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THEMATIC REPORT FOR THE GUIANAS–BRAZIL SUB-REGION

A discussion paper for the CLME Synthesis Workshop

by
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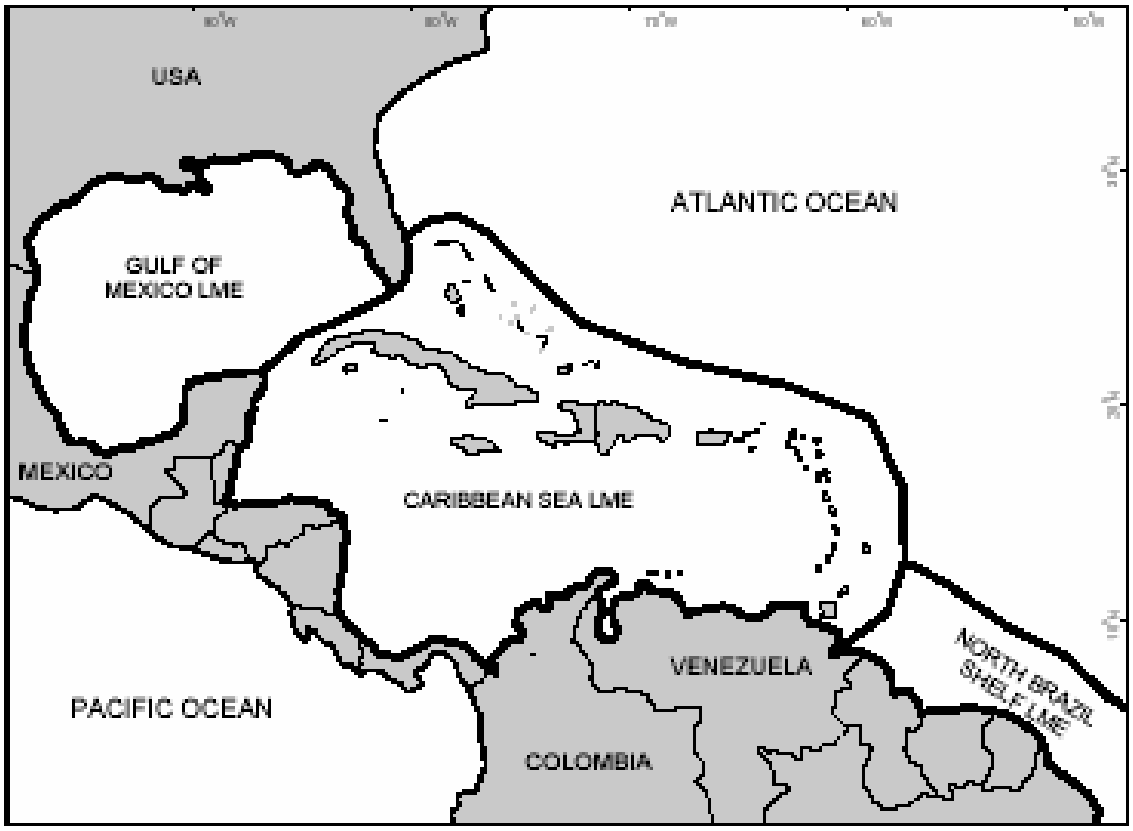

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List of Acronyms and Abbreviations

CARICOM	Caribbean Community
CBD	Convention on Biological Diversity
CEPNOR	Centro de Pesquisa e Extensao Pesqueira do Norte do Brasil
CFRAMP	CARICOM Fisheries Resource Assessment and Management Programme
CLME	Caribbean Sea Large Marine Ecosystem
CLME TTT	CLME Technical Task Team
CRFM	Caribbean Regional Fisheries Mechanism
DOF	Department of Fisheries
EEC	European Economic Community
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FONAIAP	Fondo Nacional de Investifaciones Agropecuarias
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GIWA	Global International Waters Assessment
IBAMA	Instituto Brasiliero do Meio Ambiente e dos Recursos Naturais Renovaveis
IFREMER	Institute Français pour l'exploitation de la mer
IUCN	International Union for the Conservation of Nature and Natural Resources (The World Conservation Union)
IUU	Illegal, Unregulated and Unreported
LME	Large Marine Ecosystem
LMR	Large Marine ecosystem Resources
MARPOL	The International Convention for the Prevention of Pollution of Ships
MCB	Marine Catchment Basin
MCS	Monitoring, Control and Surveillance
MSY	Maximum Sustainable Yield
WECAFC	Western Central Atlantic Fishery Commission
UK	United Kingdom
UN	United Nations
UNCED	United Nations Convention on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
USA	United States of America

1 INTRODUCTION

The Caribbean Sea Large Marine Ecosystem (see cover) is a semi-enclosed tropical sea bounded by North America (South Florida), Central and South America and the Lesser Antilles Chain of Islands. The Caribbean Sea and adjacent regions include a wide variety of tropical ecosystems, associated natural resources and biodiversity. The region includes 26 countries and 19 dependent territories of the USA, UK, France and Netherlands, with countries ranging 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 a high dependence on marine resources for livelihoods, particularly from fishing and tourism. As such, the sustainability of its living resources is of considerable importance to an appreciable portion of the countries in the region.

Figure 1. The Caribbean and Adjacent Large Marine Ecosystems (CLME Project Unit).

The overall objective of the CLME Project is the sustainable management of the shared living marine resources of the Caribbean LME and adjacent regions through an integrated management approach. It is expected that the Project will provide the opportunity for the implementation of management reforms that will permit sustainable development and management of the shared LMRs of the Caribbean Large Marine Ecosystem and adjacent regions. Since most LMRs are shared in some way, these reforms can be expected to lead to improved food security and

enhanced livelihoods in coastal communities that rely on fisheries and tourism (CLME Project Coordinating Office, 2006).

This Thematic Report will outline the key transboundary living marine resources issues for the Guianas–Brazil sub-region, the root causes and potential options for addressing them. For the purpose of this Report, the Guianas–Brazil sub-region will be viewed as the marine area comprised of the North Brazil Large Marine Ecosystem and the Gulf of Paria (Figures 1 and 2). This area is bordered by Brazil (states of Amapá, Pará, Maranhão), French Guiana, Guyana, Suriname, the southeastern part of Venezuela and Trinidad (Republic of Trinidad and Tobago) (Heileman. In press, Charlier 2001, and http://en.wikipedia.org/wiki/Gulf_of_Paria).

2 DESCRIPTION OF THE GUIANAS-BRAZIL SUB-REGION

This section provides an overview of the Guianas-Brazil sub-region, covering the geographical characteristics of the sub-region, its ecological status, a summary of the socio-economic situation and governance.

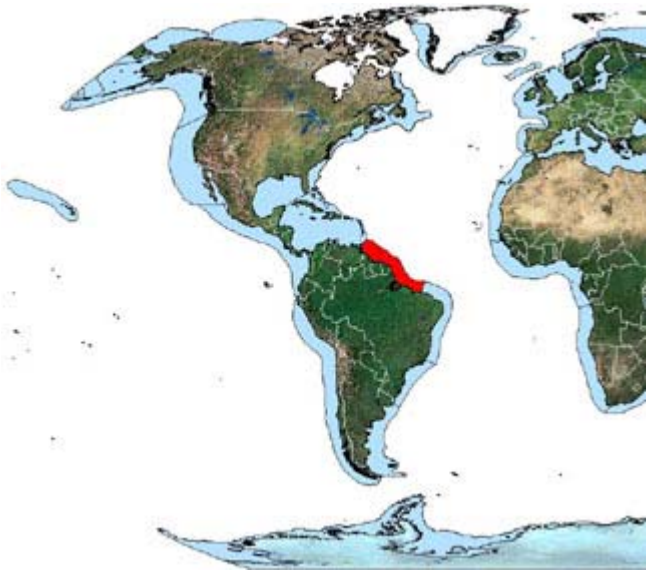


Figure 2. North Brazil Shelf LME (LME #17: North Brazil Shelf)

2.1 Physical and Geographical Characteristics

The North Brazil Shelf Large Marine Ecosystem (Figure 2) is characterized by its tropical climate. It owes its unity to the North Brazil Current, which flows parallel to Brazil's coast and is an extension of the South Equatorial Current coming from the East (LME 17: North Brazil Shelf). It extends along northeastern South America from the Parnaíba River estuary in Brazil to the boundary with the Caribbean Sea and has a surface area of about 1.1 million $km^{2.}$ It contains 0.01% of the world's coral reefs and 0.06% of the world's sea mounts. The hydrodynamics of this region is dominated by the North Brazilian Current, which is an extension of the South Equatorial Current and its prolongation, the Guyana Current. Shelf topography and external

sources of material, particularly the Amazon River with its average discharge of 180,000 m^3s^{-1}, exert a significant influence on the marine ecosystem, with this being complemented by discharge from other rivers such as Tocantins, Maroni, Corentyne, and Essequibo. A wide continental shelf, macrotides and upwellings along the shelf edge are some other features of this LME. (Heileman. In press, and LME 17: North Brazil Shelf). The Gulf of Paria, is a 7800 km^2 inlet of the Caribbean Sea, lying between the Venezuelan coast (including the mountainous Paria Peninsula) and Trinidad. It extends about 160 km east-west and 65 km north-south, and is linked with the Caribbean to the north by the strait called the Dragon's Mouths and with the Atlantic to the south by the Serpent's Mouth (both roughly 16 km wide) (http://www.britannica.com/eb/article-9058456/Gulf-of-Paria).

