September, 2011

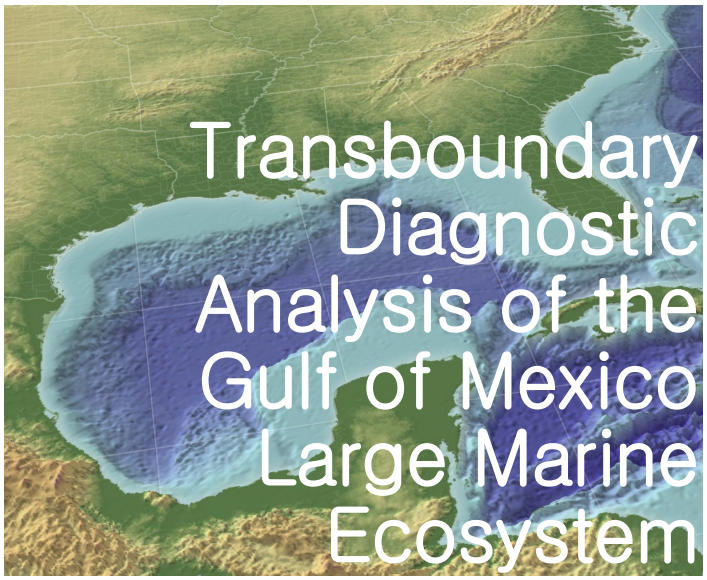
Integrated Assessment and Management of the Gulf of Mexico Large Marine Ecosystem

Transboundary Diagnostic Analysis

Executive Summary

GLOBAL ENVIRONMENT FACILITY

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION



OVERVIEW

The Gulf of Mexico (GoM) is a semi-enclosed sea located between tropical and subtropical North Atlantic latitudes, and includes a wide variety of marine habitats. As one of the 64 Large Marine Ecosystems in the world, it generates about 700,000 tons of fisheries catch and its one of the most important water bodies economically within the Mexican and US Exclusive Economic Zones. With a surface area of 1,623 X 10^6 km^2, the GoM now supports fishery landings of over one million tons per year, not accounting for the large amount of discards.

A very high diversity of marine habitats that includes tropical and temperate ecosystems, estuaries, shallow inshore waters with soft bottoms, rocky bottoms and reef communities, and a large extension of deep sea, sustains an ample diversity of living marine resources (LMR). More than 300 species sustain local fisheries (including fish, crustaceans, mollusks, echinoderms and other invertebrates) but also LMR with unique ecosystem value in the trophic structure, such as sea birds, marine mammals, and sea turtles.

The Gulf Coast region is especially vulnerable to a changing climate because of its relatively flat topography, rapid rates of land subsidence, water engineering systems, extensive shoreline development, and exposure to major storms.

The Gulf Coast regional temperature over the 20th century, according to data from the United States Historical Climatology Network data set, increased from the turn of this century until the 1950s, when a significant cooling took place. Since that time a general warming trend has been established again. Compared with the previous 24 years (1971-94), there were twice as many hurricanes in the Atlantic, including two and a half times more major hurricanes (reaching category 3 strength and higher).

PRODUCTIVITY

Primary productivity is the synthesis and storage of organic molecules during growth and reproduction of photosynthetic organisms: in coasts and seas the photosynthetic organisms or primary producers are represented by phytoplankton, sea grasses, macro algae, marsh plants and mangroves.

The GoM as a Large Marine Ecosystem is considered oligotrophic in open oceanic waters, related to the influence of anti-cyclonic gyres in the central basin of the GoM, yet there are areas of high productivity. These high productivity areas support an important global reservoir of biodiversity and biomass of

fish, crustaceans, mollusks, sea birds and marine mammals. Productivity in these areas of the LME has been unbalanced in recent years due to three main factors:

1) habitat destruction from coastal development impacting the coastal ecosystems connectivity and the resilience of the ecosystem;

2) eutrophication which can result in ecosystem stressors such as hypoxia and harmful algal blooms (HABs) and lead to seagrass and secondary productivity reduction, among other water quality and living resource impacts;

3) low quantity/quality and timing of fresh water inflows which impact the balance among inputs, transformation and export of matter and energy between inland and coastal-marine ecosystems.

Eutrophication and related problems, such as hypoxia and HAB´s, are widespread in the GoM, with dead zones close to the Mississippi River discharge and near Terminos Lagoon clear examples of these phenomena. Marine currents could be a factor in harmful species dispersion.

However, one of the major problems to the capability to conduct a harmonic and homogenized management action plan for the entire GoM LME, is the strong difference between countries in the basic assessment of the coastal condition habitats and water quality, as well as the lack of monitoring programs to support decision-making and adaptive management.

