panulirus argus*, followed by *P. guttatus*, and *P. laevicauda* (Carpenter, 2002). During the last three years, the lobster has been the only species captured in all the countries, with Nicaragua having the highest landings (1.3 million kg) followed by Honduras and Quintana Roo (Table 1). These countries have wide continental platforms, which provide suitable conditions for the settlement and growth of the larvae.

Lobsters are transboundary resources owing to the long duration of their larval stage (8 – 12 months), which are dispersed over wide geographic areas by oceanic currents. The life cycle of the Caribbean spiny lobster has been widely described (Riveros, 1972; Olsen and Koblic, 1975; Bowen, 1980; García, 1980; Marx and Hernnkind, 1986; Cruz, 1987; Colin, 1988; Phillips *et al.*, 1994). Research conducted in Nicaragua has shown that the peak spawning periods (Martínez, 1997), as well as peak recruitment take place in June, when more young individuals are caught (Barnutti, 2000; Barnutti, 2001; FAO, 2003a). These life cycle studies reveal the possibility that larval transportation by oceanic currents is an important mechanism in the recruitment of lobster to fisheries in areas distant from the spawning grounds (Ehrhardt, 1994).

During the recruitment phase, the young lobsters remain in shallow waters, where they are easily caught by divers in large quantities. Because of their high price, these small lobsters are sold illegally in the USA. Spawning females captured in deeper waters with bag nets are manipulated to remove the eggs, causing severe disruption of their biological cycle. Controls to prevent illegal fishing or to prevent the sale of females with eggs are inadequate. Exchanging lobsters for drugs at sea has become a routine practice. The degradation of critical habitats over corals and submarine vegetation, in which the settlement of the puerulus larval stage takes place, has also contributed to the decline of lobsters in the sub-region. Due to the wide distribution of lobster, including its widely-dispersed larvae stage, it must be jointly managed by all the countries that exploit this resource.

The only regional initiative to harmonize fishing for lobsters has been developed by OSPESCA, during the workshop called “Regional Alternatives for a Harmonious Administration of Spiny Lobster Fishing, Based on Joint Actions”. In this workshop Honduras and Nicaragua reached an agreement to harmonize the prohibition, sizes, and other management measures, supported by the other participating countries, among which were Belize, Bermudas, and Colombia.



Conch: The conch species of highest commercial interest in the Western Central Atlantic are: *Strombus gigas* (queen conch), *S. costatus*, *S. pugilis*, and *Melongena melongena* (Fischer, 1978). Queen conch is the most important species and of which the biology is best known (Hesse, 1979; Brownell and Stevely, 1981; Botero, 1984; Appeldoorn, 1988; Rathier, 1992). Within the sub-region Quintana Roo has the highest catch of queen conch (Table 1). The catches by other countries are more modest, since they have been obliged by the Convention on International Trade in Endangered Species (CITES) to reduce their catches and in some cases, to close the fishery - as in Honduras, which in 2002-2003 caught more than 1 million kg of queen conch.

Queen conchs are generally found at shallower depths than lobsters. Their adult phase is strictly herbivorous, feeding on algae and seagrass. It has been reported that more than 52 species of food items are consumed, mainly green algae (Suárez *et al.*, 1990). Since this type of food is always found in shallow waters where capture by divers is easier, this factor might contribute to their over-exploitation. Also, the easier access to conch in shallow waters provides an alternative to lobster fishing or to incidental fishing. This has caused a great impact on conch, resulting in the closure of several of the most important fisheries in the Caribbean. The traditional queen conch banks are found in the Bahamas, Turks and Caicos, Honduras, Grenada, Mexico, and Belize.

Excessive fishing effort for queen conch is a severe problem throughout the Caribbean, especially due to the decrease in its abundance as a consequence of the increase in its value during the last few years. This requires strict management measures, as in the case of Venezuela and other countries where some fisheries have been closed. The queen conch is a transboundary resource that is dispersed in the larval phase, therefore its management must be approached jointly by the countries in which it is exploited.

Demersal species: Some demersal species such as red snapper, sea basses, and groupers are important fisheries resources in the sub-region. These include the red snapper (*Lutjanus campechanus*), cherna rojo (*Epinephelus morio*), Nassau sea bass (*E. striatus*), Goliath sea bass (*E. itajara*), red drum (*Sciaenops ocellata*), and the besugo (*Rhomboplites aurorubens*). Other commercially important snapper species such as *L. guttatus*, *L. analis*, and *L. synagris* are also captured throughout the sub-region. The condition of the majority of the species of lesser commercial importance is unknown (Carpenter, 2002). Some demersal species are transboundary in their adult phase, migrating from the spawning areas – in the open sea or coral reefs – towards nursery areas, which could be within one or more countries.

With few exceptions, the snapper and sea bass fisheries are conducted by artisanal fishers and using primitive gear and boats. Venezuela has the highest landings of snappers, which amounted to more than 3.8 million kg in 2003 (FAO, 2005b), followed by Honduras and Nicaragua (Table 1). The Central American countries do not have important fishing industries for this resource and only Honduras targets snappers. Nicaragua's export to the USA was 1.8 million kg of snappers and 52.7 million kg of sea basses, which included the catches from the Pacific Ocean (Rivera *et al.*, 2005). In Colombia the catches also contain species from the Pacific Ocean, therefore they are not

included. In 2003, Quintana Roo landed around 258 thousand kg of different snapper species and 799 thousand kg of sea bass and other similar species (CONAPESCA, 2003).

In countries such as Mexico, Colombia, and Venezuela there are very precise regulations to control exploitation of demersal species of commercial importance, while in the other countries there is no specific regulation for such species. In Central America – with the exception of Honduras – these species are not fully exploited since there are no fisheries specifically targeting them.

Pelagic species: In the Central/South American sub-region, a number of pelagic species are of commercial importance, for direct consumption, as well as for sport and industrial fishing. In this report, only the large pelagic resources are considered, given their transboundary and/or highly migratory characteristics. The species of large tunas found in the sub-region are: *Thunnus alalunga*, *T. albacares*, *T. atlanticus*, *T. obesus*, and *T. thynnus*, as well as their smaller relatives *Auxis rochei rochei*, *Euthynnus alletteratus*, and *Katsuwonus pelamis* (Carpenter, 2002). Other important species are: *Scomberomorus brasiliensis*, *S. cavalla*, *S. maculatus*, and *S. regalis*, which are exploited at the local level, as well as the species captured in sport fishing such as *Istiophorus albicans*, *Makaira nigricans*, *Tetrapturus albidus*, *T. pfluegeri*, and *Xiphias gladius*, which is a cosmopolitan species (Carpenter, 2002).

Table 1 shows the landings of pelagic species in the Central/South American sub-region. These catches do not include only tunas, and in the case of Venezuela, the figures correspond only to mackerels and jack since, as in Colombia, the largest tuna catches come from the Pacific Ocean. Venezuela has the highest landings of pelagic species (5 million kg) followed by Nicaragua and Quintana Roo (729 thousand and 461 thousand kg, respectively), which shows the importance of these fisheries in these countries. The Central American countries capture mainly mahi-mahi (dolphinfish - *Coryphaena hippurus*) and tuna fishes in the Pacific Ocean; in the Caribbean Sea they capture mainly mahi-mahi, swordfish, sailfishes, marlin, jacks, and sharks.

As can be deduced from Table 1, with the exception of Venezuela, the sub-region's large pelagic fisheries can be considered modest and are under-exploited, especially in the Central American countries. The coastal communities have limited access to these resources due to a lack of appropriate fishing and navigation equipment, illiteracy, poverty, and lack of government attention to these communities. In contrast to the insular States that depend more on the pelagic species for consumption and trade, the Central/South American continental countries obtain larger catches of demersal or coastal pelagic species – such as sharks, snook, and sea trouts - very close to the coast or in inshore lagoons, using artisanal gear and methods. Recent strategies to exploit the large pelagic resources as well as the technical support from extra-regional countries may promote the exploitation of these species, not only as a food source, but also for sport fishing, which is increasing in the whole region. Measures to harmonize the management of sport fishing are being developed and are expected to help in the conservation of these species.

The migratory nature of these resources gives rise to important transboundary linkages with the problems and activities of other continental and insular countries, where the high exploitation of pelagic species has had an impact on their size and abundance. It is very likely that this has also affected the abundance and availability of these species in the countries where they are not fully fished. In most of the countries the regulation of the pelagic fisheries is not very specific, and in some cases, even non-existent. There are also cases of foreign vessels that have not complied with their contracts due to the deficient monitoring and vigilance of their fishing activities.

Turtles: The sea turtle species found in the sub-region are *Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata*, *Dermochelys coriacea*, as well as *Lepidochelys olivacea*, found mainly in Colombia and Venezuela (Carpenter, 2002). In spite of the fact that turtles are no longer commercially exploited in the Central/South American sub-region, their meat and eggs are still used for subsistence consumption. Harvesting of turtles takes place mainly by the Miskito ethnic group of Honduras and Nicaragua. In Nicaragua more than 11 thousand turtle are consumed annually, while in Costa Rica, more than 4 million eggs are consumed each season (Troëng and Drews, 2004). In the reefs and the channels between them, the capture of turtles is common, especially the green (*C. mydas*) and the hawksbill (*E. imbricata*). The exploitation and subsistence consumption of the green turtle is an ancient tradition, while the hawksbill shell is used in gold and silver jewelry and other objects that have a high demand in national and international markets.

Almost all the marine turtle species are in danger of extinction, despite the fact that most of the countries have some type of regulation for the consumption of turtle meat and eggs. In addition to direct captures for food, incidental capture in non-selective fishing gear such as longlines, gillnets, and shrimp trawl nets poses another threat to turtles. This problem should be addressed at the regional level, since it exists in almost all of the countries of the region, and is linked to other activities that promote, not only the catching of turtles, but the overfishing of other species and the degradation of the region's habitats. The lack of a feasible and sustainable nutritional alternative for the indigenous human populations of the Caribbean continental countries aggravates the problem. The key sectors that contribute to this problem are mainly the shrimp trawler fishers, the artisanal fishers, the native groups that consume their meat and collect the eggs for sale among the indigenous population. Important protection and re-population efforts have been made in Mexico, Costa Rica, Colombia, and Venezuela, which provide good examples and experiences for transfer to the other countries of the sub-region.