2.2 Ecological Status

2.2.1 Productivity

The North Brazil Shelf LME is considered a Class I, highly productive ecosystem (>300 $gCm^{-2}yr^{-1}$), with the Amazon River and its extensive plume being the main source of nutrients. Primary production is limited by low light penetration in turbid waters influenced by the Amazon, while it is nutrient-limited in the clearer offshore waters. Primary productivity on the continental shelf has been found to be greatest in the transition zone between these two types of waters, occasionally exceeding 8 $gCm^{-2}day^{-1}$. It has a high number of amphibians, birds and reptile species. In addition to high production, the food webs in this LME are moderately diverse. Brazil's coral fauna is notable for having low species diversity yet a high degree of endemism (Heileman. In press and LME 17: North Brazil Shelf). The Gulf of Paria is a brackish water body, with wet season salinities being below 23 ppt. The extensive mangroves along the Venezuelan and Trinidadian coastlines are considered to be an important wildlife habitat and probably play a crucial role in regional fisheries (http://en.wikipedia.org/wiki/Gulf_of_Paria).

Major fronts within the North Brazil LME are associated with outflow from the Amazon River and, to a lesser extent, that of the Orinoco River. The Amazon plume initially turns northwestward and flows along the Brazil coast as the North Brazil Current. Off the Guiana coast, between 5°N and 7°N, the North Brazil Current retroflects and flows eastward. This retroflection develops seasonally and produces anticyclonic rings of warm, low-salinity water that propagate northwestward toward Barbados, the Lesser Antilles Islands and eventually the Caribbean Sea. The second major source of fresh water is the Orinoco River plume. Most thermal fronts are associated with salinity fronts related to freshwater lenses and plumes originated at the Amazon and Orinoco estuaries. Such fronts are relatively shallow, sometimes just a few meters deep. However, these fronts are important to many species whose ecology is related to the upper mixed layer. Fresh lenses generated by the Amazon and Orinoco outflows persists for months, largely owing to the sharp density contrasts across TS-fronts that form their boundaries (in case of fresh, warm tropical lenses, the temperature and salinity contributions to the density differential reinforce each other) (Heileman. In press).

2.2.2 Fish and Fisheries

The shrimp resources in the Guianas–Brazil sub-region support one of the most important export oriented shrimp fisheries in the world. These resources include four of the larger penaeids

(southern brown shrimp *Penaeus subtilis,* pink spotted shrimp *P. brasiliensis,* southern pink shrimp *P. notialis* and southern white shrimp *P. schmitti*) and the smaller seabob shrimp (*Xiphopenaeus kroyeri*), with their general distribution and abundance differing markedly amongst the countries in the region. In general, the brown shrimp, *P. subtilis*, is more abundant in the eastern (Brazil through Suriname) than in the western (Guyana through Venezuela) regions of the shelf, while the pink spotted shrimp, *P. brasiliensis*, is far more important in Guyana and Suriname than in the remaining countries. The species is not caught in the Brazilian fishery and usually very large individuals are caught off the Venezuelan coast, but the species is secondary to *P. subtilis* in the inshore areas of the Gulf of Paria (Ehrhardt, 2001).

The groundfish resources such as red snapper (*Lutjanus purpureus*), weakfish (*Cynoscion* sp.*)*, whitemouth croaker or corvina (*Micropogonias furnieri*) and sea catfish (*Arius* sp.) in the Guianas-Brazil shelf region are important for commercial and social reasons, with the red snapper probably being the most important groundfish in the region as its distribution range is throughout the region and it is mainly exported. The fisheries are multigear, multispecies and multinational, using fishing methods that can be classified as industrial or artisanal depending on the level of mechanization (Booth *et al*, 2001). Sardine (*Sardinella* sp.) and tuna are also exploited, and although the volume of the tuna catch is relatively small, the value is significant (Heileman. In press).

The total annual fish landings in this area showed a steady increase to 438,000 tonnes in 1973, following which they were more or less stable for about a decade, declined slightly, and then stabilised (Figure 3). The value of the annual landings peaked at over 900 million US$ in 1986 (Figure 4).

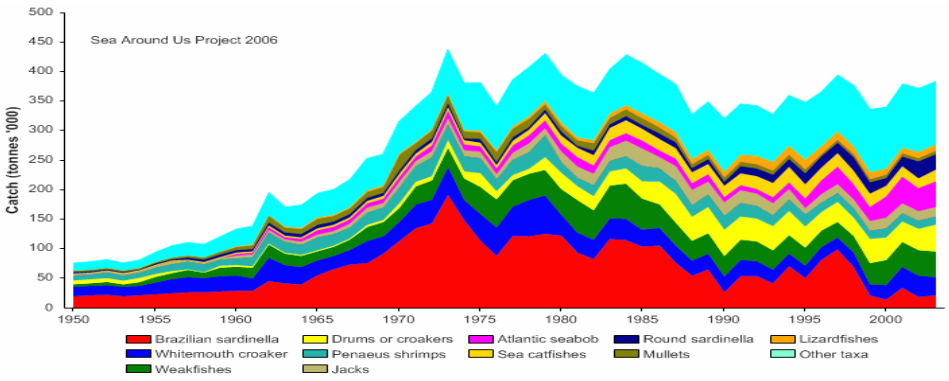


Figure 3. Annual fish landings in the North Brazil Shelf LME (Sea Around Us 2006)

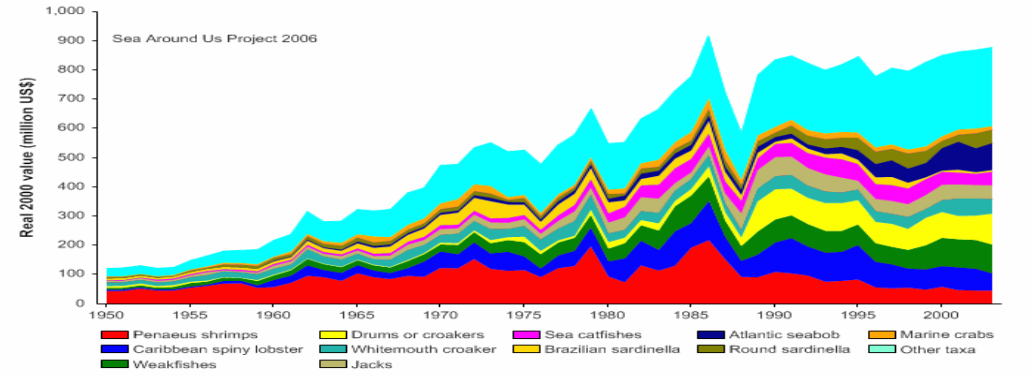


Figure 4. Value of fish landings in the North Brazil Shelf LME (Sea Around Us 2006)

Brazil, followed by Venezuela, Guyana and Suriname, accounts for most of the catch from this area (Figure 5).

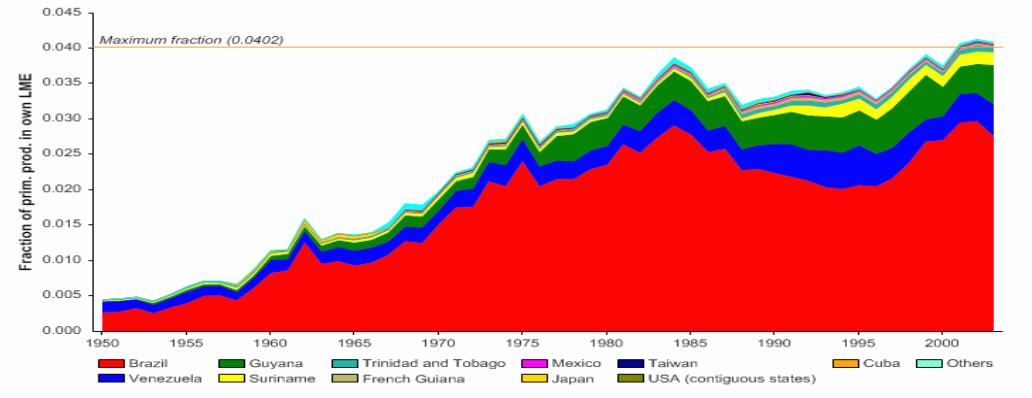
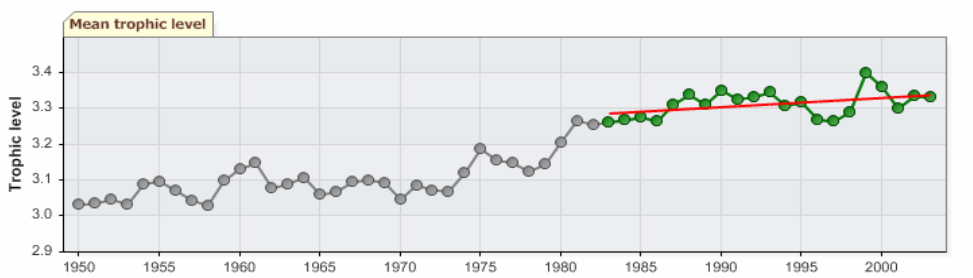


Figure 5. Primary production required by the catches by countries in the North Brazil shelf LME (Sea Around Us 2006)

Between 1983 and 2003, the MTI showed a slightly increasing trend (Figure 6 top), while the FiB index remained relatively constant (Figure 6 bottom). These trends reflect the targeting of higher trophic level species and stable catches over this period, and suggest some degree of fisheries sustainability (Heileman. In press).



