September, 2011

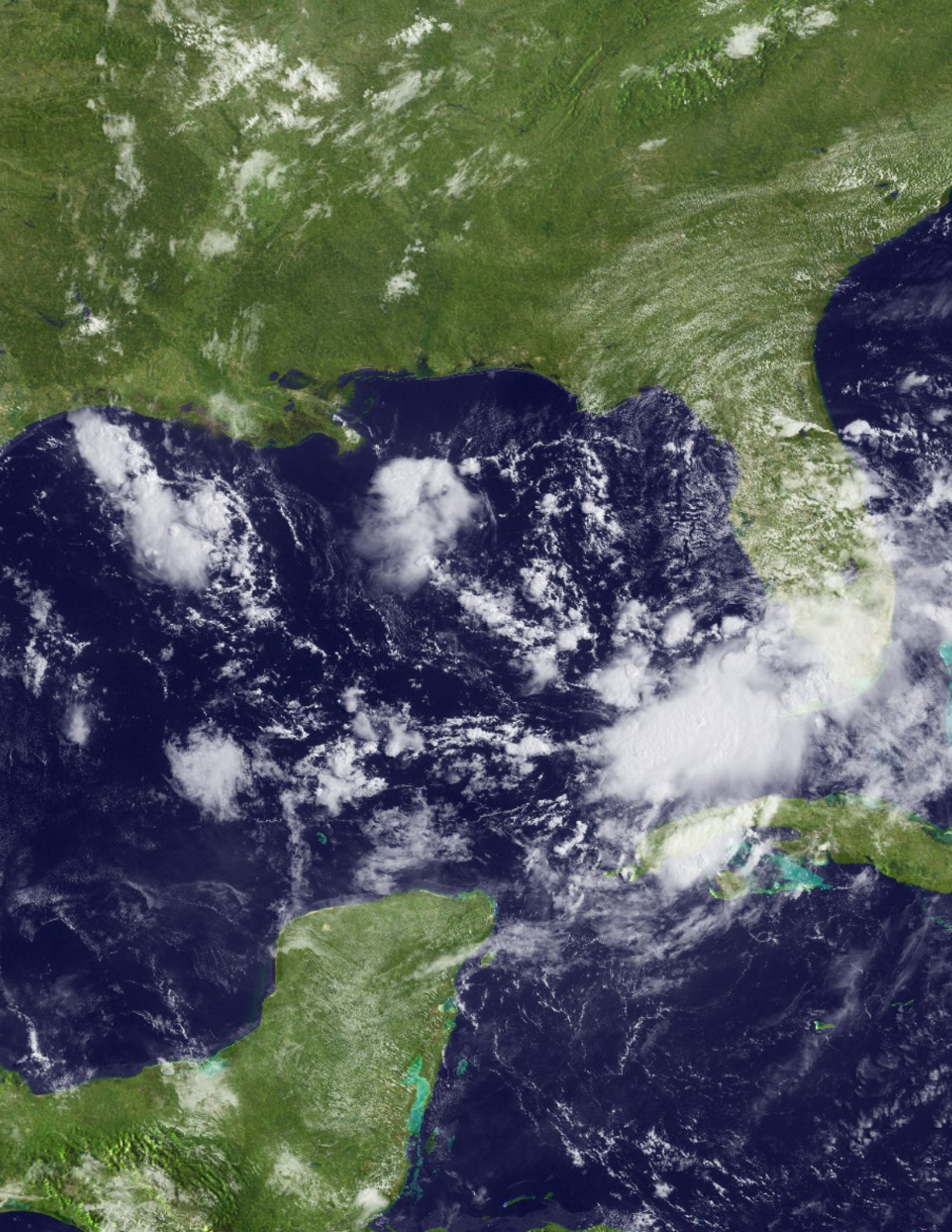
Integrated Assessment and Management of the Gulf of Mexico Large Marine Ecosystem

Transboundary Diagnostic Analysis

GLOBAL ENVIRONMENT FACILITY

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

GULF OF MEXICO LME



Acknowledgments

On behalf of the Project Coordination Unit, The Gulf of Mexico Large Marine Ecosystem Project wishes to express its most sincere appreciation to all experts, consultants, and participants for their valuable insights and assistance in producing this document.

The project thanks the Global Environment Fund for financial support , the United Nations Industrial Development Organization for administrative implementation of the project and both US and Mexico Country Project Focal Points, the National Oceanic and Atmospheric Administration (NOAA) and the Ministry of Environment and Natural Resources (SEMARNAT) for their unconditional technical support and advice.

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Message from project country focal points

The Gulf of Mexico Large Marine Ecosystem (GoM LME) provides bordering nations with economic wealth, products, food, services, cultural heritage and valuable energy resources. The present Transboundary Diagnostic Analysis (TDA) document represents a bi-national effort to accomplish regional integrated management of the Gulf's resources and at the same time, serves as the baseline for the GoM LME Strategic Action Plan, which seeks to enable a paradigm shift to an ecosystem-based approach resources management.

The US and Mexico recognize, through this joint effort, that the fact-finding process has defined with clarity the existing current priorities that both nations face in the pursuit of a more healthy, productive and resilient Gulf of Mexico. Special recognition is given to the work done during the last two years, engaging experts, scientists and stakeholders at large from both countries; putting aside barriers to establish a clear and open dialogue; exchanging expertise, data, partnerships, and strengthening of our friendship in light of the definition of the key priority areas to address transboundary priority elements in the Gulf region.

It is a fact that both countries also worked closely during the hard time posed by the catastrophe of the Deepwater Horizon Platform MC252 well oil spill, and we recognize that the Gulf of Mexico LME project played an important role and supported both countries to enter into a fine and deep dialogue in the summer of 2010, one that allowed actual cooperation and mutual understanding to date.