### **2.2.3 Pollution and ecosystem health**

The coastal and marine environment and the living marine resources of the Central/South American sub-region are greatly influenced by socio-economic activities, especially on land. These activities are associated with sectors such as urbanization, tourism, industry, agriculture, forestry, aquaculture, fishing, and shipping. Marine pollution is mainly the product of the discharge of municipal and industrial solid wastes and residual waters, of the rain water that runs through agricultural areas, and of marine transportation (especially of dangerous substances, oil and gas). The regional capacity for the treatment

of residual waters is low; approximately 90% of the residual domestic waters are discharged without any treatment whatsoever<sup>1</sup> into the Wider Caribbean.

The river valleys and coastal and marine areas are closely linked by physical and biological processes, with the latter invariably serving as receivers of river-borne pollutants and being affected by hydrological changes in the basins (UNEP, 2006). Poor agricultural practices in the countries' watersheds significantly impact coastal waters. Removal of vegetation and the excessive use of fertilizers and agricultural pesticides result in soil erosion and large sediment loads being transported to coastal waters, as well as in pollution of these waters from agricultural chemicals.

Fishing and aquaculture activities contribute to pollution of the sub-region's coastal and marine environment. One of the functions of the Western Central Atlantic Fisheries Commission (WECAFC) is "*to promote and coordinate, within the national and regional scope, the studies on the effect on the environment and contamination on fishing, as well as the studies on adequate control and enhancement methods*"<sup>2</sup>, which indicates the importance of the subject of pollution from fishing activities. The following are the main sources of pollution from fishing and aquaculture:

- Hydrocarbon residues and bilge water from vessels;
- Remains of riggings and structural materials, both in the sea and in the coastal zone;
- Use of chemical substances in fishing for lobsters;
- Sewage from the processing companies;
- Packaging materials and plastics from the companies and vessels;
- Nutrients from the shrimp farms due to the limited or absence of treatment of waste water from the farms.

Tourism in the coastal zone has high potential for pollution of these areas. According to Altés (2006), one of the negative environmental impacts more frequently associated with tourism is the contamination of water bodies through recreational activities or the dumping of untreated residues from tourism infrastructure such as hotels, and from recreational vessels. In many cases, these effects are not directly attributable to tourism, but tourism makes the existing problems more evident, more so than in other sectors, since the natural environment is an important asset in tourism.

Some of the countries in the Central/South American sub-region (Venezuela, Mexico, and Colombia) are dedicated to offshore extraction of oil and gas. In addition to operational discharges of pollutants from activities related to exploration, production, transportation, and distribution of oil and gas, the offshore oil and gas industry is subject to dangerous environmental conditions, especially storms, huge waves, and strong currents (COI, 2002), which increase the risk of accidents and spills. The oil industry is doubtlessly one of the greatest environmental threats for the countries of the sub-region. This threat is considered as increasing, for instance by Venezuela's offer to support some

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<sup>1</sup> : [www.sustainlabour.org/documents/](http://www.sustainlabour.org/documents/)

<sup>2</sup> : <http://www.rlc.fao.org/organos/copaco/default.htm>

of the countries of the region in the supply of petroleum by the construction of oil pipelines.

Within the Caribbean there is also great concern over pollution from activities in the sea. These include the unloading of petroleum and of residual ballast water and sewage, as well as the dumping of garbage and other human wastes from ships (Burke and Maidens, 2005). The Panama Canal has significant influence on pollution within the canal and in the Caribbean Sea, although Panama has formal laws that govern the passing of the ships through the canal and the discharge of hydrocarbons from them (Agreement No. 71 of December 16, 2003). Despite the fact that international regulations exist regarding the dumping of hydrocarbons and sewage, these are not adequately implemented and enforced in most of the countries. Usually, the issuance of navigation certificates for fishing is left at the discretion of the port and naval authorities, without considering the condition of the vessels.

Natural causes such as climatic and meteorological factors also contribute to pollution of coastal areas. For instance, heavy rains can cause large quantities of sediments and agricultural chemicals to be carried to coastal areas and be deposited in the critical habitats such as mangrove swamps. Hurricanes also transport solid materials such as wood, metal, and plastics, which are products of the destruction caused by the phenomenon itself. While it has not been quantified, it is assumed that large quantities of contaminating substances are deposited annually in coastal areas as a result of natural causes.

#### **2.2.4 Habitat and community modification**

Environmental degradation is the gradual change in the quality of an ecological system, as a consequence of satisfying human needs and the processes and activities that are carried out at a given time. The interaction of mangrove swamps, seagrass meadows, and coral reefs is being severely impacted by activities carried out in the respective watersheds, especially deforestation and intense agriculture, which produce sediments and contamination by fertilizers and pesticides. These pollutants also affect the aquatic populations. The increase in the liberation of sediments into coastal waters causes significant stress on the coral reefs; it hampers the penetration of light necessary for photosynthesis, threatens the survival of young corals due to the loss of adequate substrate for settlement and in extreme cases leads to the complete asphyxia of the corals.

One of the problems faced by the sub-region is coral bleaching, an impact of global warming that is affecting the biodiversity of the Caribbean Sea (Burke and Maidens, 2005). Coral bleaching occurs independently of the extensive use of chemical substances by divers to catch lobsters on the reefs, which also provokes death of the corals.

Another cause of habitat degradation is destructive fishing practices and aquaculture. The most harmful is bottom trawling by shrimp boats, for which no mitigation or preventative measures currently exist. This is followed very closely by the catching of lobsters with traps, which cause the breaking of corals when they are allowed to fall on them. Portable

fish traps, the fishing gear most widely used in the Caribbean Sea, are very cheap, effective and can also be destructive and wasteful: destructive when they are dropped directly on the reef, breaking the corals and wasteful when they are lost in the water and continue catching fish for extended periods, a phenomenon known as phantom fishing (Burke and Maidens, 2005).

A source of marine waste that requires special attention is abandoned fishing gear, both sections of or entire nets, as well as discarded lines and plastic parts associated with traps and nets. Whether they are intentionally discarded or accidentally lost during storms or fishing operations, abandoned fishing gear poses serious threats worldwide, trapping marine life, destroying coral reefs and other habitats and even putting people in danger. Almost all the fishing nets are made of synthetic fibers that are extremely resistant to degradation. Even though the abandonment of fishing gear is a global problem, at present no international treaty or action plan takes it into consideration (U.S. Commission on Ocean Policy, 2004).

Aquaculture in coastal areas can also degrade coastal habitats, for instance, through the destruction of mangrove swamps and the discharge of nutrients into coastal inlets and lagoons. These can have important impacts on the populations of juvenile fish and the abundance of marine fish. In the case of aquaculture, basic studies are an essential element of a monitoring program for regulation purposes and should be undertaken before establishing an aquaculture farm or extending an existing one. The scope of the study should consider seasonal variations, as well as the size and the impact of the potential of the planned activity (GESAMP, 1996).

Tourism has also contributed to the degradation of the once pristine coastal zones and bottom habitats, especially coral reefs, not only through physical impacts, but also by the discarding of cardboard and plastic materials, personal articles, and waste. The degradation of the environment also occurs as a consequence of shoreline modification and removal of terrestrial and aquatic vegetation for building of infrastructure.

According to Altés, C. (2006), the following are the impacts on habitats more frequently associated with tourism:

- Rapid urban growth and unplanned coastal development;
- Pressure on scarce resources and the destruction of fragile ecosystems, such as coral ecosystems, mangrove swamps, and seagrass;
- Contamination of bodies of water by recreational activities, or the dumping of untreated residues; and
- Aesthetic deterioration of the landscape and urban surroundings.

### ***2.3 Socio-economic background***

The political division and maritime boundaries of the countries within the Central/South American sub-region are shown in Figure 2. This has been published in United Nations documents even though some countries have not yet publicly delimited their maritime

borders, mainly due to unresolved border conflicts. However, for the purposes of this report, Figure 2 has been adopted to illustrate the maritime spaces, since it explicitly describes the borders of the countries located within the Central/South American sub-region. This also illustrates graphically the relationship of the migratory routes of some of the living marine resources, and potential transboundary influences and intervention possibilities.

The socio-economic indicators of the Economic Commission for Latin America (CEPAL, 2005) place Mexico as the most populated country in the sub-region, with a total of 106,147 million inhabitants, followed by Colombia and Venezuela, with 46,039 and 26,577 million inhabitants, respectively (Table 2). Among the Central American countries, which have a total population of 33,350 million inhabitants, Belize has the lowest population of only 270 thousand (Table 2). Costa Rica has the lowest gross mortality (4/thousand persons), while Guatemala reached 6.1/thousand in 2005; the rest of the countries show similar numbers around 5.1/thousand (CEPAL, 2005). The child mortality trend is very similar to gross mortality, with Costa Rica having the lowest (10.5/ thousand live births), and Guatemala the highest with 38.6/thousand (CEPAL, 2005). The average for the sub-region is 25.9/thousand, which implies the existence of a health problem that is still unresolved.

The sub-region's population above 15 years old has educational problems, with an average of 13% of the population being illiterate. Nicaragua has the highest illiteracy index of 31.9%, while Costa Rica, which has notably overcome illiteracy, only 3.7%.

The highest Human Development Index (HDI) is shown by Costa Rica (0.834) and the lowest by Guatemala (0.649), which is a clear reflection of the violence and extreme poverty in this country (PNUD, 2002, quoted in Hoagland and Jin, 2006). The socio-economic indicators show that Mexico, Colombia, and Venezuela have the highest economically active population of the sub-region, as well as the highest aggregated value to production (Table 3). The highest Gross Internal Product is shown by Venezuela (9.3) while the lowest is shown by Belize (3.1). The annual average unemployment rates indicate that Colombia, Venezuela, and Panama have the highest with 13.9, 12.4, and 12.0, respectively (CEPAL, 2005).