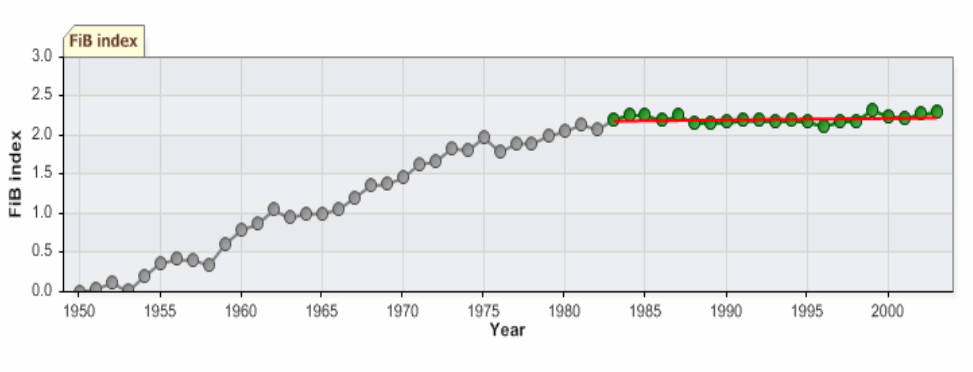


Figure 6. Marine Trophic Index (top) and Fishing in Balance Index (bottom) in the North Brazil Shelf LME (Sea Around Us 2006)

Despite the relatively stable catches, overexploitation was found to be severe, with there being evidence that some of the fisheries in this area may be fully or overexploited, particularly some of the groundfish stocks. In cases where assessments have been undertaken, there are clear signs of overexploitation of the southern red snapper (*Lutjanus purpureus*) resource, with declining catch rates and a decrease in the size of this species. Recent trends in catch per unit effort and other analyses indicate that the corvina is now overexploited in some areas, with the low stock levels of this species being commensurate with exploitation levels beyond the MSY level. Similarly, lane snappers (*L. synagris*), bangamary (*Macrodon ancylodon*) and sharks are also showing signs of overexploitation. A decrease in the average size of some groundfish species has raised sustainability issues. The increasing capture of small individuals is potentially compromising recruitment to the spawning stock. For instance, in Brazil, immature southern red snappers comprise over 60% of the catch of this species. Trawl and Chinese seines harvest bangamary at ages far below the age at maturity. Some deep slope demersal and pelagic species, however, are underexploited and have significant potential for development (Heileman. In press).

In general, all the shrimp species in the region are subjected to increasing trends in fishing mortality and the fishery is generally overcapitalised. Stocks of brown and pink spotted shrimp may be close to being fully exploited, with the latter being overexploited in some areas. There has been a general downward trend in the abundance of brown and pink shrimps, particularly during the late 1980s and throughout the 1990s. The trends in fishing mortality were not high enough to have created the very conspicuous decline in abundance, which implies that environmental factors (seasonal river run-off and rainfall) may be more significant than fishing in determining recruitment in these species.

Excessive by-catch and discards and destructive fishing practices are severe, and are of concern throughout the area, with the shrimp by-catch situation being well know for the region. (Heilemen. In press). Analysis of the species and sizes composition of shrimp by-catch has indicated that many commercial species are included, with only a small part being utilised, and that undersized individuals generally predominate. It is also felt that the species composition has changed over the years and that several species have practically disappeared from the by-catch (Charlier, 2001). In 1998, a study showed that by-catch from the shrimp fishery in northern Brazil was about 7.2 kg of by-catch per kg of shrimp, with 4.4 kg of by-catch being useful for human consumption. It is possible that the above rates have not changed significantly since then.

For the same period, in Venezuela, the by-catch amounted to 93% of the total catch in the nets, with 33 % being sold in the local markets and about 60% being returned, mostly dead to the sea (FAO/WECAFC, 2002.). Artisanal fishing gears such as "Chinese seines" and pin seines also catch large numbers of undersized fish, which result in inefficient utilization while making a significant contribution to overexploitation (FAO/WECAFC, 2001).

IUU fishing poses one of the biggest threats to fisheries management for developing states, with the problem being compounded by a number of factors, such as the large area of marine space to be policed; close proximity of the states leading to situations of stocks straddling the borders of neighbouring states; migratory nature of some fisheries resources and the fishing fleets that follow them; lack of financial and technical resources for surveillance and enforcement; and the lack of skilled manpower for maintaining adequate management systems (CRFM, 2005). It is know that such activities occur within the Guianas–Brazil area, especially in the shrimp and red snapper fisheries, with Brazil, Suriname, Guyana, Venezuela and Trinidad & Tobago having identified illegal fishing as a key management issue that needs to be addressed (Chakalall et al, 2002).

2.2.3 Pollution and ecosystem health

Overall, pollution was found to be moderate, but severe in localised hotspots near urban areas. Most of the pollution is concentrated in densely populated and industrialised coastal basins, and not widespread across the region. Water quality in the coastal areas are threatened by human activities that give rise to contamination from sewage and other organic material, agrochemicals, industrial effluents, solid wastes and suspended solids (Heileman. In press).

Effluents from industries are released, sometimes untreated, into the water bodies. Contamination by mercury as well as by agro-chemical wastes is the main source of chemical pollution in the Amazon Basin. Gold is exploited in all the countries of the region and mercury from mainly artisanal and small scale gold mining operations is dispersed into the air, with the assumption that the largest part ends up in rivers, transforms into methyl-mercury and other chemical compounds and concentrates along the food chain. Mercury contamination could, on the longer-term, become a hazard for the coastal marine ecosystem and for human health, if suitable measures to limit its use are not implemented. There is also the potential risk of pollution from oil extraction, both in the coastal plain and the sea.

Agricultural development is concentrated along the coast and includes intensive cultivation of sugarcane, bananas and other crops. This involves the application of large quantities of fertilisers and pesticides, which eventually end up in the coastal environment. Sugarcane plantations along the coast are also suspected to contribute persistent organic contaminants, which are widely used in pest control, to the coastal habitats (Heileman, In press and LME 17: North Brazil; Shelf.)

As a result of the coastal hydrodynamics in this area, the potential for transboundary pollution impacts is significant. River outflow is deflected towards the northwest and influences the coastal environment in an area situated west of each estuary. It has been estimated that 40-50% of the annual Amazon run-off transits along the Guyana coast. In fact, Amazon waters can be detected as far away as the island of Barbados. As a result, most of the coastal area of the Guianas-Brazil region has been described as an 'attenuated delta of the Amazon'. This implies

that contaminants in river effluents, particularly those of the Amazon, could be transported across national boundaries and EEZs (Charlier, 2001 and Heileman. In press).

2.2.4 Habitat and community modification

Brazil holds about one-third of the world's remaining rainforests, including a majority of the Amazon rainforest, and is also overwhelmingly the most biodiverse country on Earth, with more than 56,000 described species of plants, 1,700 species of birds, 695 amphibians, 578 mammals, and 651 reptiles. Due to the vastness of the Amazon rainforest, Brazil's average loss of 34,660 square kilometers of primary forest per year between 2000 and 2005 represents only about 0.8 percent of its forest cover. However, deforestation in Brazil is one of the most important global environmental issues today. The increase in Amazon deforestation in the early 1970s coincided with the construction of the Trans-Amazonian Highway, which opened large forest areas to development by settlers and commercial interests, while in more recent years, growing populations in the Amazon region, combined with increased viability of agricultural operations, have caused a further rise in deforestation rates (http://rainforests.mongabay.com/20brazil.htm).

The rainforests of French Guiana are still largely unexploited and sparsely populated, with the majority of the population living on the Atlantic coastal zone. For the immediate future, the forests of French Guiana face relatively few threats, although timber extraction is increasing and a relatively high population growth rate of displaced Lao farmers and other local groups may pressure coastal forest regions with subsistence agriculture. Gold potential in the interior regions is attracting foreign development interest, and there are some concerns over a potential road project (http://rainforests.mongabay.com/20frenchg.htm). Suriname's extensive forest cover and low population, about 400,000 concentrated in the capital and coastal cities, with 5 percent living in the rainforest, give it one of the lowest deforestation rates in the world. However, in the past years there has been increasing concern over the developing mining sector, as Suriname is known to have rich deposits of gold and bauxite. Also, its inexpensive power costs makes it attractive to the energy-intensive aluminum business. Such developments suggest deforestation is likely to increase. (http://rainforests.mongabay.com/20suriname.htm).

Guyana, a small, lightly populated country, is about three-quarters forested, with approximately 60 percent being classified as primary forest. In the past, these extensive forests have been lightly exploited, largely due to obsolete equipment and lack of capital. However, in the early 1990s, a large logging concession was granted to a foreign logging firm, and there was a rush from other firms to obtain similar concessions, but this was curtailed, and today, the level of harvesting in Guyana is very low (http://rainforests.mongabay.com/20guyana.htm). Venezuela is one of the ten most biodiverse countries on Earth, with extensive rainforests that are increasingly threatened by development. Each year, roughly 287,600 hectares of forest are permanently destroyed, while other areas are degraded by logging, mining, and oil extraction. Between 1990 and 2005, it is reported that Venezuela lost 8.3 percent of its forest cover, or around 4,313,000 hectares (http://rainforests.mongabay.com/20venezuela.htm).

At present, the tropical forests of the Guianas–Brazil sub region would appear to be relatively unexploited and face few threats, but with increases in large scale logging, artisanal and industrial gold mining, agricultural operations and the growing populations in some of the forested areas, the impacts of these activities can lead to environmental degradation.