Mexico and the US are proud of being able to define the key transboundary elements for the GoM LME in order to enhance regional cooperation towards specific strategic actions that may allow both nations to maintain the mentioned cultural, economic and ecological connectivity of the Gulf.

The Gulf of Mexico LME project has undertaken important steps towards integrated management and it should continue its activities in spite of the complexity of ecosystems and societies engaged in the process. The TDA report represents a first step upon the long-term duration of the project, which needs to focus entirely in the regional scale integrated management and assessment of the Gulf of Mexico's resources.

The National Oceanic and Atmospheric Administration (NOAA) and the Ministry of Environment and Natural Resources (SEMARNAT) from the US and Mexico respectively, are thankful to all experts and stakeholders involved in the project during this phase, to the Project Coordination Unit team that made the execution of project activities and the production of the transboundary diagnostic analysis possible, to the United Nations Industrial Development Organization (UNIDO) for overseeing and executing the project, and last but not least to the Global Environment Facility (GEF) for co-financing a project that enables two nations to fit into their ideal of resolving regional conflicts and strengthens their cooperation and understanding.

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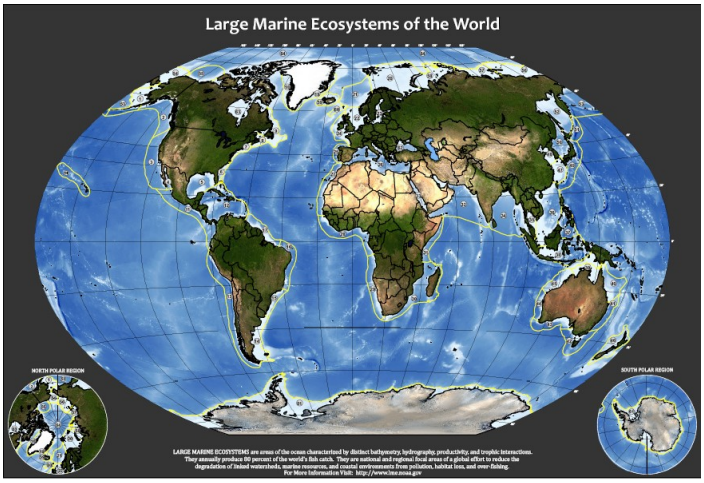
Foreword

Of the 64

large marine ecosystems of the world the Gulf of Mexico LME stands out for its unique inter-connectivity whether cultural, economic, or ecological, and as a result of its high multi-sectoral economic value.



The Gulf of Mexico bordering nations Mexico, Cuba, and the US are increasingly aware of the threats, risks and other relevant issues related to the management of the Gulf of Mexico Large Marine Ecosystem, its natural assets, socioeconomic value and derived benefits to our societies, as well as their importance in the overall regional economic wealth.

Among these threats the deterioration of coastal areas adjacent to urban centers due to pollution, oil spills, habitat loss, and unsustainable exploitation of marine and coastal natural resources stand out. Among the most outstanding consequences are an increase in algal blooms, low oxygen extended events or hypoxia, recent oil spills events, boat groundings on delicate coral reefs and continuous oil exploration and contamination along the coast and beyond, with the respective risk of contamination threats to coastal and marine biodiversity in a basin that is highly vulnerable to storms and fluctuating climate conditions. Given that scenario, it is necessary to adopt new integrated management schemes to organize human activities in the Gulf of Mexico, with the objective of avoiding more serious economic and social consequences.

An apparent rise in the frequency of marked environmental changes in this ecosystem is evidenced by fluctuations in the distribution and abundance of fish, birds and mammals. This causes serious problems requiring different management levels for coastal and marine areas of the Gulf of Mexico Large Marine Ecosystem.

The modular approach to large marine ecosystems is designed to link scientific assessments to states of change of coastal ecosystems, with the objective of supporting long-term sustainability and environmental quality.

The integrated ecosystem management concept or approach seeks to ensure intergenerational sustainability of the ecosystem assets and services or processes, including hydrological and productivity cycles. This approach represents a change in paradigm, and allows multi-sectorial interventions and a broader vision entailing an integrated ecosystem management approach that moves spatially from small to larger scales and from short-term to long-term management practices.

These efforts are geared towards intra-sectorial integration in coastal productivity, fisheries and ecosystem contamination/health relative to socio-economic benefits and government systems. The application of such assessments within the sphere of an ecosystem and its management is partly supported by funds from the Global Environment Facility (GEF) in collaboration with the national governments of the US and Mexico and implemented by the United Nations Industrial Development Organization (UNIDO) through its Project Coordination Unit based in Mexico.

GEF's operational strategy calls for the development and implementation of projects within the International Waters Program (IW), designed to attain global benefits,

in such context the Gulf of Mexico LME is currently implemented by Mexico and the US under a more structured approach to restore and protect the environment in international waters.

The goal of the International Waters Program is to give countries the necessary support to make pertinent changes in human activities carried out by different sectors, to promote sustainable maintenance of a particular body of water and the numerous basins of each country. GEF has given special priority to the change of sectorial policies and activities responsible for the most important and serious basic causes of transboundary environmental concerns.

The Transboundary Diagnostic Analysis (TDA) document presented here represents the high importance and commitment from both nations, Mexico and the US, towards a healthy and productive Gulf of Mexico Large Marine Ecosystem.

It determines the baseline for transboundary priority issues in the Gulf region, and will serve as the basis for the immediate and long-term actions needed to modify sectoral policies or activities and to find base investments, so that GEF can fund incremental costs of the additional measures agreed upon.

One of the central areas of GEF funding is geared to mitigating stress factors in the Gulf of Mexico Large Marine Ecosystem, fostering priority strategic actions to improve environmental quality and sustainable development of resources within the Gulf, aspects that are important for economic growth, food security and community resilience.