Latin America and the Caribbean attracted US\$61 billion in direct foreign investment net flow in 2004, 50% more than in 2003. This was only slightly behind East Asia and the Pacific and behind Europe and Central Asia (WDI, 2006). Private investment in infrastructure development has made important contributions that have served to alleviate the demand for coercive taxes, improvement of service infrastructure, and the expansion of some services to the poor. Latin America and the Caribbean attracted more than one third of the total private investment in infrastructure in the developing world during 2000-2004. However, a little more than US\$70 billion of private investments in regional infrastructure in 1998 fell to only US\$17 billion dollars in 2004 (WDI, 2006). This reflects a total decrease of the private investments in infrastructure projects in developing countries, from a little more than US\$114 million dollars in 1997, to approximately US\$64 million in 2004 (WDI, 2006).

Fishing and tourism are very important in the Central/South American sub-region and a great majority of the inhabitants, such as specialized laborers, depend on these sectors. In 2003, the total marine fisheries landings for the Sub-region amounted to nearly 2.3 million metric tonnes (mt), of which Mexico accounted for about 62% (Table 4). The case is similar for marine plants, in which Mexico accounted for 38% (FAO, 2003, quoted in Hoagland and Jin, 2006).

The tourism sector in the Central/South American sub-region is very irregular, caused mainly by the lack of infrastructure, inadequate facilities, and especially by the extreme poverty in some of the countries. Nevertheless, the countries are making increasing efforts to enhance tourism, especially from the USA and Europe. Mexico leads in the maritime activity indices. This country dominates the tourism sector, followed by Costa Rica and Guatemala. The State of Quintana Roo, with more than 59,000 hotel rooms, had 10.8 million tourists in 2004<sup>3</sup>, one million more than the previous year. Of these, 3.5 million arrived on luxury cruise ships and half a million from Belize and from Mexico itself. In contrast, countries such as Guatemala, Nicaragua, and Panama do not have adequate transportation infrastructure and other facilities, even though there are many pristine areas with potential for tourism. In Colombia the tourism sector has expanded and become modernized, with a direct foreign investment in 2003 of US\$208 million; in 2004, the number of hotel rooms reached 55,110<sup>4</sup>. Venezuela currently has 2,456 tourist lodging establishments (hotels, inns, camps, residential hotels, motels), with 78,212 rooms and 169,910 beds<sup>5</sup>.

### **3 KEY TRANSBOUNDARY ISSUES**

In the Central/South American sub-region, socio-economic activities generate problems in the coastal and marine environment and their living resources, which the government of each country is trying to prevent, mitigate, or restore at the national level. The problems affecting the marine areas sometimes transcend the borders of the countries. The identification of transboundary problems in the Central/South American sub-region is one of the most important purposes of the Transboundary Diagnostic Analysis (TDA). In the Central/South American sub-region the transboundary problems that affect two or more countries from the north of Mexico to the south of Venezuela are taken into consideration in this report. Priority is given to those which, due to their very particular characteristics, are well-known by scientists, technicians, national administrations, and users in general. These are, in order of priority:

- Species and overfishing;
- Pollution;
- Habitat degradation; and
- Resources with transboundary trophic linkages.

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<sup>3</sup> : <http://sedetur.qroo.gob.mx/index.php>

<sup>4</sup> : [www.turismocolombia.com](http://www.turismocolombia.com)

<sup>5</sup> : [www.embavenarg.org](http://www.embavenarg.org)



Table 5 presents the problems identified, the intensity of the impact itself – appraised as None, Low, Medium, High and Very High - as well as the problem’s tendency to decrease or increase in time and intensity, and a brief description of the specific resources affected.

Within the context of the LME Modules (productivity, fish/fisheries, pollution/ecosystem health, socio-economics, and governance (Duda and Sherman, 2002), the key transboundary issues in the Central/South American sub-region that need to be addressed are set out below.

### ***3.1 Fish and fisheries***

#### **3.1.1 Environmental impacts**

The issue of overfishing repeatedly comes up in discussions of marine resources in the Central/South American sub-region. As a result of the excessive fishing pressure on the sub-region’s fish stocks, overfishing is one of the major problems in almost all the fisheries (Table 5). Overfishing and destructive fishing practices have resulted in a decrease in catches and in the sizes of fish caught, as well as in a number of endangered species in the sub-region.

The main problem in the shrimp fisheries arises from the destruction of their habitats and the high incidental catches, mainly of young stages of species of commercial and recreational importance, which may have transboundary impacts in the region. Recruitment and growth overfishing are also seriously affecting the shrimp fisheries. Lobsters are also overfished in a number of areas in the sub-region, as a result of high fishing pressure and the catching of undersized lobsters and of berried females. The queen conch is heavily exploited on the traditional queen conch banks and, in several areas has been over-exploited (FAO, 1997). Almost all the marine turtle species are in danger of extinction in the sub-region, largely as a result of heavy subsistence fishing on adults and harvesting of the eggs by indigenous people, as well as their incidental capture in non-selective fishing gear such as gillnets and trawls.

In the countries where the demersal species are being fully exploited or overfished, the main problem is excessive fishing effort, which has reduced the stocks and the individual sizes of the captured species. Some demersal species, such as red snapper and the sea basses and groupers, are also impacted as a result of fishing during the spawning periods, during which time they are highly vulnerable to capture. The high incidence of bycatch and discarding of demersal fish species has resulted in changes in the species composition of the faunal communities. Various studies show that the changes in the composition of fish species have dramatic effects on other animal species that are dependent on fish, such as birds and marine mammals (Monaghan 1992, and Hamre 1994, both in Gray, 1997; Monaghan 1996).

The overexploitation of migratory pelagic species in other continental and insular countries has had an impact on the size and abundance of these stocks, which has very likely affected the abundance and availability of these species in areas where they are not

as highly exploited. In spite of fisheries regulations, the oceanic fishing industry continues to decline, with almost 70% of the stocks fully exploited or overfished (UNEP, 2001).

### **3.1.2 Socio-economic consequences**

Overfishing has important socio-economic consequences in the Central/South American sub-region. It has been widely documented among the diver population of the Miskito ethnic group from Honduras and Nicaragua – as in other Caribbean countries – that diving accidents are more frequent than believed, and that the social-economic effects in this sector are the most serious compared to other activities conducted in the sea, since the affected people usually become crippled or disabled, and on many occasions face death

One of the issues that has not been considered in this document, but which is of great importance, is that of the native cultures and their traditions, “which tend to disappear with their languages and knowledge, with people who live in close harmony with their environment being at greatest risk” (UNEP, 2001). In the neighborhood of San Andres, fish stocks are depleted. In Providencia, the fisheries are still exploitable because there is only artisanal fishing by the people of Providencia; in the keys, the depletion is accelerated by Honduran, Jamaican and, to a lesser degree, Colombian fleets. If prohibitions and controls are not established for fishing, the resource will suffer irreversible deterioration; this is perhaps already the case in some instances, resulting in a loss of social welfare<sup>6</sup>.

### **3.1.3 Linkages with other transboundary problem**

Overfishing is linked with habitat degradation, as in the case of destructive fishing practices. For instance, lobster fishing poses a threat to coral reefs, since the bag nets, traps, use of chemical substances to take the lobsters out of the hideout within the coral, as well as the divers themselves produce negative and occasionally irreversible alterations in the reefs.

### **3.1.4 Immediate causes**

Some of the immediate causes of overfishing are presented in Table 6. The main problem is excessive fishing effort represented by large numbers of vessels and fishers, and non-selective fishing gear (e.g. in the shrimp fishery), including small mesh sizes and the resulting high incidence of by-catch and discards. Another recurring problem is illegal fishing practices, especially in countries where surveillance is inadequate or non-existing. This also encourages foreign fleets to enter those territories to fish commercially important species such as snapper.

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<sup>6</sup> : <http://www.lablaa.org/blaavirtual/geografia/carcol/visisl.htm>

### **3.1.5 Underlying causes**

The main underlying causes of overfishing are given in Table 6. Despite the existence of fisheries laws, these are not efficiently applied. There is an extremely chaotic policy in allocating access rights, since there is always the tendency to distribute more fishing licenses and permits than are necessary to achieve the allocated catches. In the sub-region knowledge gaps also prevent the development of effective and harmonized fisheries management measures. Other causes include non-compliance with regulations by foreign fleets due to inadequate monitoring and surveillance.

### **3.1.6 Socio-economic, legal, and political root causes**

The main socio-economic, legal, and political roots causes of overfishing in the Central/South American sub-region include poverty, lack of alternative food sources for local human communities, social and institutional problems, lack of adequate governance, lack of political will, and the general lack of harmonized regulations for the transboundary fisheries. In reference to environmental issues, the Secretary-General of the United Nations, during his Millennium Report, stated that “The ecological crises that we are confronting have many causes. They include poverty, negligence and greed – and above all, failures in governance” (UNEP, 2001). This has proved to be true in Latin American countries, since “despite all the enormous efforts that practically all the countries in the region have made, the problem of poverty persists as one of the greatest challenges in this Century” (Parker, 2002).

### **3.1.7 Knowledge gaps**

A number of knowledge gaps exist in the different fisheries, including:

- Disparity regarding knowledge of the biological, economic, and social status of the shrimp fisheries, which prevents the use of harmonized methodologies;
- Level of fishing effort, for instance, in the lobster fishery, the number of bag nets in the sea or the exact number of divers is unknown;
- Lack of knowledge of lobster puerulus settlement spatial and temporal distribution, which would help to determine protected areas for lobsters;
- The biology of queen conch has many uncertainties, such as the size at first maturity and reproductive needs, which makes it difficult to establish appropriate measures to protect the different maturity and reproduction phases of this species. This is partly due to the inability to externally distinguish the sex and maturity of queen conch. It is very common to find small individuals that are already mature and large ones that have not yet matured. This lack of relationship between size and maturity makes the management measures based on the conch itself very uncertain, and *a priori* management measures have been taken;
- Inadequate information on the origin of conch catches. Some countries might be exporting conch caught outside their territory, either legally or illegally. This makes abundance or distribution studies difficult, thus masking the real exploitation areas and catch volumes;

- For demersal fish, knowledge gaps include local, national, and regional information about their biology and dynamics, as well as their distribution on the continental platform;
- For turtles, despite the existence of many very good studies on the biology and dynamics of the turtle in the Caribbean Sea, a vacuum exists regarding its life cycle stages, as well as of the appropriate mechanisms to efficiently raise awareness among fishermen and consumers. This should be taken into consideration in any programme for the protection of these resources, as in the case of turtle excluder devices (TEDs);
- Information on the key trophic linkages among the living marine resources of the sub-region.