POLLUTION & ECOSYSTEM HEALTH

The Gulf of Mexico is one of the main oil drilling areas in the world, and there are many industrial facilities associated with the oil industry both in Mexico and in the United States. The recent spill from the Macondo 252 oil well is a clear warning that more needs to be done to prevent these accidents, but it also showed the limitations of current knowledge about the fate and effects of oil spills in the deep sea.

Other industrial activities, such as urban waste water, and particularly agriculture, are also important inputs of pollutants to the Gulf. All these activities introduce pollutants such as metals (mercury is the main cause for fish consumption advisories in the US), hydrocarbons (from the oil industry activities, but also from vehicle exhausts, industrial sources, rivers, urban runoff, etc.), pesticides from agricultural and urban use, and a recently recognized threat: emerging pollutants such as pharmaceuticals of human and veterinary use, personal care products, etc.

The input of raw or partially treated wastewater into the Gulf is a problem, particularly in Mexico. Urban sewage contains not only organic matter and pathogens, but also a suite of other pollutants such as hydrocarbons, metals, pesticides, and pharmaceuticals and personal care products. Waste water treatment plants are not all designed to remove these pollutants, and these

compounds enter the marine environment, representing a risk to the environment and the human population.

Monitoring programs in the coastal zone are not yet fully developed in Mexico or the US, and are essential to understand the magnitude and consequences of environmental events as well as to determine current status and trends and develop realistic management goals. Joint monitoring programs between the countries that share the Gulf of Mexico are necessary, as well as harmonized strategies so the data are comparable.

BIODIVERSITY

Biodiversity is at risk in the Gulf of Mexico (GoM). Critical habitats, such as coral reefs, mangrove forests, and sea grass meadows, are being lost or fragmented at alarming rates. A major factor is the accelerating development of coastlines for industry, agriculture, and tourism. Fishing activities can cause dramatic shifts throughout ocean ecosystems, slowing or even preventing restoration of depleted fish populations and their habitat.

At present global fishery resources are facing a number of threats, which have principally been attributed to commercial exploitation. However, several other factors (effects of trawling and dredging, recreational fishing, by-catch, fishing down marine food webs, excess fishing capacity, illegal, unreported and unregulated fishing, etc.) have also striking effects on marine fish stocks and marine ecosystems.

Plastic waste has emerged as a dominant global marine pollution problem on the basis of its widespread impacts. Plastics pose a particular threat in the marine environment due to their durability. Modern fishing gear (constructed of synthetic fibers) now comprises the most significant input of marine debris to the world's oceans. Lost fishing gear and gear scraps have been shown to cause declines in populations of marine mammals and “ghostfishing' (the effect of lost and discarded fishing gear that continues to catch marine species indefinitely) has also been demonstrated to negatively affect commercial fish stocks. Evidence emerged that plastics also transport a wide variety of organisms around the planet, potentially transporting harmful and non-indigenous species. Debris is introduced into the marine environment not only by its improper disposal, but also by accidental loss and by sources such as extreme hydro meteorological events.

Point- and nonpoint-source pollution is another significant threat to biodiversity. The greatest pollution threat to coastal marine life today is the runoff of excess nitrate-nitrogen from different sources. Environmental dissolved oxygen depletion in sub-pycnocline waters has significant deleterious ecological effects on living resources in many ecosystems throughout the world, and particularly in the GoM.

Invasive species are non-indigenous species that adversely affect the habitats and bioregions they invade either economically, environmentally, and/or ecologically. They disrupt by dominating particular habitats and destroying natural controls. The rise in global trade through commercial shipping in particular has dissolved historical barriers for distribution of marine organisms and has led to an unprecedented increase in the rate of marine introductions in the last 200 years.

Historically, aquaculture has also been an important source of foreign introductions. It has been considered that following habitat destruction, ‘alien invasions’ are the second most important threat to loss of biodiversity.

FISH AND FISHERIES

The high productivity of the GoM is evident when fishing productivity is reviewed. GoM fishing catches is about 1.2 million tons per year, representing 15% and 25% of national commercial landings of US and Mexico, respectively. Since the late eighties, landings in both countries show descending trends (roughly 30% less), while commercial fishing effort has increased considerably (almost double from 1980 to 1997).

From the 53 stocks managed by the Gulf of Mexico Fisheries Management Council (GMFMC) in 2010, 4 are subject to overfishing (the fishing mortality exceeds the one required to produce the Maximum Sustainable Yield) and 4 are overfished (their biomass levels are below a biological threshold specified in its fishery management plan).

In spite of the large deep water area in the Gulf (about 60% of the total area), most fishing grounds are in coastal areas, and major commercial fishing profitability is due to shrimp catches whereas small coastal pelagic fisheries are the largest in weight of all fisheries (66%).