Human activities along the coastlands have led to severe habitat modification in the Guianas–Brazil area. Mangroves, which dominate a major part of the shoreline, have been seriously depleted in some areas. For example, in Guyana, mangrove swamps have been drained and replaced by a complex coastal protection system, while on the Brazilian coast, there has been significant reduction in the original mangrove area by cutting for charcoal production and timber, evaporation of ponds for salt, and drained and filled for agricultural, industrial or residential uses and development of tourist facilities. In Brazil, erosion also threatens coastal habitats and some coastal lagoons have been cut off from the sea (Heileman. In Press.).

In the past, the coral reefs were mined for construction material. Currently, they are exposed to increased sedimentation due to poor land use practices and coastal erosion, chemical pollution from domestic sewage and agricultural pesticides, overfishing, tourism and development of oil and gas terminals. Additionally, there has been some coral bleaching associated with climate variation (Heileman. In press and LME 17: North Brazil Shelf).

Trawlers often operate without restriction in the shallower areas of the shelf, over ecologically sensitive areas inhabited by early life stages of shrimp. The environmental impact of such activities is likely to be high, considering the intensity of shrimp trawling operations in these areas. Evidence from other regions suggests that precautionary measures should be undertaken in environmentally sensitive areas of the continental shelf. Trawlers also catch significant quantities of finfish as by-catch, of which dumping at sea is still a widespread practice in the region. In Suriname, small-scale fishers have reported the incidence of 'dead waters', in shallow areas, following fishing activity by trawlers. These dead waters were scattered with dead fish in larger amounts than could have been discarded by the trawlers. Vast areas were devoid of live fish, as they had apparently died or moved out of the area. Such mortality could be the result of local oxygen depletion, caused by the re-suspension of anoxic sediment combined with the presence of organic matter dumped from the vessels.

Growth of the local human population and pressures associated with urban and industrial development will continue to threaten the environmental health of this sub-region. The problems are, however, potentially reversible, considering that there is a greater public and governmental awareness about environmental issues and several measures at national and regional levels are being taken to address some of these problem (Heileman. In press).

2.3 Socio-economic Situation

The coastal zone in the Guianas–Brazil sub-region has not been an area of spectacular economic or industrial development, with the largest part of the coast being even virtually untouched by human activities. Urban development is concentrated in the neighbourhood of river mouths and on riverbanks close to sea, with human impact being probably the highest at both extremities of the region: on the right bank of the Amazon-Para estuarine system, and along the Gulf of Paria, on the Trinidadian side (Charlier, 2001).

Human uses include subsistence agriculture (rice, corn, cassava and beans), fisheries (mostly artisanal and focused on shrimp), and the exploitation of gold in the Amazon Basin. Also, logging and mining are taking place in the Amazon basin. There is coastal exploitation of clay

and sand, and limited ecotourism. (LME 17: North Brazil Shelf and Heileman. In press). In Guyana and Suriname, agriculture (crops cultivated in the coastal areas), fisheries, and natural resources such as gold and bauxite are among the main economic activities.

Marine fisheries constitute an important economic sector in the region, providing foreign exchange earnings, employment, incomes, and animal protein. A significant portion of the region's population depends upon fishing for its survival and is unable to substitute fish with other sources of animal protein. In Brazil, while fisheries activity does not make a significant contribution to the GDP, about 0.4 %, it makes an important contribution to the livelihoods of the population living along the extensive coast, lakes, rivers and weirs, and has created about 800,000 jobs directly, with about 4 million persons depending indirectly on fisheries and fish farming (http://www.fao.org/fi/fcp/en/BRA/profile.htm).

In Guyana, the fishery sector is of critical importance to the economy and to social well-being, with its economic contribution having grown dramatically in recent years. The sector contributes about 6% to GDP and employs about 10,000 persons directly. Furthermore, fish is the major source of animal protein, with per capita consumption of about 60 kg in 1996, more than four times the world average (Heileman. In press). In Trinidad and Tobago, the economy is dominated by oil, natural gas and petroleum exploration and export, so the contribution of the fisheries sector to the Gross Domestic Product (GDP) is small, and is estimated to be about 0.3%, representing about 13 % of the total contribution of agriculture to GDP. However, it is estimated that the fishing industry employs over 10, 000 individuals directly, with another 50, 000 or so engaged in ancillary and support services, representing approximately 10% of the agriculture labour force (http://www.fao.org/fi/fcp/en/TTO/BODY.HTM).

In general, unsustainable overexploitation of living resources as well as environmental degradation may result in threats to the food security of fishers and loss of employment, as well as loss of foreign exchange to the countries bordering this sub-region. (Heileman. In press).

2.4 Governance

Five countries (Brazil, Suriname, Guyana, Venezuela, Trinidad and Tobago) and one dependency (French Guiana) border the Guianas–Brazil sub-region, and need to address the key transboundary living marine resources issues existing in it. The fragmented nature of coastal and marine resource management is a legacy of the colonial past. The languages and cultures of the foreign occupiers (Portugal, France, the Netherlands, Great Britain and Spain) were different, as were the management systems and laws they passed on to these territories, five of which are now independent democracies. These countries are party to several international environmental agreements, for example CBD, UNFCCC, UNCLOS, MARPOL and Ramsar Convention on Wetlands. However, there is presently a lack of coordinated support among them for ecosystem monitoring and management.

The coming into force of the UNCLOS and recent international initiatives in fisheries, such as Agreement to Promote Compliance of International Conservation and Management Measures by Fishery Vessels on the High Seas (Compliance Agreement), The Code of Conduct for Responsible Fisheries, Agenda 21 of the United Nations Conference on Environment and Development (UNCED) and the Agreement for the Implementation of the Provisions of the

United Nations Convention on the Law of Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN Fish Stocks Agreement) have made it necessary for the countries of the Guianas-Brazil sub-region to revise their legislation.

For example, in Brazil, Article 187 of the Federal Constitution of Brazil provides for the definition of an agriculture policy and explicitly includes agro-industrial activities, agriculture and livestock, fisheries and forestry, while Article 225 identifies a number of principles that concerns the environment. Included among these principles, are the protection of fauna and the ecological management of species and ecosystems, with both these principles implicitly including fisheries. The responsibility for the application of these principles lies with the "Poder Publico" (the Government). French Guiana as an overseas department of France is covered by the common fisheries policy of the European Union, which came into effect in January 1983. Among other things, the policy calls for common rules for fishing in the maritime waters and co-ordination of structural policies of Member States to promote harmonious and balanced development of the fishing industry (Council Regulation (EEC) No. 101/76) (Chakalall *et al,* 2002).

In Guyana, the fisheries are being regulated by the Fisheries Act 2002 (replaced the 1959 Fisheries Act and portions of the 1977 Marine Boundaries Act), which includes a number of new provisions, such as authorizing the Minister to promote the development and management of fisheries to ensure the optimum utililization of fisheries resources; mandating the Chief Fisheries Officer to prepare and keep under review a plan for the management and development of fisheries, including consultations with fishermen and others stakeholders and the creation of a Fisheries Advisory Committee (DOF, 2006). In Suriname, fisheries are regulated by the Decree on Marine Fishery, Decree C-14, in force since 1st January 1981. This legislation has been revised and a new fisheries law was drafted in 1992, which, when it comes into force would stipulate the elaboration of annual management plans for the fishery types, in which all regulatory measures will be established. This approach should allow fisheries managers to adapt to the changing conditions of exploitation.

In Trinidad and Tobago, the existing legislation, the Fisheries Act of 1916, was found to be inadequate as a legal basis upon which a modern fisheries management system can be structured, so in June 1995, a draft Fisheries Management Act and Policy Directions for Marine Fisheries in Trinidad and Tobago in the 1990s were prepared. The Act provides the framework for the management of both local and foreign fishing activity in the waters under the jurisdiction of Trinidad and Tobago, with one of the major objectives as outlined in the draft National Marine Fisheries Policy being to provide for a move from a system of uncontrolled, free access to the fisheries resources towards a system of controlled access. The Policy would be dependent upon the preparation of Fishery Management Plans based on the best available scientific and socio-economic information, and the revised legislation would take into consideration the Government's participation in international agreements and national responsibilities for management of the resources of the Exclusive Economic Zone.

In Venezuela, trawl fisheries have been regulated by the joint resolutions of the Ministry of Agriculture (MAC/DGSPA/No. 46) and Ministry of the Environment (MARNR/DAA/No. 103)

from 30th January 1980. The fishing areas for the trawling fleet and the ones reserved to the artisanal fishers are specified, both in the coastal zone and in the island territories. A second resolution (MAC/DGSPA/No. 391) from 13th December 1990 (Annex III) regulates the activity of the trawling fleet in the Gulf of Venezuela. All these resolutions are under study, in order to establish up-to-date norms for this fishery (Chakalall, *et al* 2002).

For the countries of the Guianas–Brazil sub-region, fisheries administration is under the Ministry of Agriculture in all the countries except Brazil, where the responsibility is shared between the Ministry of Agriculture, responsible for development, issuing of licences and for the economic aspects, and IBAMA (Instituto Brasiliero do Meio Ambiente e dos Recursos Naturais Renovaveis), responsible for conservation and management and for enforcement. In most countries fisheries research is also conducted by the national fisheries administration, which is under the Ministry of Agriculture. Brazil and Venezuela have delegated fisheries research to specialised agencies. In Brazil CEPNOR (Centro de Pesquisa e Extensão Pesqueira do Norte do Brasil) is responsible for research in the North of Brazil (Atlantic Ocean and Amazon Basin), while in Venezuela FONAIAP (Fondo Nacional de Investigaciones Agropecuarias), a specialised research agency under the Ministry of Agriculture has the responsibility for fisheries research. In French Guiana, IFREMER (Institute Français pour l' exploitation de la mer) is responsible for research and it provides scientific advice on all aspects of fisheries to the French Ministry of Agriculture, which is responsible for conservation and management, including monitoring control and surveillance.