### **3.1.8 Proposed options**

Policies to address overfishing should attempt to:

- Develop a harmonized system in the region that will provide information on artisanal fishing effort, and reduce fishing capacity in over-exploited fisheries;
- Apply a system of licenses to fishers in order to limit access, as well as the total prohibition of fishing of endangered species;
- Involve fishers, owners, and processors in managing lobsters and other fisheries in the Caribbean, and with the consent of government officials involved in fisheries management. In some cases - Mexico, Nicaragua, Honduras, and Panama - the indigenous populations play an important role in lobster conservation;
- Enhance environmental education (including on life cycles of the resources such as conch and lobsters) and administration principles at early ages of the resource users. Sustainable management of the resources should address all stages of the production cycle, from capture to marketing;
- As in the case of lobsters, management of the queen conch fishery should involve the key sectors (industrial private sector and the artisanal fishing sector), as well as the fishing institutions in each of the countries, and regional and non-government organizations that promote protection of this resource. Mitigating the negative effect of the industry on these fisheries requires dedicated effort to fully understand the biology of this species, information on the origin of the catches, in order to make inventories and to assign quotas according to those inventories;
- For the snapper and sea bass fisheries artisanal fishers must be among the key persons involved in management of these resources, along with the fishing administration and local government. It is essential to conduct assessment of the populations, their regional distribution and abundance, as well as the size at first maturity and spawning seasons;
- Draw up a specific plan for the protection of marine turtles affected by fishing;
- Develop a regional consultation process that will permit the harmonization of the existing standards regarding the management of the transboundary living marine resources;

- Draw up a short, medium and long term plan to address current transboundary impacts on the living marine resources of the Caribbean Sea, which must be binding to the signatories of the relevant international agreements.

## **3.2 *Pollution and ecosystem health***

### **3.2.1 Environmental impacts**

Pollution in the Central/America sub-region arises from a number of sources and includes petroleum and its derivatives, agrochemicals, plastics, packaging material, and soil erosion (Table 5). In Colombia and Venezuela pollution was evaluated as moderate. Microbiological pollution affects the Magdalena Basin, mainly in the dry season when the capacity for dispersion by the rivers is reduced due to their decreased volume. Poor land-use practices have increased the concentration of suspended solids in the water bodies, thus obstructing river flow and increasing sedimentation. In many cases, the sediments contain pesticides and nutrients, causing localized eutrophication and the bioaccumulation of chemical substances in aquatic species (PNUD, 2006).

In general, in Mexico and Central America pollution has severe environmental impacts. The marine environment has been affected unfavorably by terrestrial sources of contamination, such as agricultural chemicals and solid wastes, causing deterioration in the quality of the water (UNEP 2002, quoted in UNEP, 2006). The negative impacts of pollution by agricultural chemicals include harm to seagrass by herbicides and changes in the structure of the reef communities, such as the loss of live coral cover and an increase of seaweeds and sponges (Burke and Maidens, 2005). The accumulation of toxic pesticides in marine organisms is another concern related to pollution from agricultural areas.

Pollution arising from industrial activities has not decreased in the past few years, with spillage of petroleum, transport of suspended and sometimes contaminated sediments arising from industrial activities upstream, and the degradation of habitats due to liquid and solid waste discharges, continuing to be an issue in the sub-region.

### **3.2.2 Socio-economic consequences**

In the Central/South American sub-region, the socio-economic consequences of pollution vary from slight to severe. These include a decrease in the value of fisheries products through contamination, and loss of economic and aesthetic value of coastal areas. Chemical and organic compounds released into the environment by industrial and agricultural activities present a permanent threat to human health. Microbiological pollution from sewage is also a threat to human health, and in some areas downstream coastal communities have a high prevalence of gastrointestinal and dermal ailments (UNEP 2006).

### **3.2.3 Linkages with other transboundary problems**

Pollution of coastal and marine areas is a direct cause of habitat degradation and could also have serious negative impact on marine fish stocks and marine biodiversity.

### **3.2.4 Immediate causes**

Immediate causes of pollution in the Central/South American sub-region are shown in Table 6, and include spillage and leakage of contaminants due to poor waste handling, and poor agricultural and land use practices. A number of sea-based activities are also among the immediate causes of pollution, including operations related to the petroleum industry, maritime shipping, and fishing.

### **3.2.5 Underlying causes**

Underlying causes of pollution in the sub-region are shown in Table 6, and include inadequate information and limited application of national and international environmental standards.

### **3.2.6 Socio-economic, legal, and political root causes**

The socio-economic, legal, and political root causes of pollution include factors related to demography (e.g. concentration of population in the coastal zones); governance (e.g. weak governance, lack of political will, inadequate sectoral planning and absence of an integrated development strategy, lack of regional policies that promote the development of river basin, coastal and marine planning and management, poor land use and waste management practices); and knowledge (decision-making processes are hampered by limited information).

### **3.2.7 Knowledge gaps**

These include the impacts of certain pollutants on living marine resources. There are insufficient research initiatives regarding sustainable technologies and few environmental education programmes (UNEP, 2006).

### **3.2.8 Proposed options**

Among the options for addressing pollution in the sub-region are:

- Improved application of national and international environmental standards;
- Improved implementation of the relevant regional (e.g. Cartagena Convention) and international agreements (e.g. MARPOL);
- Development of a regional action plan to prevent practices that result in the degradation of the coastal zones, including dumping of contaminating substances in the coastal zones and their associated ecosystems by addressing the different sources of pollution, including the fishing, tourism and industry sectors.

### **3.3 *Habitat and community modification***

#### **3.3.1 Environmental impacts**

The destruction of coastal habitats is especially severe in tropical regions, where they are being destroyed at alarming rates. Of particular concern is the degradation of coral reefs, mangrove swamps, and seagrass meadows (Table 5).

Deforestation and mining, which are frequently many kilometers inland, have led to a great increase in the sediment loads in coastal areas. This has smothered coral reefs and other coastal habitats in the sub-region, especially in Colombia and Costa Rica (Lundin, 1993, quoted in Gray, 1997). Damage caused to coral reefs by sedimentation has also been documented in the coasts of Panama, Costa Rica, and Nicaragua, among other localities by Burke and Maidens (2005). The ecosystems of the islands of San Andres (Colombia) and Margarita (Venezuela) are among the most threatened, due to habitat destruction, overexploitation of the natural resources, and the introduction of exotic species<sup>7</sup>. Another problem faced by the sub-region's coral reef ecosystems is coral bleaching (Burke and Maidens, 2005).

The cutting of mangrove trees for the construction of houses and the production of charcoal is a common practice of Central American Caribbean communities. This affects the biodiversity of the marine fauna, several species of which use the coastal lagoons as spawning and nursery areas. The destruction of seagrass habitats by shrimp boats has a considerable impact on the feeding of turtles, which are also very vulnerable to the shrimp nets. The boats do not have TEDs, or if they do, they often do not function effectively.

Habitat degradation and community modification has far-reaching impacts in the sub-region. For instance, various studies have shown that the changes in the composition of fish species have dramatic effects on other animal species that are dependent on fish, such as birds and marine mammals (Monaghan, 1992; Hamre, 1994, quoted in Gray, 1997).

#### **3.3.2 Socio-economic consequences**

The economic impacts of habitat modification are moderate in the sub-region. The continued degradation of critical areas or habitats and the unsustainable exploitation of fisheries and other living marine resources in the sub-region could lead to unemployment and reduced incomes and consequent deterioration in the quality of life among coastal communities. Habitat and environmental degradation could lead to social disturbances, for instance, conflicts between tourists and the local population. Habitat degradation has potentially grave consequences for native people who live in close harmony with their environment (Altés, 2006).

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<sup>7</sup> : <http://www.provitaonline.org/programas/bioinsula/>

### **3.3.3 Linkages with other transboundary problems**

Habitat degradation is linked with pollution, since pollution is a direct cause of degradation of the sub-region's coastal habitats. It is also linked with species and overfishing, in that loss of critical habitats could exacerbate declines in fish stocks and biodiversity loss.

### **3.3.4 Immediate causes**

The immediate causes of habitat degradation and community modification include the increase of tourism and industry in coastal areas (Table 6), as well as deforestation and coastal erosion. Other causes include pollution, destructive fishing practices, removal for construction of aquaculture farms and other infrastructure, for building materials and other purposes, and natural causes such as coral bleaching.

### **3.3.5 Underlying causes**

The underlying causes can be attributed to:

- Non-existing standards or their limited application;
- Poor land use practices;
- Demand for food crops (nutrition and export); and
- Limited alternatives in other sectors.

### **3.3.6 Socio-economic, legal, and political root causes**

The socio-economic, legal, and political root causes of habitat degradation and community modification include factors related to demography (e.g. concentration of population in the coastal zones); governance (e.g. weak governance, lack of political will, sectoral planning and absence of an integrated development strategy, lack of regional policies that promote the development of river basin, coastal and marine planning and management, poor land use practices); knowledge (decision-making processes are hampered by limited information on environmental and economic characteristics, including ecosystem values); poverty (forces the inhabitants to employ unsustainable practices to exploit natural resources for their short-term survival) (UNEP, 2006).

### **3.3.7 Knowledge gaps**

Knowledge gaps include economic valuation of coastal and marine ecosystems, and environmental degradation trends of river basins and aquifers. There are insufficient research initiatives regarding sustainable technologies and few environmental education programmes (UNEP, 2006).

### **3.3.8 Proposed options**

Many environmental challenges can only be addressed by means of international cooperation. Climate change, the access to sustainable sources of energy, the need to



protect rivers, lakes, and coastal zones from the pollution and degradation are challenges that require efficient multilateral focus (PNUD, 2006). Olsen *et al.* (2006) advocate that the governments regulate the extraction and the use of the resources of the LME in order to mitigate excessive exploitation, pollution, and destruction of habitats. Furthermore, they propose that the supervision, surveillance, and conduct of economic activities by relevant sectors (fishing, mining, tourism, waste management, and land use) should be linked.