Based on the above, Mexico and the US started a long-term partnership in 2009 towards the Integrated Management of the Gulf of Mexico Large Marine Ecosystem. This phase presents the TDA, which will serve as the basis for a Strategic Action Plan (SAP).

The modular integration of the Gulf of Mexico Large Marine Ecosystem TDA was developed with the participation of many scientists, experts, managers, and stakeholders at large from both countries during several workshops, seminars, expertise exchange, and thematic specific forums conducted through 2009-2011. Large audiences and experts from the US and Mexico were involved in this endeavor and we are thankful to all participant institutions and stakeholders that contributed with their expertise, knowledge, and a true interest for collaboration.

Making use of the great mass of existing information on this Gulf of Mexico Large Marine Ecosystem and linking each of its components, will certainly allow accomplishment of its main goal: the integrated and sustainable management of the Gulf.

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Chief Technical Advisor
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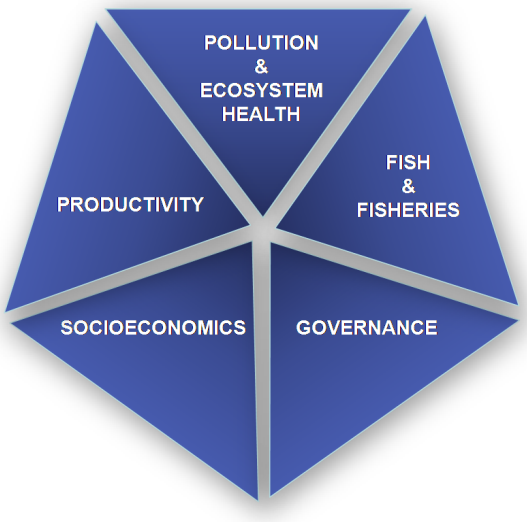


Today, as we discover a long-term identity, we the inhabitants of the Gulf of Mexico must take the full historic responsibility to strengthen those urgent actions that may halt environmental degradation.

A. The Gulf of Mexico:
background and introduction

A note on the Gulf of Mexico region historical and cultural connectivity

A millenary regional history has elapsed in the Gulf of Mexico. A history of connectivity that has had several expressions and has happened at different levels and temporal scales for the benefit of the Gulf´s communities: today the three nations bordering the Gulf.

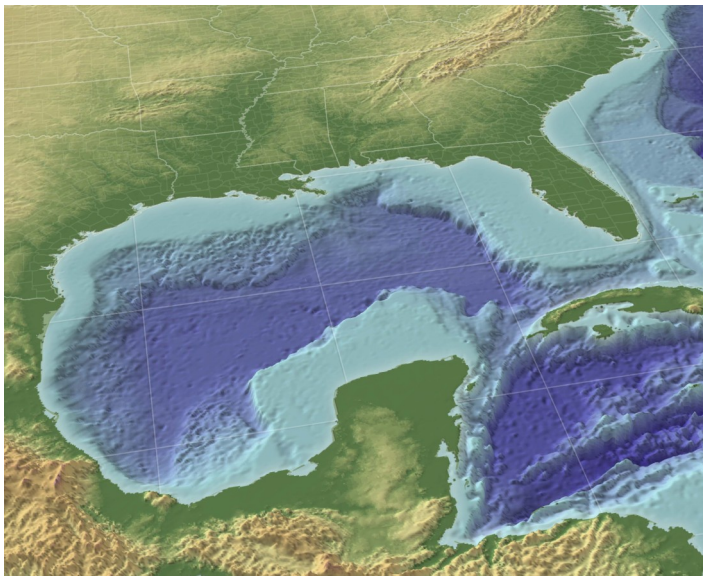
The relationship between the inhabitants of the northern and southern Gulf Coasts can be traced back in legends collected by Fray Bernardino de Sahagún where he declares that the Olmecs migrated from the banks of both the Missouri and Mississippi rivers along the coast aided by large river boats and founded Temoanchán next to the Panuco River, and then went down to the Isthmus region. This information has been archaeologically and scientifically supported by Miguel Covarrubias and Roman Piña Chan through different studies conducted at the site known as Huasteco of Tantoc, San Luis Potosí, whose outline and mounts are common to those of the Mound Builders cultures in the Mississippi region.

The Gulf's inhabitants have shown similar human reactions to the weather but mainly to the force of the ocean. Since pre-Hispanic times –when temples were erected by the Olmec culture in the north and south coasts and along river banks (Tajín and the swamps of Tabasco) as well as by the Troyville and Creek cultures in the banks of Mississippi, Arkansas, Alabama, and Florida in order to appease the "God of Wind", to later years in the New Spain and the nineteenth century –when prayers and invocations to the Virgin Mary and many saints were uttered to cope with storms from Pensacola to New Orleans, Veracruz, and Havana, and even more recently in the twentieth century –when technology has been idealized, a global mistaken belief has expanded from Galveston down to Campeche that the Gulf is a container with the capability to absorb and process the most destructive waste generated in the farmlands, factories and oil wells; a false belief that, if left unchanged, may as well remain a long-lasting phenomenon.

Trading has occurred in Mexican waters at all times defying the meteorological dynamics by navigating with steam, fuel, and even atomic energy-powered vessels. The Gulf's neighbors have endeavored to fish and catch shrimp in deep waters after having done it for hundreds of years along its shoreline and flowing river banks in Morgan City, Louisiana, and Ciudad del Carmen, Campeche.

More recently, starting the second third of the twentieth century, the Gulf's inhabitants dared to explore the marine bottom off the coasts of Louisiana, Veracruz and the Campeche Sound in search of oil. Not less important is the fact that in many ports facing the Gulf of Mexico several industrialization processes with different technological development levels began after World War II, triggered by the possibility of transporting raw materials and finished products towards all its surrounding coasts with its consequent wastes. All this has intensely strengthened the Gulf's connectivity.