In most countries, the navy, air force, army, coast guard or police have been delegated the responsibility for monitoring, control and surveillance. This is done in collaboration with the national fisheries administrations, through agreements with the appropriate line agencies, which is the Ministry of Agriculture in most countries and IBAMA in Brazil (Chakalall, *et al* 2002).

Regional and sub-regional organizations such as the FAO/WECAFC and CRFM having been actively promoting fisheries management and development in the Guianas–Brazil subregion. The Member States of FAO/WECAFC include Brazil, French Guiana (EU/France), Suriname, Guyana, Venezuela and Trinidad and Tobago, while those of the CRFM include Suriname, Guyana and Trinidad and Tobago.

There is a need in the sub-region to share a knowledge base, harmonize legislation and effectively enforce regulations, with it being necessary to improve public awareness and involve the resource users in the management process. Institutional reform will help bridge the gap between national and regional efforts (LME 12: Caribbean Sea).

3 KEY TRANSBOUNDARY ISSUES

Based on a review of the existing literature, this section will identify the key transboundary living marine resources issues for the Guianas–razil sub-region and the root causes underlying these issues.

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 Guianas–Brazil sub-region that would need to be addressed are set out below.

Fish and Fisheries
The key transboundary issues identified within the Guianas–Brazil sub-region would appear to be:

(i) Overexploitation of the shrimp and groundfish fisheries.
(ii) Excessive by-catch and discards and destructive fishing practices.
(iii) Illegal, Unreported and Unregulated (IUU) fishing.

Pollution and Ecosystems Health
With regards pollution and ecosystem health the key transboundary issues would appear to be:

(i) Heavy metal pollution by mercury from the gold mining industry.
(ii) Chemical pollution by fertilisers and pesticides from agriculture.

Habitat and Community Modification

(i) Under habitat and community modification, the key transboundary issue would appear to be modification or loss of ecosystems (mangroves/corals) and ecotones.

3.1 Fish and Fisheries

3.1.1 Environmental Impacts

3.1.1.1 Overexploitation of the shrimp and groundfish resources

The effects of fisheries activities on the environment are considerable in the Guianas- Brazil region and can affect fisheries productivity, with the intensity of these effects depending on local conditions, particularly the type of substrate and benthic cover, and the natural variability of the environment. They may be more marked, as far as the benthic environment is concerned, in the outer part of the shelf (beyond 20 m depth) than in the shallow, coastal, soft-bottom zone. But the impact on the structure of the fish communities themselves (species and size composition) is real both on the inshore and offshore components of the ecosystem. However, at present, the interactions between the fisheries and environment are difficult to define and quantify, as understanding these interactions requires a detailed knowledge of the mechanisms of the ecosystem, including its natural variability, which is not currently available (Charlier, 2001).

3.1.1.2 Excessive by-catch and discards and destructive fishing practices

Practically all fishing gear catch non-target species that cannot, in general, be returned alive to the sea. This unintended fishing mortality has reduced drastically several fish populations around the world, particularly demersal species in areas where there is an intensive shrimp trawl fishery. Fish populations can even be reduced outside the fishing grounds. The shrimp by-catch issue is well known in the Guianas–Brazil sub-region, where studies in several countries have attempted to quantify the impact on several commercial species. Analysis of the species and sizes composition of the by-catch reveals that many commercial species are included, that only a small part is utilised, and that undersized individuals generally predominate. It is also felt that the

species composition has changed over the years and that several species have practically disappeared from the by-catch, indicating a dramatic shrinking of their populations, notably in the case of sharks (Charlier, 2001) "Chinese seines" and pin seines also catch large numbers of undersized fish.

Destructive fishing practices, such as the use of explosives and poisons on the reefs and mangroves to capture octopus and crabs respectively, and the use of nets to catch lobsters also contribute to habitat degradation.

3.1.1.3 IUU Fishing

IUU fishing does not pay heed to national boundaries or regional/international attempts to manage fisheries resources, so it can place unsustainable pressure on fish stocks, marine wildlife and habitats (http://www.illegal-fishing.info/).

3.1.1.2 Socioeconomic Consequences

Overexploitation of the shrimp and groundfish stocks in the Guianas–Brazil sub-region with inadequate fisheries management could impact on income, employment, food supply, and foreign exchange earnings in the countries of the region. IUU fishing can lead to major losses in revenue in an area where dependency on fisheries for food, livelihoods and revenues are high.

3.1.2 Linkages with other transboundary problems

In addition to overcapacity in the fishing operations, overexploitation may be linked to environmental factors, which may be more significant than fishing in determining recruitment in some of these species. Shrimp and fin-fish trawls by legal and illegal operators can contribute to habitat and community modification.

3.1.1.4 Causal Chain Analysis

3.1.2.1.1 Overexploitation of the shrimp resources

The immediate causes for overexploitation of the shrimp resources can be attributed to overcapacity (fishing effort, processing infrastructure) in the mainly industrial fishery; and IUU Fishing. Habitat loss or degradation due to nearshore trawling, deforestation of mangrove forests, and possibly chemical pollution from the agricultural (fertilizers and pesticides) and mining (mercury and possibly cyanide) sectors may also be contributing factors.

The underlying causes for overexploitation of the shrimp resources may be due to the high level of investment in a fishery that is driven by the export demand for the product, with the main markets being the USA, Japan and the EU, and the need for foreign exchange by the countries involved. Subsidies in the form of duty free equipment, fuel, spares, etc. may also be contributing to this problem. In addition, inadequate institutional frameworks for fisheries and coastal zone management, such as ineffective policies, deficiencies in legislation and lack of technical capacity in such areas as data management, analysis, management and enforcement in the countries bordering the Guianas – Brazil area may be among the underlying causes.

The main economic and political root causes for the overexploitation of the shrimp resources can be attributed to the need by the industry to obtain adequate returns on their investment and lack of integrated governance structures.

3.1.2.1.1.1.1 Overexploitation of the groundfish Resources

The immediate causes for overexploitation of the groundfish resources can be attributed to overcapacity (fishing effort) in the mainly open access, multigear artisanal fishery based in rural communities; indirect fishing effort by the shrimp trawl fisheries; destruction of juveniles by "Chinese seines" and pin seines; and IUU fishing, especially as it relates to the red snapper fishery. Habitat loss or degradation due to deforestation of mangrove forests, and possibly chemical pollution from the agricultural (fertilizers and pesticides) and mining (mercury and possibly cyanide) sectors may also be attributing to overexploitation.

The underlying causes for overexploitation of the groundfish resources may be due to the demand for fish as a source of protein in the local markets, and the export demand for red snappers, some large sciaenids and marine catfishes to North America. Subsidies in the form of duty free equipment, fuel, spares, etc. may also be contributing to this problem. In many rural communities fishing, often the employment opportunity of last resort, is a main source of employment and income. Also, like with the shrimp fisheries, inadequate institutional frameworks for fisheries and coastal zone management, such as ineffective policies, deficiencies in legislation and lack of technical capacity in the countries bordering the Guianas–Brazil area may be among the underlying causes.

The main socio-economic and political root causes for the overexploitation of the groundfish resources can be attributed to rural poverty, lack of education and lack of integrated governance structures.

3.1.2.1.1.1.2 Excessive by-catch and discards and destructive fishing practices

The immediate, underlying and root causes for excessive by-catch and discards and destructive fishing practices are closely associated with those that are causing overexploitation of the shrimp and groundfish resources, with a significant factor being the multispecies nature of these fisheries.

3.1.2.1.1.1.3 IUU Fishing

The immediate causes for IUU fishing, moreso for the shrimp, red snapper, large sciaenids and marine catfish fisheries, can be attributed to the decline in catches for these resources, which have led to fishers operating in breach of management controls within their respective EEZ's as well as fishing in the waters of other countries. The underlying causes may be attributed to the level of investment in the vessels that catch these species; the export demand and inadequate monitoring, control and surveillance capacities within the countries bordering the Guianas–Brazil sub-region, with the root cause being one of weak governance.

3.1.2.1.1.2 3.1.1.5 Knowledge gaps

Recent work on the brown shrimp and pink-spotted shrimp show a consistent decrease in biomass in recent years, with the decline being attributed to such factors as fishing mortality, increasing fishing close to shore where immature shrimp are caught, and environmental factors possibly linked to rainfall and river outflow. However, there is still need to improve on the quality of data/information as it relates to the fishing capacity, including processing infrastructure, operating in the Guianas–Brazil shrimp fishery and on the intensity and effects of near shore fishing by shrimp trawlers. In like manner, there is need to determine the possible links between recruitment and environment and its likely effects on the fishery. Also, more bio-economic assessments are required as previous work had shown that the current levels of exploitation were above the economic minimum, suggesting that potential revenue was being dissipated. In addition, there is need to evaluate the effectiveness of the management tools, such as effort control, closed areas and closed seasons being used in the shrimp fisheries, and determine how they can be improved. Basic assessment work needs to be done on the seabob as this species is now being targeted by the industrial trawl fleets in countries such as Guyana and Suriname (FAO/WECAFC, 2001).