#### **4 STAKEHOLDERS ANALYSIS**

Key stakeholders who participate in living marine resource utilization and management have different reasons and purposes for their involvement. For some, it is a regulatory role, such as governments who are charged with management of the resources while for others, it is the pursuit of an economic activity and the maximization of profits, such as the small-scale and industrial-scale fishers. A list of key stakeholders is given in Table 7. Figure 3 describes the basic commercialization chain (assessment, harvesting, processing, and sale), including wild fish captures by industrial or artisanal fishers, as well as of aquaculture production.

In general, utilization of living marine resources starts with the availability of the resource (stock), the assessment of its status, and management by the regulators in order to establish a catch quota and the required level of fishing effort. Both the Fisheries Departments and the Environmental Agencies work collaboratively to determine the allocated quotas for both artisanal and industrial fishers, with the latter providing information on landings, fishing effort, processing, and fisheries explorations. In most cases the artisanal fishing sector is more difficult to manage. Processing, exportation, and internal marketing are carried out by the private sector. Table 7 shows the key stakeholders, their present and potential roles, and their capacity to carry out their functions.

#### **5 GOVERNANCE ANALYSIS**

The institutions involved in the governance of living marine resources in the Central/South American sub-region relate to the sectors involved in economic and/or conservations activities, with those related to fishing, environment, and tourism being the most important (ANNEX II).

##### ***5.1 Fishing***

In most of the countries, fishing has traditionally been controlled by the Agriculture and Livestock Ministries, a tendency that continues today with little exception, as shown in Table 8. The most important recent changes have been in the administrative structures, such as in Mexico and Nicaragua. During the 1980s these countries had ministries of fisheries and aquaculture, which have now been absorbed by other ministries or secretaries; this is considered a step backward for these sectors. Within Central America, Costa Rica and Panama have established administrative agencies, which have technical

and financial independence. This allows them to operate under more flexible schemes, consistent with the dynamics of the fishing and aquaculture sectors.

With the exception of Colombia, all the countries in the Central/South American sub-region are members of the Latin American Organization for Fishery Development (OLDEPESCA), created in 1982 and based in Lima, Peru. The purpose of OLDEPESCA is to assist in adequately meeting the food requirements of the people of Latin America, using their potential fisheries resources, through agreed joint actions for the sustainable development of the countries and to permanently strengthen regional cooperation in the sector (OLDEPESCA<sup>8</sup>).

The Central American countries are also members of the Fishing and Aquaculture Organization of the Central American Isthmus (OSPESCA<sup>9</sup>), an inter-governmental organization created in 1995 and based in San Salvador, El Salvador. The purpose of OSPESCA is to promote sustainable and coordinated development in fisheries and aquaculture within the Central American integration process, defining, approving, and implementing regional fishing and aquaculture strategies, programmes, and projects.

Belize belongs to the Caribbean Community (CARICOM<sup>10</sup>) and to the Caribbean Regional Negotiation Machinery (CRNM<sup>11</sup>), which are organizations for exchange and trade, inside as well as outside the region. Belize also belongs to the CARICOM Regional Fisheries Mechanism (CRFM<sup>12</sup>), whose mission is to promote the sustainable use of the fisheries resources within and among the Member states, through the development, administration, and conservation of these resources, in collaboration with all the users and actors, for the benefit of the population of the Caribbean Region.

All the countries in the sub-region are members of FAO, as well as of its regional body, WECAFC, which includes all the states of the FAO statistical area 31.

The countries benefit from the Caribbean Basin Initiative (CBI), which is a USA government programme to promote the economic development of the region, through the exemption of taxes in American territory for the majority of the products coming from the region. The CBI began in January 1984, with 12 years duration. This was made permanent by the CBI II in August 1990.

## **5.2 Environment**

The importance of and the political will that the countries show towards living marine resources and the environment is reflected in the position of the responsible agencies, all of which are at the highest level in the government hierarchy (Table 9). These institutions are charged with protecting the environment and preventing damages from economic activities within the sub-region. This is usually carried out with the support of Non-

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<sup>8</sup> : [www.oldepesca.org/](http://www.oldepesca.org/)

<sup>9</sup> : [www.sica.int/ospesca](http://www.sica.int/ospesca)

<sup>10</sup> : <http://www.caricom.com/>

<sup>11</sup> : <http://www.crnmm.org/>

<sup>12</sup> : [www.caricom-fisheries.com/](http://www.caricom-fisheries.com/)

Governmental Organizations (NGO) such as the World Wildlife Fund (WWF), the World Conservation Union (IUCN), The Nature Conservancy (TNC) among others, and UN organizations such the United Nations Environment Programme (UNEP).

With more than four decades in existence, WWF is the world's biggest conservationist independent organization, and has been one of the organizations most involved in the continental and coastal areas of the Central/South American sub-region. Well known is the Meso-American Barrier Reef project, in which Mexico, Belize, Guatemala, and Honduras are participating.

In the General Secretary of the Central American Integration Systems (SICA), the Central American Environment and Development Commission (CCAD<sup>13</sup>), stands out, and has developed the environmental agenda of the region for 15 years, playing an environmental conservation and protection, and pollution prevention role. The Constituting Agreement of CCAD was signed in February 1989 in Costa Rica by the Presidents of Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua, with the mission to develop the regional environmental cooperation and integration regime, which may contribute to improving the quality of life of the Central American people. The highest decision-making body of CCAD is the Ministerial Council, consisting of the seven ministers of the Central American isthmus countries, as well as Dominican Republic, which has adhered to the agreement of SICA.

The Environment and Natural Resources Secretariat (SEMARNAT<sup>14</sup>) from Mexico has been recently created, and according to the Public Administration Organic Law (2003) its main purpose is “to promote the protection, restoration, and conservation of the ecosystems and the natural resources, and environmental goods and services, in order to promote sustainable development”. Under this objective, Mexico has the highest number of protected areas among the countries in the region, covering more than eight million ha (Table 10). The Presidential Decree of the Official Diary of the Federation was published on January 20<sup>th</sup>, 1986, thus creating the Sian Ka'an Biosphere Reserve, with a surface area of about 528,148 ha located in Quintana Roo (SAM, 2005).

In Colombia there are 27 regional autonomous corporations, including eight for Sustainable Development, six Environmental Urban Units, five research institutes, and the Colombian Oceanographic Commission – presided over by the Vice-President of the Republic. This is a national government inter-sectoral body to assess, consult, plan, and coordinate matters regarding the Ocean and Coastal Spaces National Policies and their different connecting, strategic, scientific, technological, economical, and environmental themes related to the sustainable development of the Colombian seas and its resources<sup>15</sup>.

In Venezuela, the main objective of the Ministry of Environment is “to guarantee the rational use of the natural resources through its systematic administration and the improvement of the environment and the population quality of life.” A mechanism that

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<sup>13</sup> : [www.ccad.ws/](http://www.ccad.ws/)

<sup>14</sup> : [www.semarnat.gob.mx](http://www.semarnat.gob.mx)

<sup>15</sup> : [www.cco.gov.co](http://www.cco.gov.co)

allows the vigilance, supervision, and control of the use and deterioration of natural resources has been created<sup>16</sup>. Much of the efforts made by Venezuela are directed towards wide terrestrial conservation zones and to address contamination in Lake Maracaibo. It must be noted, however, that it is the second most advanced country in the Central/South American sub-region regarding marine protected areas, as well as the ratification of the Cartagena convention and its three protocols:

- **Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region**, of which the objective is to protect and manage the marine area and the coastal zones of the Wider Caribbean Region (Cartagena Convention);
- **Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region**, in order to promote regional cooperation for the adoption of preventive as well as corrective measures necessary to protect the marine and coastal areas of the Wider Caribbean Region from hydrocarbon spills;
- **Protocol Concerning Specially Protected Areas and Wildlife (SPAW)**, of which the objective is the protection of rare and vulnerable ecosystems as well as the habitat of threatened or endangered species;
- **Protocol Concerning Pollution from Land-based Sources and Activities**, to adopt adequate measures to prevent, reduce, and control pollution from land-based sources and activities in the Greater Caribbean Region.

### 5.3 *Tourism*

The arrangement of the agencies in charge of tourism in the sub-region is irregular (Table 11). In five of them the agencies come under a Minister or Secretary, with a similar position, while the other four are institutes, most of which have technical but not financial autonomy.

## 6 SUMMARY AND CONCLUSIONS

The concept of Large Marine Ecosystems as an approach to assessment and management of the living marine resources is relatively recent. It has also been useful in efforts to manage the resources that, because of their migratory characteristics, transcend national marine boundaries. A focus at the LME level also serves to recognize changes in the alterations to the ecosystem, especially the anthropogenic interventions in the coastal zone, pollution, introduction of exotic species, and the natural resource management processes.

Within the Central/South American sub-region, five areas of concern related to transboundary living marine resources were identified:

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<sup>16</sup> : [www.marn.gob.ve](http://www.marn.gob.ve)

- Species and overfishing;
- Pollution;
- Degradation of habitats;
- Resources with trophic transboundary linkages; and
- Socio-economic aspects.

In the case of species and overfishing, an assessment was made of the main fisheries of the sub-region: shrimps, lobsters, queen conch, as well as some demersal and large pelagic species. The assessment showed that most of the countries in the sub-region have shrimp, lobster, and queen conch fisheries that are considered fully exploited and, in some cases, overexploited. The problems associated with these fisheries include excessive fishing effort and growth and recruitment overfishing, which have led to noticeable declines in the stocks of these species, accompanied by decreasing sizes. Some fishing methods – such as for lobster and queen conch – can be harmful or lethal for the fishers.

With the exception of Venezuela, the landings of demersal and pelagic species in all the countries tend to be under-reported, mainly due to the lack of logistics and appropriate technology. The fishing fleets are specialized according to the species fished, with most of the fishing done with artisanal vessels and gear. Most of the catch from the coastal lagoons is consumed or sold locally, and some is even exported.

The problem of the capture of turtles and/or eggs for food has still not been solved; some coastal communities do not have alternative sources of proteins, apart from marine products. A consequence is the absence of recovery of the turtle populations, with the exception of the leatherback turtle. This is a continuing problem, for which data and information are needed in order to be effectively addressed.