Today, as we discover a long-term identity, we the inhabitants of the Gulf of Mexico must take the full historic responsibility to strengthen those urgent actions that may leverage the halting to environmental degradation phenomena and to provide new hopes for a long-lasting, healthy life in this region of the globe.



Current Regional Connectivity

The Gulf of Mexico Large Marine Ecosystem (GoM LME) is an important one in terms of biological productivity and includes a very high diversity of marine habitats comprising tropical and temperate ecosystems, estuaries, shallow inshore waters with soft bottoms, rocky bottoms and reef communities, as well as a large extension of deep sea that sustains an ample biodiversity of living marine resources (LMR). There are more than 300 species sustaining local fisheries (including fishes, crustaceans, mollusks, echinoderms and other invertebrates) in addition to LMR with unique ecosystem value in the trophic structure, such as sea birds, marine mammals, and sea turtles.

Additionally, the Gulf of Mexico LME is a major asset to these countries, in terms of fisheries, tourism, agriculture, oil, infrastructure, trade and shipping. Commercial fishing and seafood processing are important components of the LME's economy. The infrastructure for oil and gas production in the Gulf of Mexico (including oil refineries, petrochemical and gas processing plants, supply and service bases for offshore oil and gas production, platform construction yards and pipeline yards) is concentrated in the coastal regions of both the USA and Mexico. Eighty five percent of Mexico's oil extraction is undertaken in this region, as well as 72% of the US offshore petroleum production. The Gulf of Mexico LME contains major shipping lanes, and the volume and value of shipping and port activities has increased in the region. Additionally, the tourism industry has been rapidly increasing. Approximately 55 million people live in the coastal states of the GoM, nearly 40 million in the US and around 15 million in Mexico.

However, this high biological importance and economic productivity are at risk from a suite of anthropogenic threats.

Many stocks in the Gulf of Mexico are over-fished, or are at (or close to) their maximum yield. Intensive fishing is considered the primary force driving biomass changes in the GoM LME. Depletion and impacts on fish stocks affects both countries given that many stocks are shared, migratory, or connected via egg or larval transport.

Habitat modification, including loss of critical habitats and connectivity, resulting from poorly planned growth in coastal and urban areas along the GoM coast, translates into a trend of urban growth at the expense of sand dunes, estuaries, marshes, seagrasses, coral reefs, mangroves and other critical habitats.

Pollution and nutrient enrichment are important threats. The Gulf of Mexico is a semi-enclosed sea, which can aggravate pollution problems. The recent spill from the Macondo 252 oil well is a clear warning that more needs to be done to prevent this type of 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, 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. As a relevant example, nutrient over-enrichment resulting from discharges in the Mississippi river results in a "dead zone" of over 18,000 km^2 that forms every year – one of the largest hypoxic zones of water in the world.

The Gulf Coast region is also especially vulnerable to the effects of 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.

These growing anthropogenic threats, and the widespread nature of their results, evidence tight interdependencies in terms of causes and effects and an LME-wide, ecosystem-based management approach is required to effectively mitigate them in the long-run.

However, existing management approaches are not consistent with an ecosystem-based perspective and there are currently no agreed bi-national programs for managing the GoM's resources taking into account ecosystem-based requirements. Furthermore, the two countries have institutional frameworks for coastal and marine resources protection, but no effective regional inter-sectoral project coordination mechanism currently exists.

The Gulf of Mexico Large Marine Ecosystem includes a wide range of habitats that sustain an ample biodiversity of living marine resources.

B. Rationale of GEF projects and aims of the TDA

B1. GEF International Waters Projects and the GoM LME Project

The Global Environment Facility (GEF) is an independent financial organization that provides funds for projects that benefit the global environment and promote sustainable livelihoods in local communities. GEF projects address six complex global environmental issues (or Focal Areas), including International Waters (IW). The GEF concept of 'international waters' differs from the legal definition under the United Nations Law of the Sea Convention, the GEF operational strategy focuses on 'transboundary' water resources, emphasizing management through a participatory process of bi- and multi-national 'stakeholders'.

The formal objective of the GEF Operational Strategy in the international waters focal area is to contribute, primarily as a catalyst, to the implementation of a more comprehensive ecosystem-based approach in managing international waters as a means to achieve global environmental benefits. Noticeable is the emphasis on acting as a catalyst. This means that the GEF programs act mainly to enhance and strengthen the many other national and international programs which have the primary responsibility for action. This enhancement should result from synergies and harmonization between these existing programs. It is perceived, that in the absence of GEF intervention, fragmented efforts with a national and an often sectoral focus will continue to be the norm.

The production of a Transboundary Diagnostic Analysis (TDA) followed by a Strategic Action Plan (SAP) is a requirement for most projects proposed for financing in the GEF International Waters Focal Area.

The TDA is a scientific and technical fact-finding analysis used to scale the relative importance of sources, causes and impacts of transboundary waters problems. It should be an objective assessment and not a negotiated document. In order to make the analysis more effective and sustainable it should include a governance analysis that considers the local institutional, legal and policy environment.

The TDA should be preceded by a consultation with stakeholders, and the stakeholders are involved throughout the subsequent SAP process. Four key points that underpin the TDA are Joint fact-finding, Prioritization, Participation, and Consensus. The TDA approach is not only a proven way of achieving progress, but it also acts as a diagnostic tool for measuring the effectiveness of SAP implementation.

The SAP is a negotiated policy document that should identify policy, legal and institutional reforms and investments needed to address the priority transboundary problems.

The main global benefit of the project will be an enhanced understanding of LME functions that will ultimately contribute to the protection and maintenance of ecosystem functions and services.