With regards to the groundfish fisheries, the results of assessments of a limited number of species indicate high levels of exploitation with most stocks being fully exploited and frequently overexploited, but despite a desire for sustainable utilization, management was seriously hindered by a lack of comprehensive and reliable information on many important species (FAO/WECAFC, 2001). For example, even though the red snapper fishery, which started in 1940, is one of the most important fisheries in the region between eastern Venezuela and northern Brazil, not much is known about the stock structure and fishing effort being applied. The identification of the structure and fishing effort would contribute significantly to more effective management (Charuau, *et al.* 2001).

Not much is known about the impacts of nearshore fishing gear such as the "Chinese seines", some nearshore gillnets, and pin seines on the resources and habitats.

The extent of IUU fishing in the Guianas–Brazil sub-region is unknown, but it is recognized that such activities can be detrimental to the management of the fisheries in the sub-region, in terms of its impact on the assessment of the resources, management and economic returns.

3.1.3 Pollution and Ecosystem Health

3.1.3.1 Environmental Impacts

In general, pollution was found to be moderate, with most of it being concentrated in densely populated and industrialised coastal basins and not widespread across the region. However, contamination by mercury from gold mining and agro-chemical wastes were identified as the main sources of heavy metal and chemical pollution, with it being pointed out that mercury contamination could, on the longer-term, become a hazard for the coastal marine ecosystem and

for human health, if suitable measures to limit its use were not implemented (Heileman. In press).

Impacts on marine ecosystems generated by land-based human activities are called Marine Catchment Basin (MCB) effects. Such effects are particularly crucial in enclosed or semi-enclosed seas, but they are also important in the case of ecosystems that are strongly influenced by river run-off, as in the shallow areas of the Guianas - Brazil shelf (Charlier, 2001).

Urban development is concentrated in the neighbourhood of river mouths and on riverbanks close to sea, with human impact being probably the highest at both extremities of the region: on the right bank of the Amazon-Para estuarine system, and along the Gulf of Paria, on the Trinidadian side. Due to the hydrodynamics of the region, the central, largest part of the area may remain basically unaffected. Effluents from the relatively industrialised and populated Belém region, situated on the East bank of Pará River, are barred from this region by the outflow of the Amazon and Pará rivers. Effluents from the west coast of Trinidad reach the Gulf of Paria and, given the Northwards current through the Columbus Channel, cannot impact any region to the South. However, some land-based human activities could have a potential impact on the marine environment and on fisheries in the region (Charlier, 2001).

3.1.3.2 Chemical pollution by fertilisers and pesticides from agriculture.

Agriculture is very important to many economies in the region. It can have a direct impact on the marine environment when it involves areas included in the "broader marine ecosystem" (including brackish zones connected with the sea). Such areas are generally not suitable for agriculture, due to their salt content. For example, it has been a policy, in Suriname not to allow agricultural projects within a certain distance from the coastline, for technical as well as environmental reasons, but exceptions have been tolerated and there have been encroachments on the mangrove and associated brackish-water biota, for rice (as well as in French Guiana) and livestock development, but the areas concerned seem to remain modest.

Agricultural development can be described as very modest in terms of area used. On the other hand, farmed areas are concentrated in a coastal stretch of a few tens of kilometres breadth, the cultures are water-intensive (rice) as well as agrochemicals-intensive (sugar cane, bananas), and the drainage is directly to the sea, without treatment or monitoring of the effluents. Local effects could therefore be observed, particularly if input of an additional nutrient charge from agriculture would combine, for example, with re-suspension of organic matter trapped in sediment.

Areas within the coastal brackish-water belt have been identified as suitable for aquaculture, particularly for marine shrimp, with a few projects having been undertaken in Suriname. These did not cover any significant part of the available area. However, aquaculture seems to have a potential for development and more extended areas could be affected in the future.

Effluents carrying chemicals used in agriculture or residues can also be expected to have impacts if they are drained in sufficient concentration to the sea. They can be pesticides, deleterious for some marine organisms, or fertilizers that may alter the nutrient balance in the sea (Charlier, 2001).

3.1.3.3 Heavy metal pollution by mercury from the gold mining industry.

Gold is being exploited on a small-scale in all countries of the region. The main technology used to separate and amalgamate gold is the least expensive available and involves the application of mercury. This mercury is dispersed into the air and it is assumed that the largest part ends up in rivers, transforms into methyl-mercury and other chemical compounds, and concentrates along the food chain. According to the IUCN, high concentrations of mercury were detected in fish as far as 800 km downstream from gold mining areas in Brazil. Recently initiated investigations in Suriname indicate that mercury concentrations in fish may approach maximum norm (0.5 mg/kg) in piscivorous fish from the upper course of rivers, close to gold mines, and decreases towards the middle and lower course. Larger scale gold mines, present as well in the region, use cyanide to separate gold. Errors can have disastrous consequences for aquatic life, as happened in 1995 in Guyana with the accidental release of cyanide into the Omai and Essequibo rivers (Charlier, 2001).

3.1.4 Socioeconomic Consequences

The value of fisheries products could decrease due to contamination by mercury and cyanide, from artisanal and large-scale gold mining respectively, and pesticides and other chemicals from agriculture. Also, the occurrence of mercury in fish species and the environment could pose problems for human health.

3.1.4.1 Linkages with other transboundary problems

If not checked, the hazards posed to the coastal marine ecosystem by contamination from some chemicals being used in agriculture and gold mining could lead to the decline in fish stocks and other marine organisms.

3.1.4.2 Causal Chain Analysis

Chemical pollution by fertilisers and pesticides from agriculture.
The immediate causes for pollution of the coastal marine ecosystems by chemicals (fertilizers, pesticides) from agriculture can be attributed to farmed areas being concentrated in the coastal belt, with culture practices being used that are water (rice) and agrochemical intensive (sugar cane, bananas), and with the drainage being directly to the sea, without treatment or monitoring of the effluents.

The underlying causes for chemical pollution by fertilizers and pesticides from agriculture can be attributed to inadequate land use policies; the need to produce crops for food (nutrition) and export; and limited job and income earning opportunities in other sectors. The root cause can be attributed to a lack of integrated development strategies, with sectoral planning giving insufficient consideration to the effects on other economic activities or on the environment.

Heavy metal pollution by mercury from the gold mining industry
The immediate cause for the pollution of the marine ecosystem by mercury from the gold mining industry is the use of the least expensive technology available for mainly artisanal mining in the interior areas of countries such as Brazil, Suriname and Guyana. With the advent of large scale gold mining which involves the use of cyanide and the storage of the waste in containment structures, contamination of rivers and the marine ecosystem due to run off could occur with inadequate construction and maintenance of these structures. The underlying cause can be

attributed to the demand for gold in the world market, unemployment and lack of income earning opportunities, illegal immigration, and insufficient institutional capacity to regulate the mining sector. The root cause can be attributed to poverty, lack of education, need for adequate returns on investment and weak governance.

3.1.4.3 Knowledge gaps

Agriculture is very important to many economies in the region, such as Suriname and Guyana, but not much is known about its impact when extended into areas included in the broader marine environment, and the effluents carrying chemicals used in agriculture if they are drained in sufficient concentration to the sea. Not much is known about the effects of mercury from artisanal gold mining on the riverain, estuarine and marine ecosystems, and on the health of the miners and those living in nearby communities.

3.1.5 Habitat and Community Modification

3.1.5.1 Environmental impacts

Modification or loss of ecosystems and ecotones

In this sub-region, there are clear indications that the entire shallow, brackish-water stretch along the seashore (0-10 m depth) plays a key role in the mobilization of nutrients and energy transfer in the lower levels of trophic webs, and serves as nursery ground for many marine fish and shrimp species. However, additional research is needed to improve understanding and quantify this role.

The existence and the capacity of this near-coastal zone to fulfill its role is highly dependent on inputs from the neighbouring mangrove and associated habitats. The mangrove is very well represented in the region, where it dominates a major part of the shore, but it is possible that not all portions of the coast would have the same importance, as some processes may perhaps be concentrated in certain areas, possibly in estuaries. Ecological research is needed to identify such "critical" zones with a view to their conservation. There seem to be other particularly valuable areas, with a high primary production, like the "lixeira", in front of the Amazon estuary. Research on the processes taking place in these areas is required as well, for the elaboration of an appropriate management strategy.

Fishing gears can alter, in a more or less persistent way, the habitats of fish populations. It is not generally known what the different species exactly require in order to complete successfully the different steps of their life cycle. But, it is known that habitats have to fulfill different functions such as shelter (hiding from predators), foraging area for food, breeding area, nursery area, and the capacity to fulfill one or more of these functions can be impaired by damage provoked by fishing gear action, with the damage being on the seabed, the benthos, or on the water quality (Charlier, 2001).

3.1.5.2 Socioeconomic Consequences

The continued degradation of "critical" zones or habitats and the unsustainable exploitation of fisheries and other living resources in the sub-region could lead to unemployment and reduced incomes and consequent deterioration in the quality of life among coastal communities.

3.1.5.3 Linkages with Other Transboundary Problems

The removal of mangroves and associated habitats as well as the degradation of nearshore areas by trawls and other destructive fishing gear could lead to changes in composition and decline in fish populations.