There is evidence that the main migratory and highly migratory fisheries resources of the sub-region have transboundary trophic linkages during their life cycle. One of the major problems in the management of these resources is that they are largely managed at the local or national level, rather than at transboundary levels. Although the International Commission for Conservation of Atlantic Tunas (ICCAT) is charged with the assessment and management of large migratory pelagics at the regional level, its mandate does not extend to artisanal fishing, which is the dominant fishing activity in the Central/South American sub-region.

Pollution is greatest in the coastal zones, and minimal in the open sea. Important contributing factors are both natural and anthropogenic, and result in the introduction into coastal areas of a range of pollutants from land-based, marine, and atmospheric sources, which hamper natural processes in coral reefs, mangrove swamps, and seagrass beds. The sectors largely responsible for pollution of the sub-region's coastal zone are tourism, fishing and aquaculture, industries (including petroleum), and maritime shipping.

In general, the impacts of the transboundary problems in the Central/South American sub-region are high, even though the problems of overfishing and pollution can be

considered very high. The institutional problems vary between high/very high, with marked differences between Mexico, Colombia, and Venezuela, and the Central American countries. This is reflected in the degree of utilization of the demersal and pelagic resources, which is carried out at the small-scale and arise from the lack of appropriate fishing technologies and processing facilities in the Central American countries.

Overfishing, pollution of the coastal zone, and habitat degradation and community modification have significant socio-economic consequences for the countries of the Central/South American sub-region. These countries, especially the coastal communities, are highly dependent on living marine resources for food and livelihoods. These resources are also a source of national income, and continued fisheries overexploitation and habitat degradation could seriously compromise the sustainable development of these countries.

The governments of the sub-region need to better manage the exploitation of the living marine resources of the LME in order to mitigate overexploitation, pollution, and habitat destruction. Furthermore, monitoring, surveillance, conduct of economic activities by other sectors (such as fishing, mining, and tourism), waste management, and land use should be integrated. It is not sufficient to establish a sound management regime for the transboundary living marine resources in the countries of the Central/South American sub-region. It is necessary to develop policies and strategies that will reverse the poor practices that are employed in the utilization of these resources, through effective governance for the entire region of the CLME, under the widely accepted concept of ecosystem-based management and the support of resource users, local governments and other stakeholders, through co-management approaches.

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## **ACRONYMS AND ABBREVIATIONS**

<b>CARICOM</b>	Caribbean Community
<b>CBI</b>	Caribbean Basin Initiative
<b>CCAD</b>	Central American Environment and Development Commission
<b>CEPAL</b>	Latin American Economic Commission
<b>CITES</b>	Convention on International Trade of Endangered Species
<b>CLME</b>	Caribbean Large Marine Ecosystem
<b>CONAPESCA</b>	Agricultural and Fishing National Commission
<b>CRFM</b>	Caribbean Regional Fishing Mechanism
<b>CRNM</b>	Caribbean Regional Negotiation Machinery
<b>EEZ</b>	Exclusive Economic Zone
<b>FAO</b>	United Nations Food and Agricultural Organization
<b>GEF</b>	World Environmental Fund
<b>GESAMP</b>	Group of Experts on Scientific Aspects for the Protection of the Marine Environment
<b>HDI</b>	Human Development Index
<b>ICCAT</b>	International Commission for Conservation of Atlantic Tunas
<b>IOCARIBE</b>	Inter-governmental Oceanographic Commission – Caribbean
<b>IUCN</b>	International Union for the Conservation of Nature
<b>LME</b>	Large Marine Ecosystem
<b>MARPOL</b>	Convention on the Prevention of Marine Pollution from Ships
<b>NGO</b>	Non-Governmental Organization
<b>OLDEPESCA</b>	Fishing Development Latin American Organization
<b>OSPESCA</b>	Organization of the Fishing and Aquaculture Sector of the Central American Isthmus
<b>SCUBA</b>	Self Contained Underwater Breathing Apparatus
<b>SEMARNAT</b>	Environment and Natural Resources Secretariat
<b>SICA</b>	Central American Integration System General Secretariat
<b>SPAW</b>	Protocol Concerning Specially Protected Areas and Wildlife
<b>TDA</b>	Transboundary Diagnostic Analysis
<b>TED</b>	Turtle Excluder Device
<b>TNC</b>	The Nature Conservancy
<b>UNDP</b>	United Nations Development Programme
<b>UNEP</b>	United Nations Environment Programme
<b>WB</b>	World Bank
<b>WDI</b>	World Development Institute
<b>WECAFC</b>	West Central Atlantic Fisheries Commission
<b>WWF</b>	World Nature Fund

## TABLES

**Table 1. Fisheries landings (kg) in the Central/South American countries**

	Shrimp	Lobster	Conch	Snapper	Sea bass	Pelagic
Belize (2004) <sup>a</sup>	74,000	278,000	241,000	?	?	?
Colombia (2002) <sup>b</sup>	-	338,800	?	?	?	?
Costa Rica (2005) <sup>c</sup>	37,503	34,109	-	-	116	5,966
Guatemala (2005) <sup>d</sup>	224,400	83,600	77,000	44,000		286,000
Honduras (2005-06) <sup>e</sup>	968,460	958,780	Closed season	620,240		?
Mexico (Q. Roo 2003) <sup>f</sup>	467,000	416,000	275,000	258,000	799,000	461,000
Nicaragua (2005) <sup>g</sup>	1,355,909	1,269,545	45,000	441,818	212,727	728,636
Panama (2006) <sup>h</sup>	1,000	5,000	-	5,000	?	5,000
Venezuela (2005) <sup>i</sup>	10,480,000	139,312 <sup>j</sup>		3,836,000		5,060,000

a: FAO, 2005 a communication

e: DIGEPESCA (2005-2006)

h: Personal

b: FAO, 2003 b

f: CONAPESCA, 2003

i: FAO, 2005 b

c: INCOPECSA (2004)

g: Rivera et al (2005)

j: FAO, 2003 a

d: UNIPESCA (personal communication)

**Table 2. Social Indicators for the Central/South American countries (2005)**

Countries	Population (x 1000)	Gross mortality <sup>1/</sup> (x 1000)	Child mortality (x c/1000 born alive) <sup>1/</sup>	Illiteracy rate % (15 or more years)	HDI <sup>2/</sup>
Belize	270	5.1	30.5	5.3	0.802
Colombia	46 039	5.5	25.6	7.1	0.737
Costa Rica	4 322	4.0	10.5	3.8	0.649
Guatemala	12 700	6.1	38.6	28.2	0.672
Honduras	7 347	5.1	31.2	22.0	0.667
Mexico	106 147	5.1	28.2	7.4	0.834
Nicaragua	5 483	5.1	30.1	31.9	0.791
Panama	3 228	5.1	20.6	7.0	0.773
Venezuela	26 577	5.1	17.5	6.0	0.778

Source: CEPAL (2005)

<sup>1/</sup>: Period 200-2005

<sup>2/</sup>: UNDP, 2002 (quoted in Hoagland P. & D. Jin, 2006)

**Table 3. Economical Indicators for the Central/South American countries**

	PEA (x 1000)	Variation of the PIB	Aggregated value to production 1/	Unemployment (annual average rate)
Belize	...	3.1	185.3	11.0
Colombia	28 608	5.1	11,572.5	13.9
Costa Rica	2 762	5.9	1,447.4	6.9
Guatemala	8 688	3.2	4,848.0	...
Honduras	5 201	4.1	969.0	6.9
Mexico	64 708	3.0	24,025.7	4.8
Nicaragua	3 827	4.0	796.1	...
Panama	1 982	6.4	966.5	12.0
Venezuela	16 743	9.3	4,720.9	12.4

Source: CEPAL (2005)

1/: \$Millions at constant 2000 prices

**Table 4. Marine Industry Indicators by Nations**

Indicator Country	Marine fishing (TM) 1/	Marine plants (TM) 1/	International tourism (Visitors) 2/	Naval construction s (100 TM) 3/	Cargo traffic (1,000 TM) 3/	Sea oil production (bbl/day) 4/	Devices in the sea (No.) 5/
Belize	5,193	10,160	215,000	0	0	0	0
Colombia	97,335	16,503	508,400	0	0	0	0
Costa Rica	28,327	5,051	1,237,000	0	7,033	0	0
Guatemala	16,834	3,776	1,004,000	0	0	0	0
Honduras	10,700	16,527	688,200	0	5,782	0	0
Mexico	1,398,250	47,991	20,237,400	2	34,776	2,603,816	39
Nicaragua	14,921	7,005	521800	0	0	0	0
Panama	223,398	6,105	592200	0	0	0	0
Venezuela	475,395	14,259	347,800	0	0	0	12

Source: Hoagland P. &amp; D. Jin (2006)

1/: FAO (2003)

2/: WB (2004)

3/: Number of ordered ships (*Shipping Statistics Yearbook 2004*; ISL 2004)

4/: US Department of the Interior (2005)

5/: *Oil and Gas Journal Databook 2004* (OGJ 2004)

**Table 5. Appraisal of the Impact and Tendency of the Transboundary Problems in the Central/South America sub-region**

<b>SUBJECT</b>	<b>PROBLEM</b>	<b>IMPACT</b>	<b>TENDENCY</b>	<b>RESOURCES AFFECTED</b>
<b>Social</b>	Little income, Lack of basic services, permanent damages and death from deep sea diving.	High	Increase	All the hydrobiological resources, human resources.
<b>Institutional</b>	Illegal fishing, illegal fishing arts, increase in contamination	High/very high	Unknown	All the resources that require special treatment for sustainability.
<b>Species</b>	Species in danger, discarding in the sea, post-harvest loss.	Moderate	Unknown	Queen conch , sea bass, turtles, demersal species, exotic species.
<b>Excessive fishing</b>	Decrease in captures, decrease in the sizes.	Very high	Increase	Shrimp, Queen conch , lobster, sea bass, red snapper and pelagics.
<b>Contamination</b>	Contamination due to petroleum and its derivatives, agrochemicals, plastic and packaging material, erosion.	Very high	Increase	Mangrove swamps, marine pastures, coral reefs and all associated species.
<b>Degradation of habitats</b>	Reduction of coastal zones, destruction of marine pastures and coral reefs.	High	Increase	Coastal zone, bottom of the sea, reefs and associated species.
<b>Resources with trophic trans-boundary links</b>	Lack of consensus in utilization and administration of the resources.	High	Unknown	All the highly migratory resources.