The development of a TDA and the formulation of a SAP should take approximately 1 to 3 years, however, to reverse environmental degradation in complex transboundary freshwater or marine situations may take decades. A whole host of scientific, social, political, institutional, cross-sectoral and sovereignty issues may have to be tackled by collaborating countries before they can commit themselves to undertaking the reforms and investments needed.

Experience in developed countries has shown that it may often take 15-20 years before meaningful commitments to joint management improvements can be secured. More time is then needed before the reductions in stress from pollution, over-fishing, sedimentation, eutrophication and habitat alterations result in measurable improvements in the environmental status of water bodies.

The Integrated Assessment and Management of the Gulf of Mexico Large Marine Ecosystem Project aims at removing identified constraints and barriers, develop common mechanisms and tools, and promote reforms and investments, to set the bases for application of the ecosystem approach in the management of the GoM LME, through a TDA-SAP process. This is complemented by discrete capacity-building activities and pilot projects in three critical aspects of the ecosystem approach: productivity, conservation and adaptive management, and robust monitoring and evaluation frameworks, as well as cross-sectoral engagement. In the long term, the transition towards the ecosystem-based management of the GoM LME will depend on a greater convergence of policy tools including long-term joint programs and actions, a clearer distribution of competencies at all three levels of government, and a robust monitoring and evaluation program. This will require a truly regional GoM initiative supported through a combination of GEF financing and co-financing including a reoriented baseline.

Within this integrated approach, the project addresses specific IW Priorities, in particular reduction of nutrient over-enrichment from land-based pollution that creates anoxic “dead” zones in coastal waters, and restoration and maintenance of costal and marine fish stocks and associated biological diversity, complemented by efforts to address degradation of coastal resources and processes.

The principal global benefit of the project will be an enhanced understanding of LME functions, to serve as input into LME management strategies through the TDA and SAP processes, and to establish an enabling environment and ecosystem-based management practices that will contribute to the protection and maintenance of ecosystem functions and services.

B2. Definitions and Objective of the TDA

A Transboundary Diagnostic Analysis is a scientific and technical assessment, through which the water-related environmental issues and problems of a region are identified and quantified, their causes analyzed and their impacts, both environmental and economic, assessed. The role of the TDA is to identify the relative importance of the sources and causes of transboundary waters problems. As previously mentioned, the TDA is an objective assessment and not a negotiated document. It uses the best available verified scientific and technical information to examine the state of the environment and the root causes for its degradation.

The analysis is carried out in a cross-sectoral manner, focusing on transboundary problems without ignoring

national concerns and priorities. The development of the TDA is the responsibility of a technical task team, coordinated by the Project's Chief Technical Advisor (CTA). The technical task team is formed of technical experts, augmented with additional external specialists.

The analysis involves the identification and prioritization of problems, their impacts (and uncertainties associated with these) and causes at national, regional and global levels, and the socio-economic, political and institutional context within which they occur.

The environmental impacts and socio-economic consequences of the relevant transboundary problems have to be identified. Part of this information should arise from stakeholder consultations since stakeholders may identify impacts or consequences and it is on this basis that problems are identified, but it is important for the technical team to revisit them, agree on whether or not the list is complete and examine their transboundary relevance. The TDA assessment should indicate which elements are clearly transboundary in character like regional/national issues with transboundary causes (*e.g.* habitat destruction from urban development), transboundary issues with national causes (like point-sources of pollution with ecosystem-wide impacts), national issues that are common to at least two of the countries and that require a common strategy (*e.g.* over-exploitation of fisheries) and collective action to address issues that have transboundary elements or implications (*e.g.* climate change).

The identification of the causes should, where appropriate, specify sources, locations and sectors and list and prioritize activities or solutions to address the issue/problem and its root causes. It is important to relate the problem identified with the causes and impacts of the problem. For example, eutrophication can result in harmful algal blooms (an environmental impact) and diminished amenity (a socio-economic consequence). A cause of eutrophication could be inadequate infrastructure capacity and a strategy to mitigate or solve the problem would be improving infrastructure.

The objective of this TDA is to provide, on the basis of clearly established evidence, structured information relating to the scale, the relative importance of the causes and sources of the transboundary problems, and to identify practical preventative and remedial lines of action to ensure the sustainable integrated management of this LME. The TDA aims at providing the technical basis for the development of a Strategic Action Plan (SAP).

B3. Design of the TDA

Information about the status of the GoM LME, the main identified problems, and their causes and impacts was gathered in two stages. The preliminary TDA, assembled in 2006 provided the basis for the construction of the Logical Framework of the GoM LME Project and provides a basis of information for further analysis.

The basis for the updated TDA is, again, a suite of Thematic Reports prepared by regional/international experts, followed by an experts/stakeholders survey/ interview process and an integration workshop that includes a prioritization and Root Cause analysis. The information is synthesized in a Matrix including some explanatory text about the identified problems, transboundary impacts or relevance, and then relates them to their major underlying institutional, societal or global root causes. These are, in turn, related to proposed lines of action to address the detected problems that serve as a general "road map" for the design of the SAP.

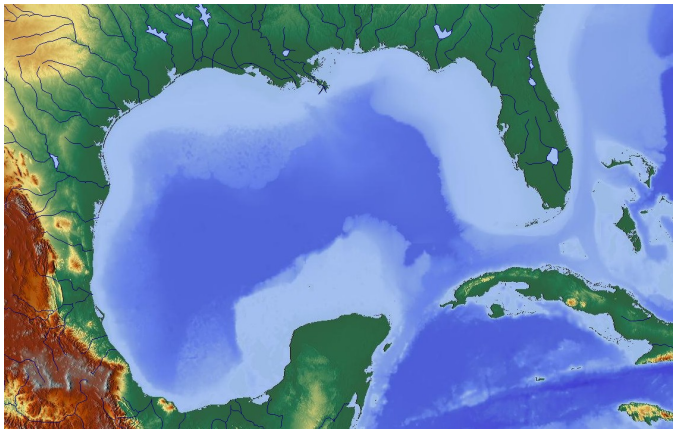
B4. Additional Information

More information about the GoM LME will be presented in the Thematic Reports and Technical Reports of the Regional Workshops organized by the GoM LME Project and a relevant literature data base in the Project's webpage.