Shared fishing management problems are: non-optimal harvesting by commercial fisheries, by-catch, over capitalization and economic inefficiencies, weaknesses in institutions and governance overseeing commercial and recreational harvesting, heterogeneous management strategies and capabilities between countries, limited inter-country exchanges of knowledge and experiences, and incomplete information and understanding of ecosystem functioning.

Information about by-catch and discards in the area is more readily available for US than for the Mexican fisheries. In the late nineties, the estimated annual bycatch from the shrimp fishery in offshore US waters was between 180,000 and 450,000 t. This affected not only commercial species but protected ones (like marine turtles) as well. This problem has decreased in importance in later years due to the introduction of by-catch excluding devices.

SOCIO-ECONOMICS

The Gulf of Mexico Large Marine Ecosystem faces two major socioeconomic problems, one related to the insufficient knowledge leading to poor informed decision making and the other related to the dynamics of the economic and social system *per se* that affects marine ecosystems.

Clusters of beneficial processes are known as ecosystem services. Valuable ecosystem services have historically

been taken for granted and therefore not properly considered in the process of permitting development projects. Coastal wetlands have for decades been recognized for the high value of their many ecosystem services, and the importance of this delivery of goods and services has been reflected in federal and state legislation for the protection of coastal wetlands and mangroves. Tidal marshes are recognized by their ecosystem services that include a number of physical, biological, social, cultural, and economic benefits.

Coastal ecosystems offer services needed by many economic activities however, despite their high importance, they are not in the traditional economic accountability as can be seen subsequently.

Currently the GoM LME's commercial economic activities account with an increasing economic value for both Mexico and the United States. The following table shows some of the most important economic activities according to their value in USD billion/yr.

Sector	Mexico Billion USD/yr	US Billion USD/yr	Total Billion USD/yr
Oil & Gas	39.8	37.9	77.7
Tourism	9.2	32.4	41.6
Fisheries	0.381	0.685	1.07
Port & Shipping	0.054	0.331	0.38
TOTAL			120.7

Four regional phenomena of interest for both countries are:

a) the significant increase of migration flows towards the most dynamic economic areas, such as Mexico's northern border;

b) the increase in poverty and employment in unproductive (and illegal) activities;

c) a spatial redistribution of population, increasing in cities in dynamic economic areas and decreasing in rural and deprived urban areas, and

d) increasing pressure on natural resources and ecosystems in particular on marine and coastal ones.

There has been a general shift of the US population where the Gulf´s population has increased by 103% since 1970 and by 150% since 1960. Population shifts have resulted in infrastructure building and urbanization, and coastal habitat losses, where wetlands, marshes and swamps were drained for agricultural and urban expansion. Secondary effects of urbanization, such as dredging and damming have led to severe losses in palustrine aquatic beds around the US Gulf.

In the Mexican Gulf, population living in poverty represents over 40%. Unequal development and income distribution is the main reason that explains the growing migration patterns from Mexico to the US. Estimations show that in the next years, migration will be the main link between both countries.

Although most of the changes in economic activities and settlement patterns have only local or national immediate impacts, in medium and long-range terms these will result in increasing migratory pressures, both at the local and international levels, and will tend to affect local and regional ecosystems and habitats in an increasing and cumulative way.

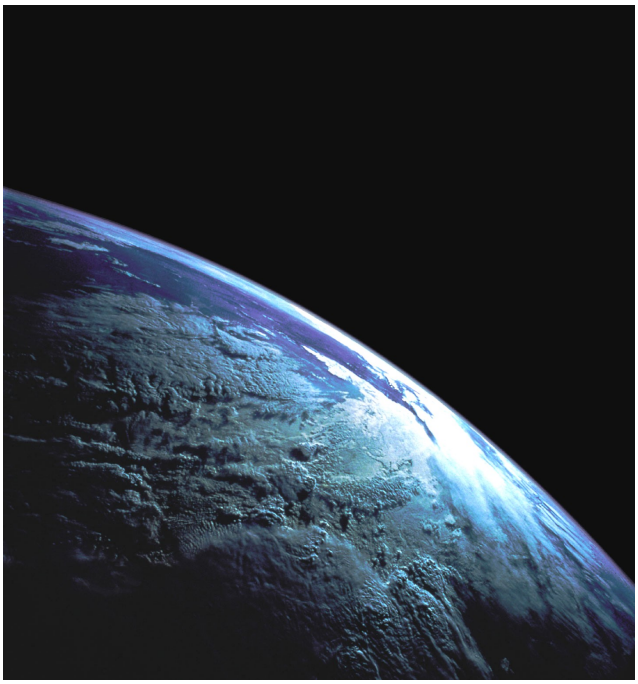
GOVERNANCE

According to the Intergovernmental Oceanographic Commission of UNESCO (IOC) "Coastal and ocean governance may be defined as the processes and institutions by which coastal and ocean areas are managed by public authorities in association with communities, industries, NGOs and other stakeholders through national, sub-national and international laws, policies and programs, as well as through customs, traditions and culture, in order to improve the socioeconomic conditions of the communities that depend on these areas and their living resources".