**Table 6. Analysis of the causes of the main transboundary problems  
in the Central/South America sub-region**

<b>SUBJECT</b>	<b>PROBLEM</b>	<b>IMMEDIATE CAUSE</b>	<b>UNDERLYING CAUSE</b>
<b>Social</b>	Little income, lack of basic services, health and safety issues including permanent damages and death from deep sea diving.	Few work alternatives, illiteracy, high risk work.	Limited development of the coastal communities.
<b>Institutional</b>	Illegal fishing, illegal fishing gear, increase in contamination.	Deficient monitoring, control and surveillance	Low budget and lack of political willingness to assign funds.
<b>Species</b>	Species in danger, discarding in the ocean, loss of post-harvest.	Trawler fishing, poor handling of the harvest	Deficiencies in the application of the legal standards.
<b>Excessive fishing</b>	Decrease in fish harvest decrease in fish sizes	Excess of industrial effort and failure to acknowledge small scale fishing efforts.	Little clarity in the proprietary rights and free access to the use of the resources by artisanal fishing.
<b>Contamination</b>	Contamination due to petroleum and its derivatives, agro-chemicals, plastic and packaging material, erosion.	Spillages and leakages of disposable substances due to poor handling and poor agricultural and industrial practices.	Deficient information and bad application of the national and international standards.
<b>Degradation of habitats</b>	Reduction of coastal zones, destruction of sea grass beds and coral reefs. .	Increase of tourism and industry in coastal zones.	Non-existing standards or standards with limited application.
<b>Resources with trophic trans-boundary links</b>	Lack of consensus in the utilization and administration of the resources.	Administration at a local or national level, lack of information.	Excessive nationalism .

**Table 7. Description of the main stakeholders in the management and exploitation of the living marine resources in the Central/South America sub-region**

<b>Player</b>	<b>Scope</b>	<b>Present role</b>	<b>Potential role</b>	<b>Capacity</b>
Entities responsible for the fishing sector.	National	Administration of living marine resources.	Guarantee the sustainability of the fisheries.	Good capacity, if there is political willingness to do it.
Entities responsible for the environmental sector.	National	Conservation of the living marine resources.	Improve the use and legislation of areas of influence.	Good capacity, if there is political willingness to do it.
Industrial fishing managers.	National	Extraction of resources by industrial methods.	Involvement in defining methods and gear used in the fisheries	Good, if we consider sustainable fishing.
Artisan fishermen.	National	Extraction of resources by artisanal methods.	Involvement in defining methods and gear used in the fisheries	Good, if we consider sustainable fishing.
Aquaculturalists	National	Production, use of the medium for cultivation.	Control and management measures.	Poor, due to cultivation methods.
Fishing product processors.	National	Industrialization of the harvests; in most cases, they are exporters.	Compliance with rules and regulations	Very good, if the work is done with the government sector.
Product collectors.	National	They purchase the product from the artisan fishermen in the different landing sites.	Compliance with rules and regulations	Very good, if the work is done with the government sector.
Middlemen	National	Processing company purchasers, who can also finance the capture operations.	Compliance with rules and regulations	Very good, if the work is done with the government sector.
Exporters	National / International	Companies in charge of exporting the processed products.	Compliance with rules and regulations	Very good, if the work is done with the government sector.
Commercial companies	National / International	Companies that commercialize the products at a national level and eventually export.	Compliance with rules and regulations	Very good, if the work is done with the government sector.
Universities	National	Academies in charge of doing research.	Increase areas of knowledge.	Good, if there are financing sources.
Research centers	National / International	Government or university entities that carry out timely research.	Increase areas of knowledge.	Very good, if there is a budget assignment.
Non-governmental Organizations	National / International	Civil society organizations that promote, carry out and finance activities in order to know the state of the resources and obtain their protection and sustainable use.	Participate in and agree on measures needed for protection and conservation with the government agencies.	Very good, if there is greater dialogue with the governments and with the donating entities.
Regional Organizations	Regional	Organisms that bring together two or more countries, in order	Generate regional information for the	Good, if there is channeling of

		to harmonize the arrangement and conservation measures.	administration.	information from the region.
International Organizations	International	United Nations organizations, or from donating countries, that support the negotiations of third countries.	Support the initiatives pertaining to management and administration.	Good, if priorities are identified and funds are assigned.

**Table 8. Fishing and Aquaculture Agencies**

<b>Country</b>	<b>Competent Institutions</b>
Belize	Ministry of Agriculture and Fishing
Costa Rica	Ministry of Production
Colombia	Ministry of Agriculture and Rural Development
Guatemala	Ministry of Agriculture, Agronomy and Food
Honduras	Secretariat of Agriculture and Cattle
Mexico	Secretariat of Agriculture, Cattle, Social Development, Fishing and Food
Nicaragua	Ministry de Industry and Trade
Panama	Panama Aquatic Resources Authority
Venezuela	Fishing and Aquaculture National Institute

Source: Country information portals

**Table 9. Natural Resources and Environment Agencies**

Belize	Ministry of Natural Resources and Environment
Costa Rica	Ministry of Environment and Energy
Colombia	Ministry of Environment, Living and Territorial Development
Guatemala	Ministry of Environment and Natural Resources
Honduras	Secretary of Natural Resources and Environment
Nicaragua	Ministry of Environment and Natural Resources
Mexico	Secretary of Environment and Natural Resources
Panama	National Environment Authority
Venezuela	Ministry of Environment

Source: Country information portals



**Table 10. Marine protected areas in the Central/South American countries**

Countries	Protected areas	
	Hectares x 1000	No.
Belize	183	22
Colombia	811	13
Costa Rica	481	21
Guatemala	10	3
Honduras	190	18
Mexico	8,206	37
Nicaragua	130	5
Panama	1,004	14
Venezuela	2,134	19

Source: CEPAL (2005)

**Table 11. Agencies responsible for tourism in the Central/South American sub-region**

Belize	Ministry of Tourism, Information and National Emergencies
Costa Rica	Costa Rican Tourism Institute
Colombia	Ministry of Trade, Industry and Tourism
Guatemala	Guatemala Tourism Institute
Honduras	Tourism Secretary
Mexico	Tourism Secretary
Nicaragua	Nicaragua Tourism Institute
Panama	Panamanian Tourism Institute
Venezuela	Tourism Ministry

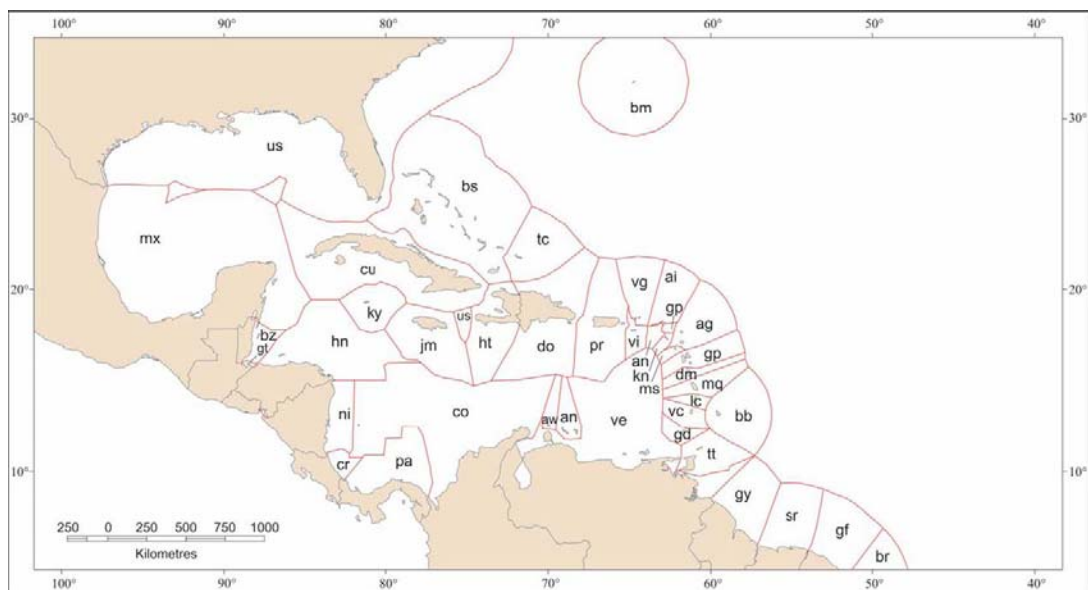
Source: Country information portals

## FIGURES

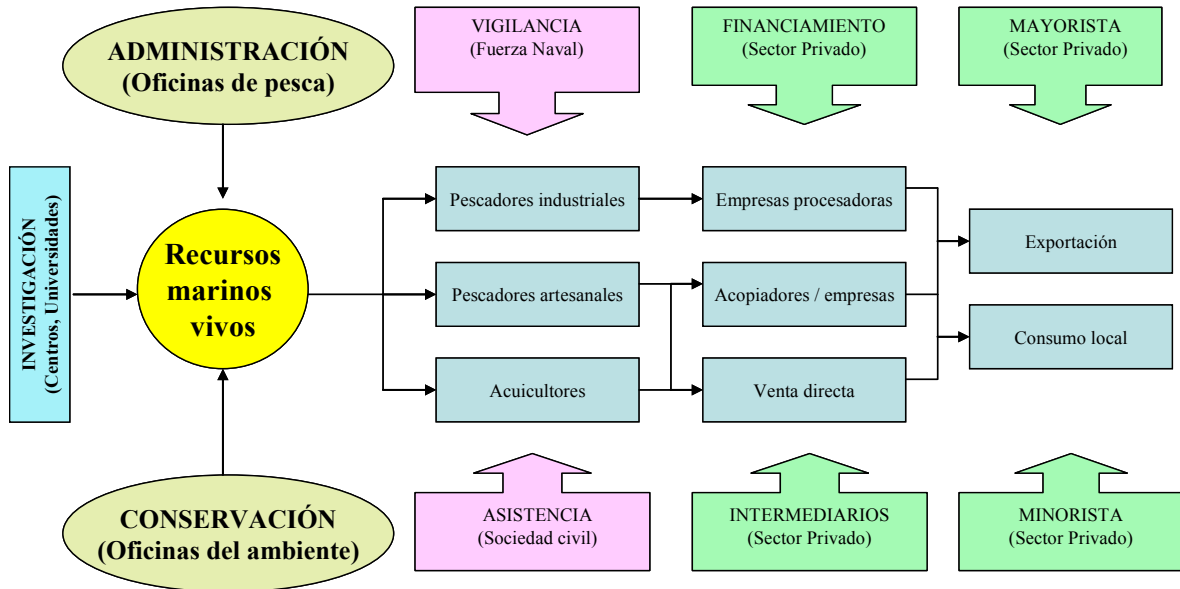
Figure 1. Borders of the Caribbean Sea sub-regions (as used by GIWA)