C. Brief overview of the information contained in the thematic reports

C1. Geographic Scope and Ecosystem Boundaries

The GoM is a 615,000 mi² (1.6 million km²) semi-enclosed oceanic basin with a water volume of roughly 660 quadrillion gallons (2.5 × 1015 m3). Its basin is shared by Mexico, the US and Cuba and was probably formed approximately 300 million years ago as a result of the seafloor sinking. Geologists agree in general that the present Gulf of Mexico basin originated in Late Triassic time as the result of rifting within Pangea. The GoM is the ninth-largest body of water in the world and the largest semi-enclosed coastal sea of the western Atlantic. The shape of its basin is roughly oval and is approximately 810 nautical miles (1,500 km) wide. It is connected to it through the Florida Straits between the US and Cuba, and with the Caribbean Sea via the Yucatan Channel between Mexico and Cuba.



The Gulf of Mexico's eastern, northern, and northwestern shores lie along the US states of Florida, Alabama, Mississippi, Louisiana, and Texas. The US portion of the Gulf coastline spans 1,680 miles (2,700 km) receiving water from thirty-three major rivers that drain 31 states. The Gulf's southwestern and southern shores lie along the Mexican states of Tamaulipas, Veracruz, Tabasco, Campeche, Yucatan, and the northernmost tip of Quintana Roo. The Mexican portion of the Gulf coastline spans 1,394 miles (2,243 km). On its southeast quadrant the Gulf is bordered by Cuba.

The Gulf of Mexico is an excellent example of a passive margin. Almost half of the basin is shallow continental shelf waters. Its continental shelf is quite wide at most points along the coast and topographically diverse, most notably at the Florida and Yucatan Peninsulas. Sizable shelf areas are found in Florida, to the West; Texas-Louisiana, to the Northwest, and Campeche and Yucatan to the South and South-East. At its deepest it is 14,383 ft (4,384 m) at the Sigsbee Deep, an irregular trough more than 300 nautical miles (550 km) long.

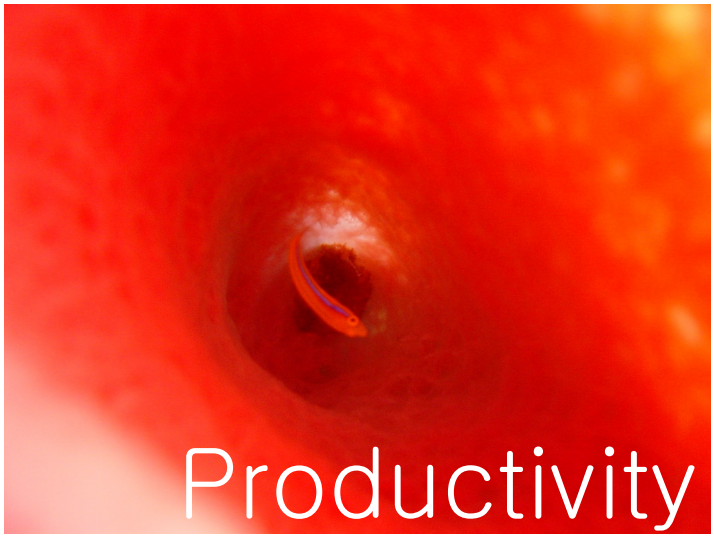
With its narrow connection to the Atlantic, the Gulf experiences very small tidal ranges. The Gulf Stream, a warm Atlantic Ocean current and one of the strongest ocean currents known, originates in the Gulf, as a continuation of the Caribbean-Yucatan-Loop Currents system. Other circulation features include the anti-cyclonic gyres which are shed by the Loop Current and travel westward where they eventually dissipate, and a permanent cyclonic gyre in the Bay of Campeche. The Bay of Campeche in Mexico constitutes a major arm of the Gulf of Mexico. Additionally, the Gulf's shoreline is fringed by numerous bays and smaller inlets. A number of rivers empty into the Gulf, most notably the Mississippi and Rio Grande rivers in the northern Gulf, and the Grijalva and Usumacinta rivers in the southern Gulf. The land that forms the Gulf's coast, including many long, narrow barrier islands, is almost uniformly low-lying and is characterized by marshes and swamps as well as stretches of sandy beach.

The GoM supports major American, Mexican and Cuban fishing industries. The outer margins of the wide continental shelves of Yucatan and Florida receive cooler,

nutrient-enriched waters from the deep by a process known as upwelling, which stimulates plankton growth in the euphotic zone. This attracts fish, shrimp, and squid. River drainage and atmospheric fallout from industrial coastal cities also provide nutrients to the coastal zone.

The GoM's shelf is also exploited for its oil by means of offshore drilling rigs, most of which are situated in the western US portion of the Gulf and in the Bay of Campeche.

The Gulf of Mexico supports major American, Mexican, and Cuban fishing industries.



1. 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.

Problem: Unbalanced biological productivity. The ecosystem productivity could be low (oligotrophic) or too high (eutrophic). 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. However, areas of high productivity exist, such as upwelling zones (Cabo Catoche), or areas influenced by freshwater inputs (Mississippi and Grijalva-Usumacinta rivers), as well as coastal ecosystems such as marshes, mangroves and sea grasses. These high productivity areas support an important global reservoir of biodiversity and biomass of fish, crustaceans, mollusks, sea birds and marine mammals. However, 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.