3.1.5.4 Causal Chain Analysis

Modification and loss of ecosystems and ecotones
The immediate causes for the destruction of mangroves and associated habitats, which serve as shelter, foraging area for food, breeding area and nursery area for many marine species and shrimp, are removal for energy/fuel, clearing for agriculture (rice), aquaculture (shrimp culture) and other development activities. The underlying causes can be attributed to inadequate land use policies; the need to produce crops for food (nutrition) and export; and limited job and income earning opportunities in other sectors. The root cause can be attributed to a lack of integrated development strategies, with sectoral planning giving insufficient consideration to the effects on other economic activities or on the environment.

3.1.5.5 Knowledge gaps

Additional research is required to improve on the knowledge of the role that the entire shallow, brackish-water stretch along the seashore (0-10 m depth) plays in the mobilization of nutrients and energy transfer in the lower levels of trophic webs, and providing nursery ground for many marine fish and shrimp species.

4 STAKEHOLDERS ANALYSIS

Preliminary assessments of the responses provided on the CLME Project Template, devised by the CLME Unit and CLME TTT, by the CLME Inter-ministerial Committees of Brazil and Guyana, are presented in this section. It is noted that this section will be updated as information requested from each of the countries in the sub-region is received.

The CLME Technical Task Team and Unit identified and advanced three key areas of concern as affecting sustainability of transboundary living marine resources, specifically, Overfishing; Pollution and Contamination; and Habitat Degradation. Both respondents agreed with these areas of concern, but did not identify any others. In the case of Brazil, pollution and contamination was ranked first and overfishing third. Guyana's primary area of concern was overfishing, with pollution and contamination listed in third place. Both countries indicated that habitat degradation was the second most important area of concern.

From the answers provided it would appear that there are areas of commonality in relation to the origins and causes of the three named areas of concern. With regards to overfishing, both parties

identified the origin of their concern to be overcapacity and IUU fishing. Also identified were excessive population growth, with concentrated occupation near the coast; poverty and hunger; and increasing demand for fish products. The causes for this concern included inadequate fisheries management planning; lack of enforcement of conservation and management measures; unsustainability of fish stocks; and the impacts on the livelihood of fishers.

Pollution from gold mining (mercury); agricultural (pesticides, herbicides and fertilizers) and human waste were common origins advanced by both parties relative to pollution and contamination. Industrial residuals; oil spills and contaminants from ships and fishing trawlers were also listed. The causes of pollution and contamination were indicated as poor infrastructure in urban coastal areas; inadequate enforcement of environmental regulations in relation to industrial and agricultural activities; and impacts on the ecosystems.

Urban development on the shore line, destructive fishing methods, over-fishing, deforestation and destruction of key habitats, namely estuaries, mangrove forests and coral reefs were indicated as origins of habitat degradation. Causes for this area of concern were given to be poor physical planning and inadequate enforcement of environmental regulations; seacoast pollution; and mangrove destruction.

Both Brazil and Guyana indicated that neighbouring countries contributed to the identified areas of concern in their respective countries. In Brazil's case, the impact was noted to be minor in the case of pollution and contamination; major in the case of habitat degradation and major to severe in the case of overfishing. Over-fishing and habitat degradation in Guyana were indicated to be severely impacted by its neighbouring countries. However, while it was noted that Guyana's neighbours contributed to their concern of pollution and contamination the extent of the impact was not known.

With regard Brazil's and Guyana's impacts on their neighbours, both countries indicated that they contributed to these concerns in neighbouring territories. Guyana was unable to rate their impact in all three cases, while Brazil rated the level of impact on its neighbours as major to severe in the case of over-fishing; major in relation to habitat degradation and minor in the case of pollution and contamination.

In response to the identified area of concern of overfishing Brazil noted its current collaborative study on the biology of billfishes and oceanic sharks involving universities in Brazil, Venezuela and USA, as well other key research and management projects dealing with the estimation of living resources in the Brazilian Exclusive Economic Zone; controls on fishery concessions; satellite tracing of fishing boats; on-board observer programmes; by-catch reduction; and licensing and registration of professional fishers. Planned activities include a marine living resources monitoring programme; enhanced management of conflicts between artisanal and industrial fishers; and improved control of fishing fleets. Guyana for current activities, under overfishing indicated its ongoing participation in the FAO/WECAFC and CRFM activities for the sub-region and MCS by their Coast Guard.

Research being undertaken by Brazil to address the concern of pollution and contamination is comprised of studies/projects in coastal management and marine pollution, including the effects

of oil spills. In addition, they are implementing plans such as the National Plan for Prevention, Preparation and Fast Response for Environmental Emergency with Hazardous Chemical Products (P2R2); the Plan for Preservation and Recuperation of Environmental Damage Related to the Oil Industry; and one addressing ballast water.

In an effort to address the concern of habitat degradation, Brazil indicated its involvement in the following programmes and projects – Hydrological Basin Management; Sanitation for Everyone; Social Action on Sanitation; Urban Solid Residue Program; Environmental Management of Fragile Habitats; Coastal Management National Plan; Oceanfront Project; and Conscious Conduct on Coral Reef Areas.

Regarding habitat degradation and pollution and contamination Guyana identified current and planned activities in the areas of education (public awareness) and monitoring respectively.

In relation to additional potential solutions that could assist with addressing the concern of overfishing, Brazil indicated that there was need for better enforcement of management measures; a more participatory decision-making process; and the use of innovative management tools such as marine protected areas to assist stock recovery, while Guyana suggested a reduction in fishing effort and the use of management tools like closed seasons and closed areas.

Improved monitoring and enforcement of environmental regulations was identified by both countries as a potential solution to pollution and contamination, with Brazil also indicating the need for greater investments in urban sewage treatment and Guyana improved collaboration. In the instance of habitat degradation, Brazil identified the need for the establishment of marine protected areas to conserve fragile ecosystems (e.g. mangrove forests and coral reefs) and improved integrated coastal management. Guyana suggested public awareness and enforcement.

In terms of types of information most needed to assist in addressing the areas of overfishing, pollution and contamination and habitat degradation, both countries indicated that scientific data was required. In addition, Brazil identified the need for socio-economic and demographic data in all three areas while Guyana indicated the need for social and economic data in the case of habitat degradation.

Both parties acknowledged that interventions in the areas of data and information; monitoring and enforcement; private and NGO involvement and the implementation of decisions were of critical importance. The data, captured in the table (Table 1) below, also show that both countries recognize as very important the need for greater collaborative efforts with neighbouring/other countries in the area of over-fishing. The need for more laws seem to be only somewhat important across the board, except in the case of habitat degradation for Guyana.

Table 1.

Area of Intervention	Brazil			Guyana		
	Over-fishing	Pollution & Contamination	Habitat Degradation	Over-fishing	Pollution & Contamination	Habitat Degradation
More data and information	3	2	3	3	3	3
More monitoring and enforcement	3	3	2	3	2	3
More laws	1	1	1	1	2	3
More inter-ministerial level decision-making	2	2	2	2	2	3
More private and NGO involvement	3	2	2	3	2	3
Better implementation of decisions	3	3	3	3	2	3
Collaborative effort with neighbouring/ other countries	2	1	1	3	2	3

Key

0 - not important
1 - somewhat important
2 - very important
3 - absolutely necessary
9 - don't know

5 GOVERNANCE ANALYSIS

The coming into force of UNCLOS and recent international initiatives in fisheries have made it necessary for the countries in the Guianas–Brazil sub-region to revise their policies and legal frameworks for fisheries management and development. To this effect, Brazil, French Guiana and Guyana have put the necessary legislation in place, while Suriname, Trinidad and Tobago and Venezuela were in the process of doing so. In general, the legislation in place or being put in place promotes the ecosystems based approach to management and calls for the development, implementation and regular evaluation of fisheries management and development plans, based on the best available scientific and socio-economic information, in consultation with the stakeholders involved in the various fisheries.

In most instances, fisheries administration and research fall under the umbrella of the Ministry of Agriculture of the countries of the sub-region, except in Brazil, where fisheries administration is shared between the Ministry of Agriculture and IBAMA, with research being delegated to CEPNOR and, in Venezuela, where research has been delegated to FONAIAP. In general, MCS is delegated to the navy, air force, army, coast guard or police. In many of these countries some level of institutional reform is taking place to better enable the fisheries administrations to carry out their mandates, as many of them are faced with such problems as insufficient staff to fulfill essential functions; poor communication between different levels and interest groups; and no clear decision-making procedures and responsibilities, with insufficient funding being an important factor in these problems (FAO/WECAFC, 2001).

As they seek to address the key transboundary living marine resource issues for the Guianas–Brazil sub-region, the countries may need to strengthen and/or develop mechanisns for sub-regional collaboration and cooperation in areas such as assessment and management; harmonise their legislation; develop a sub-regional database for fisheries and related data; establish mechanisms for strengthening MCS at the national and sub-regional levels; involve the various stakeholders in the management process; and build public awareness.

Following on the decisions taken at the 1996 Fourth Meeting of WECAFC Ad Hoc Shrimp and Groundfish Working Group of the Guianas–Brazil Shelf and CFRAMP Shrimp and Groundfish Subproject Specification Workshop, WECAFC in partnership with CFRAMP (now CRFM) conducted a series of workshops on the assessment and management of shrimp and groundfish fisheries on the Guianas–Brazil Shelf from 1997 to 2000 for the countries bordering the sub-region. This series of workshops culminated in a meeting of fisheries managers and ministers of the sub-region in 2001, and the First Regional Conference on the Sustainability of Fisheries Resources in the Brazil–Guianas Shelf in 2002, which sought to involve both resource managers and users. This approach to promoting fisheries resource assessment and management in the sub-region was viewed as an effective one, despite some shortcomings, and its continuation recommended (FAO/WECAFC 2001).