Figure 2. Maritime Boundaries and the Economic Exclusive Zones of the coastal states of the Central West Atlantic



**Figura 3. Descripción de los actores que intervienen en el uso de los recursos marinos vivos**



## ANNEXES

### ANEXX I

#### Summary of the fishing and Acquaculture data in the Central American Countries

	Belice	Costa Rica	Guatemala	Honduras	Nicaragua	Panama	TOTAL
Production (t)	15353	79580	60600	54112	19746	285990	515380,74
Artisan	666	3799	19800	21780	6052	36117	88214
Industrial	3605	57989	22000	8450	3331	234526	329901
Continental	36,74	0	13346	3882	730	3884	21879
Aqculture a	11045	17792	5454	20000	9633	11463	75387
# of companies	4	44	13	11	19	9	100
# of fishermen	1700	3500	25000	22000	11000	11000	74200
# of vessels							
Artisan l	600	3500	5500	11000	2600	6600	29800
Industrial	4	66	90	295	148	512	1115
Contribution to PIB (%)	5	0.5 - 1	1,3	2	1,5	2,76	1,79
Consumption per capita (Kg/ye	13,2	5,8	2,0	3,3	2,7	15,3	6,04
Export destination	USA, CARICOM, UE, México,	UE, USA, Caribe, CA.	USA, UE, Taiwán	USA	USA	USA, UE, Japón, China.	
Valor export (US\$ x 1000)	31153	138400	25649	154378	104231	412708	866519
Main exporting products	Lobster Shrimps, snail .	Tuna fish, shrimp, tilapia, other fishes	Tuna fish shrimps, fishes	Shirmps, lobster, snail, fishes	Shrimps, lobsters, snail, fishes	Shrimp, snapper, sword fish, tuna fish other fishes	
Valor import (US\$ x 1000)	2574	32100	16544	15500	9200	7485	83403

FAO, Resumen Informativo sobre la Pesca por Países (FAO; años 2002 y 2003)

NMFS-NOAA, National Marine Fisheries Services (División de Estadísticas y Economía Pesquera; Importaciones de USA por país; año 2005)

FAO/OSPESCA., 2006., Mejoramiento de los sistemas de información y recolección de datos pesqueros para América Central y el Caribe., Informe del Taller Regional FAO/OSPESCA sobre el Mejoramiento de los sistemas de información y recolección de datos pesque

Morales, V. & R. Morales., 2006., Sistema regional del desarrollo de la acuicultura; 1. América Latina y el Caribe - 2005., FAO Circular de Pesca No. 1017/1., 177

## ANEXO II

### Fishing and Acquaculture Institutions

Country	Institution	
Belice	Ministry of Agriculture and Fishing	<a href="http://www.agriculture.gov.bz/">http://www.agriculture.gov.bz/</a>
Costa Rica	Ministry of Agriculture and Cattle	<a href="http://www.mag.go.cr/">http://www.mag.go.cr/</a>
Colombia	Ministry of Agriculture and Rural Development	<a href="http://www.minagricultura.gov.co/">http://www.minagricultura.gov.co/</a>
Guatemala	Ministry of Agriculture, Cattle and Food	<a href="http://www.maga.gob.gt">www.maga.gob.gt</a>
Honduras	Secretary of Agriculture and Cattle	<a href="http://www.sag.gob.hn/">www.sag.gob.hn/</a>
México	Secretary of Agriculture, Cattle, Social Development, Fishing and Food	<a href="http://www.sagarpa.gob.mx/cgcs/">www.sagarpa.gob.mx/cgcs/</a>
Nicaragua	Ministry of Promotion, Industry and Trade	<a href="http://www.mific.gob.ni/">www.mific.gob.ni/</a>
Panama	Authority of Aquatic Resource Panama	(En construcción)
Venezuela	Fishing and Acquaculture Nationa Institute	<a href="http://www.inapesca.gob.ve/">www.inapesca.gob.ve/</a>

### Leading Institutions in natural resources and environment

Belice	Ministry of Natural Resources and Environment	<a href="http://www.mnrei.gov.bz/">http://www.mnrei.gov.bz/</a>
Costa Rica	Ministry of Environment and Energy	<a href="http://www.minae.go.cr/">http://www.minae.go.cr/</a>
Colombia	Ministry of Environment, Living and Territorial Develp.	<a href="http://www.minambiente.gov.co">www.minambiente.gov.co</a>
Guatemala	Ministry of Environment and Natural Resources	<a href="http://www.marn.gob.gt/">http://www.marn.gob.gt/</a>
Honduras	Secretary of Natural Resources and Environment	<a href="http://www.serna.gob.hn/">www.serna.gob.hn/</a>
Nicaragua	Ministry of Environment and Natural Resources	<a href="http://www.semarnat.gob.mx/">www.semarnat.gob.mx/</a>
México	Secretary of Environment and Natural Resources	<a href="http://www.marena.gob.ni/">www.marena.gob.ni/</a>
Panama	Environment National Authority	<a href="http://www.anam.gob.pa/">http://www.anam.gob.pa/</a>
Venezuela	Ministry of Environment	<a href="http://www.marn.gov.ve/">http://www.marn.gov.ve/</a>

### Torurism leading entities in the Central/South American Sub Region

Belice	Ministry of Tourisn, Culture, Information and Diffusion	<a href="http://www.belize.gov.bz/cabinet/m_espat/welcome.shtml">http://www.belize.gov.bz/cabinet/m_espat/welcome.shtml</a>
Costa Rica	Costa Rican Tourism Institute	<a href="http://www.mideplan.go.cr/pnd/actores/sector_publico/ict/index.html">http://www.mideplan.go.cr/pnd/actores/sector_publico/ict/index.html</a>
Colombia	Ministry of Trade, Industry and Tourisn	<a href="http://www.mincomercio.gov.co/eContent/home.asp">http://www.mincomercio.gov.co/eContent/home.asp</a>
Guatemala	Guatemala Tourisn Institute	<a href="http://www.inguat.gob.gt/">www.inguat.gob.gt/</a>
Honduras	Tourism Secretariat	<a href="http://www.gob.hn/portal/poder_ejecutivo/secretarias/turismo/">http://www.gob.hn/portal/poder_ejecutivo/secretarias/turismo/</a>
México	Tourism Secretariat	<a href="http://www.sectur.gob.mx/">www.sectur.gob.mx/</a>
Nicaragua	Nicaragua Toursim Institute	<a href="http://www.intur.gob.ni/">http://www.intur.gob.ni/</a>
Panama	Panama Tourism Institute	<a href="http://www.ipat.gob.pa/ipat/index.php">http://www.ipat.gob.pa/ipat/index.php</a>
Venezuela	Ministry of Tourism	<a href="http://www.mintur.gob.ve/portal/index.php">http://www.mintur.gob.ve/portal/index.php</a>

**ANNEX III**  
**INFORMATION ON FISHING LINKS IN THE SUB-REGION**

	Country	Institution/Organization/Company	E-mail address
<b>FISHING DIRECTORS</b>			
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#### ANNEX IV. WEB PAGES LINKS

- 1 : [www.oldepesca.org/](http://www.oldepesca.org/)
- 2 : [www.sica.int/ospesca](http://www.sica.int/ospesca)
- 3 : [www.caricom-fisheries.com/](http://www.caricom-fisheries.com/)
- 4 : <http://www.caricom.com/>
- 5 : <http://www.crn.org/>
- 6 : [www.ccad.ws/](http://www.ccad.ws/)
- 7 : [www.semarnat.gob.mx](http://www.semarnat.gob.mx)
- 8 : [www.cco.gov.co](http://www.cco.gov.co)
- 9 : [www.marn.gob.ve](http://www.marn.gob.ve)
- 10 : <http://sedetur.qroo.gob.mx/index.php>
- 11 : [www.turismocolombia.com](http://www.turismocolombia.com)
- 12 : [www.embavenarg.org](http://www.embavenarg.org)
- 13 : <http://www.rlc.fao.org/organos/copaco/default.htm>
- 14 : [www.sustainlabour.org/documents/](http://www.sustainlabour.org/documents/)
- 15 : <http://www.lablaa.org/blaavirtual/geografia/carcol/visisl.htm>
- 16 : <http://www.provitaonline.org/programas/bioinsula/>
- 17 : <http://www.mejorambiente.org/>
- 18 : <http://www.lablaa.org/blaavirtual/geografia/carcol/visisl.htm>
- 19 : <http://www.gcfi.org/>
- 20 : <http://www.searoundus.org/lme/SummaryInfo.aspx?LME=12>
- 21 : <http://www.mbrs.org.bz/>
- 22 : [http://www.st.nmfs.gov/st1/trade/cumulative\\_data/TradeDataCountry.html](http://www.st.nmfs.gov/st1/trade/cumulative_data/TradeDataCountry.html)
- 23 : <http://www.gpa.unep.org/>
- 24 : <http://ioc3.unesco.org/iocaribe/>
- 25 : <http://www.ww2bw.org/home>
- 26 : <http://ioc.unesco.org/iocweb/index.php>
- 27 : <http://www.worldbank.org/>
- 28 : <http://www.un.org/spanish/>
- 29 : <http://gefweb.org/>
- 30 : <http://www.undp.org/gef/05/>
- 31 : <http://www.imo.org/>
- 32 : <http://gesamp.imo.org/>
- 33 : [http://www.fao.org/fi/body/rfb/weca/c/weca/c\\_home.htm](http://www.fao.org/fi/body/rfb/weca/c/weca/c_home.htm)
- 34 : <http://www.biodiv.org/default.shtml>
- 35 : <http://www.unep.org/wssd/>