Transboundary elements: All of the threats to primary productivity in the GoM have a transboundary aspect, because of the strong trophic links in this system. Fishery species, marine mammals, sea turtles, and waterfowl that are supported by primary production in estuaries and lagoons move throughout the GoM transferring biomass and energy across both ecological and political boundaries. In addition, commonalities exist in threats to coastal habitats throughout the GoM making this a transboundary issue. Similarly, impacts of coastal eutrophication, harmful algal blooms, and hypoxia extend well beyond the immediate areas of these phenomena.

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.

2. POLLUTION AND ECOSYSTEM HEALTH

Problem: One of the most important threats to the marine environment that occurs in the coastal areas is the pollution directly related to the human population's economic activities. Pressures from rising coastal populations include increased solid waste production, higher volumes of urban and agricultural point and non-point runoff, and the generation of industrial residues. Contaminants generated by cities, agriculture and industry are carried and introduced to the marine environment by rivers, underground water, erosion, and wind, threatening all organisms including man.

Marine pollution by hydrocarbons is associated with the activities of the oil industry, but also with urban runoff and other sources such as vehicle exhaust, forest and grassland fires, etc. 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.

Metals are also an environmental concern in the Gulf of Mexico, with mercury as the main cause for fish and shellfish consumption alerts. Metal pollution can originate from industrial waste, urban runoff, incinerators, mining and oil drilling activities.

Pesticides are an additional concern, with levels of legacy compounds (such as the organochlorine compounds) still present in many coastal ecosystems. Persistent pollutants, many of them pesticides, are still a problem with some compounds currently in use, and others very recently added to Annex A of the Stockholm Convention, such as Lindane and Endosulfan. Monitoring in both countries indicates that in a significant number of sampling stations concentrations of these pollutants exceed the sediment quality guidelines.

A recent problem is emerging pollutants, which are compounds that are either new classes of pollutants, or compounds not previously considered as pollutants. In this group are included human and veterinary pharmaceuticals, personal care products, brominated flame retardants, new classes of detergents, etc. Very little is known in the Gulf of Mexico about these pollutants and their effect on the marine environment.

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

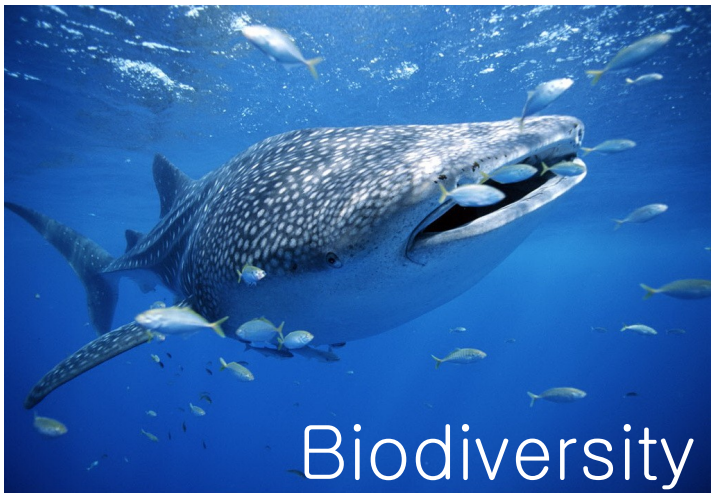
designed to remove these pollutants, and these compounds enter the marine environment.

Transboundary elements: The Gulf of Mexico is a semi-enclosed sea, which can aggravate pollution problems. It 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. Other industrial activities, urban waste water, and particularly agriculture, are also important inputs of pollutants to the Gulf.

Public awareness programs and environmental education will play an important role in improving environmental and ecosystem quality, particularly in Mexico. In addition, the strengthening and updating of wastewater treatment plants, as well as industrial processes, will become increasingly relevant.

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.

Metals are also an environmental concern in the Gulf of Mexico, with mercury as the main cause for fish and shellfish consumption alerts.



2.1 BIODIVERSITY

Problem: Threats to Biodiversity. The word "biodiversity" is a contracted version of "biological diversity". The Convention on Biological Diversity defines biodiversity as: "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems." In recorded history mankind has been one of the greatest factor affecting biodiversity, with adverse impacts occurring at an accelerating pace since approximately the Industrial Revolution. Human interventions in ecosystem function have been expressed through habitat destruction and fragmentation, fishing activities, and pollution.

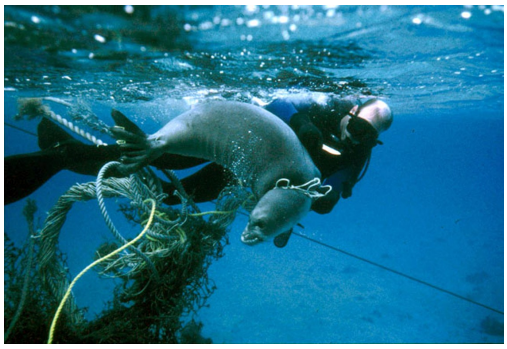
Habitat destruction is the process in which natural habitat is rendered functionally unable to support the species present. Coastal areas are home to over 90 percent of all marine species, which thrive in ecologically-rich and diverse shallow water habitats. These habitats –coral reefs, mangrove forests, and sea grass meadows, are being lost at alarming rates. A major factor is the accelerating development of coastlines for industry, agriculture, and tourism. Habitat fragmentation has been defined as the division of natural habitat into progressively smaller patches of smaller total area isolated from each other that contribute to a decline in biological diversity.

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.

Marine debris, sometimes termed marine litter or floating marine debris (FMD), is any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environments.

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.

Following habitat destruction, 'alien invasions' are the second most important threat to loss of biodiversity.



Lost fishing gear and gear scraps have 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 natural disasters. The debris generated by the storm surge of Hurricane Katrina or Rita was spread a significant distance from the nominal waterline. Practically, this meant that the resulting debris was to be found a considerable distance from the pre-storm coastline, both inshore and offshore.

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.