The Gulf of Mexico represents a challenge to fully apply this governance intention following an Integrated Coastal and Ocean Management (ICOM) scheme. ICOM is an integration process on a geographic area overcoming the fragmentation of sectoral management, jurisdictional rules, land-water-high seas interfaces and short-term policies.

The governance chapter in the Gulf of Mexico TDA document addresses three of the most important aspects in environmental management: policy, regulation and administration. It shows the basic legal framework for each country, major government institutions, most national and international agreements and treaties for collaborative management of transboundary issues in GoM waters, and most relevant and common weaknesses regarding these aspects.

Also it identifies the most important governance actors and crucial stakeholders in Mexico and US GoM coastal and oceanic waters. Finally it also mentions some important efforts to incorporate Mexican, US and Cuban scientists in a tri-national common platform of experience exchange that eventually could help to strengthen national and international capabilities for sustainable use and long-term vision of this shared Large Marine Ecosystem.



CLIMATE CHANGE

Climate change is a clear crosscutting issue in the Gulf of Mexico region and it must be addressed jointly by its neighboring countries.

Models have shown that the recent climate change may be attributed to anthropogenic forcing, particularly greenhouse gases. Some of the major petroleum industries operating in the Gulf of Mexico have been

classified among the biggest carbon dioxide-emitting companies in the US.

One of the most serious consequences of climate change during the past century to the Gulf Coast environments is sea-level rise in response to melting of some polar ice and thermal expansion of warmer oceans. The historical data indicates a sea level rise of about 12 cm (5 inches) over the last 100 years with a projected rise of 21.8 cm to as much as 48 cm (8.4 to 19.2 inches) over the next century. Sea level rise is more dramatic than the global average along the Gulf Coast.

Rising sea level is gradually inundating wetlands and lowlands, eroding beaches, increasing coastal flooding, threatening coastal structures, raising water tables and increasing the salinity of rivers, bays and aquifers. All of these changes result in increasing loss of habitat and threats to biodiversity.

Ocean acidification (linked, like climate change, to increased atmospheric CO2 concentrations) in the Gulf of Mexico could represent one of the most serious threats to biodiversity, considering the potential sensitivity of significant reef areas in the Gulf and the substantial negative consequences for some plankton species central in ocean food chains.

ENVIRONMENTAL EDUCATION

Another crosscutting issue in the Gulf region is environmental education and outreach. Both public participation and a mutual understanding of country cultural background are needed in order to enhance regional cooperation and partnership.

Education and public participation is considered a necessity for informed societies to be able to promote the sustainable management of natural resources through active participation. A continued investment in sound science, generation and integration of data on different aspects of the GoM LME is necessary. There is also an increased necessity for expanding environmental educators' networks where experiences, information, technological improvements, measurable benefits, and lessons learned can be shared. Furthermore, a continued capacity-building effort for different stakeholders is an asset in order to support the recovery and maintain sustainability of marine and coastal ecosystems in a changing world.

Several problems that have led to deterioration of the Gulf of Mexico are due to a lack of knowledge and appreciation of the environmental services that marine and coastal ecosystems provide in the Gulf of Mexico. Formal and informal environmental education programs

to different target audiences as part of initiatives from both countries can serve as a tool to reduce problems identified and to overcome boundaries through effective teaching and learning experiences.

More professionals interested in the study of marine and coastal resources are required. In the Gulf of Mexico the academic supply related to environmental issues and marine and coastal management is not enough to address the problems that have been identified in the GoM LME.

With an increasing population in the region, the demand of more resources for daily subsistence will need efficient educational programs at different levels (government, academy, NGOs, local communities, landowners, forest managers, enterprises, etc.) in order to strengthen informed societies able to take the most suitable decisions for the sustainable management of the GoM LME. There are only a few institutions in Mexico that foster research on marine and coastal ecosystems. More programs to promote research activities on ocean issues in the GoM LME are required.

FINAL MESSAGE

In order to support informed decision making and adaptive management of marine and coastal resources, Mexico and the US must work in the development of priority research issues for the Gulf and to address the major cultural and country differences and the educational gaps.

It is urgent and clear that substantial funds must be allocated for the Gulf of Mexico LME leveraged by both countries towards the region´s educational and scientific development.

The present TDA sets the basis for the Strategic Action Plan of the Gulf of Mexico Large Marine Ecosystem. Both countries are currently fully committed and special emphasis must be given to the most recent delivered document “Gulf Coast Restoration Strategy” released on October 5th 2011 by the US government, a visionary document that addresses and promotes the restoration of the Gulf after the oil spill.

There is no doubt that country by country actions will add in the construction of the Strategic Action Program for the entire Gulf.

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