6 SUMMARY AND CONCLUSIONS

Based on a review of existing literature the key transboundary living marine resource issues identified for the Guianas–Brazil shelf are:

Fish and Fisheries

(i) Overexploitation of the shrimp and groundfish fisheries.
(ii) Excessive by-catch and discards and destructive fishing practices. Illegal, Unreported and Unregulated (IUU) fishing.

Pollution and Ecosystems Health

(i) Heavy metal pollution by mercury from the gold mining industry.
(ii) Chemical pollution by fertilisers and pesticides from agriculture.

Habitat and Community Modification

(i) Modification or loss of ecosystems (mangroves/corals) and ecotones.

Having reviewed the situation and determined the causes and knowledge gaps, the interventions to address the key transboundary issues are set out below.

6.1 Fish and Fisheries

Overexploitation of the shrimp and groundfish resources combined with excessive by-catch and discards and destructive fishing practices and IUU fishing due to inadequate fisheries management and enforcement could lead to further loss of income, employment, food supply and foreign exchange in the sub-region and should be urgently addressed. Among the interventions required are:

(i) Determination of the level of poverty in the fishing communities and the identification of alternative livelihood programmes.
(ii) Institutional strengthening of the fisheries administrations and research institutions at the national and sub-regional levels.
(iii) Harmonisation of fisheries and related legislation in the sub-region.
(iv) Strengthening of the existing mechanisms for sub-regional collaboration in resource assessment and management.
(v) Development of mechanisms for improved stakeholder participation in the management process.
(vi) Development of mechanisms for conflict resolution.
(vii) Development of a sub-regional database for fisheries and related data/information.
(viii) Evaluation of the tools being used for fisheries management in the sub-region.
(ix) Continued assessment, including bio-economic assessments, of the shrimp and groundfish resources.
(x) Review and determination of the most suitable methods for by-catch utilization and reduction. In this instance, the information from the GEF Reduction of Environmental Impact From Tropical Shrimp Trawling through the Introduction of By-Catch Reduction Technologies and Change of Management, in which Venezuela and Trinidad and Tobago were involved, could be reviewed and utilized (http://www.fao.org/figis/servlet/static?xml=gef_shrimp.xml&dom=org&xp_nav=1,4).
(xi) Determination of the extent of IUU fishing in the sub-region and the development of mechanisms to combat it at the national and sub-regional levels.
(xii) Determination of the environmental factors that may be influencing recruitment to the shrimp fishery.

6.2 Pollution and Ecosystems Health

Heavy metal pollution from mining and agro-chemical pollution, if not effectively managed, could lead to degradation of the coastal marine ecosystems. In the case of mercury, it could affect the health of miners, as well as the health of other members of the community should it enter the food chain. Among the interventions required are:

(i) Strengthening of the institutional framework for integrated coastal management.
(ii) Improved land use and mining policies.
(iii) Determination of the level of poverty in the mining areas and the identification of alternative livelihood programmes.
(iv) Development and implementation of adult education and public awareness programmes.
(v) Strengthening of the institutional mechanisms for monitoring and enforcement in the mining industry.
(vi) Improved knowledge of the effects of agro-chemicals and heavy metals on coastal ecosystems.

If the GEF/ UNIDO project to formulate a global action plan for countries that pollute their waters with mercury used as part of the process of artisanal gold mining is still being developed

and/or implemented, then, in addition to Brazil, the countries bordering the sub-region should seek to become involved in it (LME 17: North Brazil Shelf).

6.3 Habitat and Community Modification

The continued degradation of "critical" zones or habitats (mangroves, corals) and the unsustainable exploitation of fisheries and other living resources could lead to a deterioration of the quality of life in coastal communities, and, as such, needs to be addressed. Among the interventions required are:

(i) Strengthening of the institutional framework for integrated coastal management.
(ii) Improved land use policies.
(iii) Improved knowledge of the role that the entire shallow, brackish-water stretch along the seashore plays in the mobilization of nutrients and energy transfer in the lower levels of trophic webs, and providing nursery ground for many marine fish and shrimp species and the impacts on these areas by human activities.
(iv) Creation of reserves to protect ecologically sensitive coastal ecosystems (e.g. mangroves).

It should be noted that Brazil, Guyana, Suriname and Venezuela, along with Bolivia, Colombia, Ecuador and Peru, are developing a Project for support by GEF, entitled "Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin", with the overall objective being to strengthen the institutional framework for planning and executing in a coordinated and coherent manner, activities for the protection and sustainable management of land and water resources of the Amazon River Basin. The project recognises the close linkages between integrated water resource management and the protection of marine habitats. Also, Brazil is seeking GEF support for the biodiversity project "Strengthening the Effective Conservation and Sustainable use of Mangrove Ecosystems in Brazil through its National System of Conservation Units", with the aim of the project being to develop conservation and sustainable management of mangrove ecosystems in Brazil to conserve globally significant biodiversity and key environmental services and functions important for national development and well-being of traditional and marginalized coastal communities (Heileman. In press).

7 REFERENCES

Booth, A., Charuau, A., Cochrane, K., Die, D., Hackett, A., Lárez, A., Maison, D., Marcano, L.A., Phillips, T., Soomai, S., Souza, R., Wiggins, S. and IJspol, M., 2001. Regional assessment of the Brazil-Guianas groundfish fisheries. FAO Fisheries Report 651:22-36.

Chakalall, B., K. Cochrane and T. Phillips, 2002. Regional Conference on the Sustainability of Fisheries in the Brazil – Guianas Shelf, Paramaribo, Suriname, 5 – 7 March 2002: Existing Approaches to Fisheries Management in the Brazil – Guianas Shelf. WECAFC/B-G/1/4. 20 p.

Charlier, P., 2001. Review of environmental considerations in management of the Brazil Guianas shrimp and groundfish fisheries. FAO Fisheries Report 651:37-57.

Charuau, A., Cochrane, K., Die, D., Lárez, A., Marcano, L.A., Phillips, T., Soomai, S., Souza, R., Wiggins, S. and IJspol, M. (2001). Regional Assessment of red snapper, *Lutjanus purpureus*. FAO Fisheries Report 651:15-21.

CLME Project Coordinating Office, 2006. Caribbean Sea Large Marine Ecosystem: Sustainable Management of the Shared Marine Resources of the Caribbean Large Marine Ecosystem and Adjacent Regions (The CLME Project). 4 p.

CRFM, 2005. A Review of the Current Situation on IUU Fishing and MCS in the Fisheries Sector of the CARICOM/CARIFORUM Region. A Strategy for Enhancing the Effectiveness of MCS and a Proposal for a Project to Enhance the Effectiveness of MCS. 55 p. Unpubl.

DOF, Guyana, 2006. Draft Fisheries Management Plan for the Fisheries of Guyana. Unpubl.

Duda, A. M., and K. Sherman, 2002. A New Imperative for Improving Management of Large Marine Ecosystems. Ocean and Coastal Management 45 (2002) 797 – 833.

Ehrhardt, N.M., 2001. Comparative regional stock assessment analysis of the shrimp resources from northern Brazil to Venezuela. FAO Fisheries Report 651:1-14.

FAO, 2000. Information on Fisheries Management in the Republic of Trinidad & Tobago. http://www.fao.org/fi/fcp/en/TTO/BODY.HTM

FAO, 2001. Fishery Country Profile. The Federative Republic of Brazil. http://www.fao.org/fi/fcp/en/BRA/profile.htm.

FAO/WECAFC, 2001. Report of the Meeting of Fisheries Managers and Ministers of the WECAFC Ad Hoc Working Group on Shrimp and Groundfish Resources in the Brazil – Guianas Shelf. Port of Spain, Trinidad and Tobago, 26-29 March 2001. FAO Fisheries Report. No. 650. Rome, FAO. 2001. 61 p.

FAO/WECAFC (2002). Regional Conference on the Sustainability of Fisheries in the Brazil – Guianas Shelf, Paramaribo, Suriname, 5 – 7 March 2002: Background to Shrimp and Groundfish Fisheries of the Region (Brazil – Guianas Shelf). WECAFC/B-G/1/5. 6p.

Gulf of Paria. http://en.wikipedia.org/wiki/Gulf_of_Paria

Gulf of Paria. http://www.britannica.com/eb/article-9058456/Gulf-of-Paria

Heileman, S. (In press) In: *The UNEP Large Marine Ecosystems Report - A Perspective on Changing Conditions in LMEs of the World's Regional Seas* (K. Sherman and G. Hempel, editors). UNEP/GEF/NOAA publication.

http://www.fao.org/figis/servlet/static?xml=gef_shrimp.xml&dom=org&xp_nav=1,4

http://www.illegal-fishing.info/

http://rainforests.mongabay.com/20brazil.htm

http://rainforests.mongabay.com/20frenchg.htm

http://rainforests.mongabay.com/20guyana.htm

http://rainforests.mongabay.com/20suriname.htm

http://rainforests.mongabay.com/20venezuela.htm

LME 12: Caribbean Sea. http://na.nefsc.noaa.gov/lme/text/lme12.htm#governance

LME 17: North Brazil Shelf. http://na.nefsc.noaa.gov/lme/text/lme17.htm

LME #17: North Brazil Shelf. http://www.edc.uri.edu/lme/text/north-brazil.htm

Pauly, D., 2005. The Marine Trophic Index.
http://www.seaaroundus.org/doc/saup_manual.htm#19.