Invasive species are non-indigenous species that adversely affect the habitats and bioregions they invade economically, environmentally, and/or ecologically. They disrupt by dominating particular habitats and loss of 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.

Transboundary elements: Both, causes and effects, of the problems described above are prevalent and widespread in the whole LME. Only joint actions can result in substantial improvements in the present situation.

3. FISH AND FISHERIES

Catches by the US fleet in the GoM represent 15.6 % of the US national commercial catches and 14% of the value of US landings. For Mexico, the commercial fisheries in Gulf waters are remarkably important at local provincial scale and their production accounts for 25% in weight of the Mexican commercial catches. Around 73% of the total GoM's catch is taken by US fleets.

Landings, both in Mexico and the United States had shown descending trends since the last eighties. Total catches in the Gulf peaked in 1987 (1,480,729 metric tons). Catches in the US portion of the Gulf of Mexico peaked in 1984 (1,194,000 metric tons) and Mexico's in 1989 (389,146 tons), while in 2008 harvest were 600,000 and 168,500 tons, respectively. Although fishermen have fished the Gulf LME for centuries, the fishing effort that has increased steadily with time and an ever more efficient technology of harvesting has resulted in threatening particularly vulnerable species and others being below their expected sustainable yield. Although complete databases of fishing effort are not available, there is evidence that commercial fishing in the GoM has considerably increased in the last two decades.

Like the majority of tropical fisheries, most of the fisheries in the Gulf have multispecies catches. There are very few fisheries that catch only one or two species (e.g. octopus, lobster); most catch a fraction of the target species or related species, and the remainder of the catch includes many species from different families.

Shrimp fisheries are the ones that generate the biggest revenues (although not necessarily the most profitable) that any other fishery in the GoM in both countries because of the high market value of their catch, although they account only for 11-13% of total annual landings. Small coastal pelagic fisheries (e.g. menhaden and herring) are the largest in weight followed by shrimps, large decapods (e.g. crabs and lobsters) and mollusks. Among fish groups, demersal fish are the second highest in terms of weights caught. Cephalopods (e.g. octopus and squids) and miscellaneous other fishes are also caught.

Recreational fisheries are centered at major tourist destinations in the US and Mexico. In the US, from 1980 to the present, landings by this fishery have tended to increase. The majority of fishing grounds are located in the Mississippi delta region and on the west coast of Florida. The US Gulf coast accounted for more than 30 percent of trips, and 41 percent of the catch of recreational fisheries in that country. In 2010, 2.7 million residents of the US Gulf coast states participated in

Few fisheries catch only one or two species; most catch a fraction of the target species or related species, and the remainder of the catch includes many species from different families.

marine recreational fishing (nearly 22 million trips and caught 147 million fish). The most commonly caught species were spotted sea trout, red drum, sand seatrout, Atlantic croaker, and Spanish mackerel. Several Mexican Gulf states attract recreational fisheries, including Yucatan, Veracruz, and Tamaulipas. However, there is no record of fishing effort, tonnage caught, or of species caught in those areas.

Numerous problems are associated with this massive harvesting of living marine organisms. These include non-optimal harvesting by commercial fisheries, overcapitalization and other economic inefficiencies, weakness in institutions and governance overseeing commercial and recreational harvesting, heterogeneous management and research capabilities between countries, lack of formal bilateral cooperation mechanisms for sharing scientific information and conducting joint stock assessments, and incomplete information and understanding of ecosystem functioning.

Problem: Non-optimal harvesting of commercial living marine resources. Non-optimal harvesting includes over-fishing, fishing of under-size fish, fishing of reproductive adults and dumping of by-catch.

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 Mexico, of the 24 most important fisheries in the GoM (in the 2010 National Fisheries Chart), 64% are at or near the Maximum Sustainable Yield (MSY) (against 63% in the 2006 NFC), 2% are exploited below their MSY (4% in 2006 NFC), 31% are considered to be deteriorated or overexploited (21% in 2006 NFC) and 3% are still considered to have potential for increasing catches (8% in 2006 NFC). This status information covers only around 20% of the total enlisted species.

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.

Problem: Overcapitalization and economic inefficiencies. It also includes non-optimal socio-economic situation of fishers and the fisheries sector overall.

Although precise data are lacking, there is a general agreement that a good number of fisheries in both countries are overcapitalized or do not operate at a full economic efficiency.

Subsidies policies, intended to mitigate the effects of those inefficiencies, should be evaluated, to avoid increasing fishing effort or maintaining it at unsustainable levels, and redirected to activities that enhance sustainable exploitation.

Problem: Institutions and governance have to be strengthened. In general, inadequate management strategies have been identified as one of the causes of the non-optimal state of world fisheries. In particular, frequently lax entry regulations, market structure and government incentives have resulted in growth of fishing effort above sustainable levels that result in non-optimal harvesting and economic inefficiencies (see above). Adequacy of management objectives and strategies, based on the harmonization of the productive capacity of the resources and the economic benefits obtained from them should be looked for.

In Mexico, institutions (particularly those that give scientific and technical support to management) have to be strengthened and the scope for decision-making, widened. Capacity-building in the areas of assessment and management should be promoted.

Illegal fishing is a growing concern in Mexico, under circumstances of limited enforcement capabilities and little economic alternatives for fishermen. Poverty is a common problem and a driver of increasing fishing of legal and illegal effort in Mexico's artisanal fisheries.

Although enforcement is an area with potential for improvement, the provision of incentives for compliance should be encouraged. Economic alternatives for artisanal fishermen should be looked as a way to ease pressures that act as drivers for illegal fishing. New schemes for stakeholder's participation in management (like co-management for artisanal fisheries) have to be explored as a way for resource users to internalize management rules and participate in enforcement efforts.

Also, harmonization of objectives and strategies with those of other economic sectors and environmental protection should be encouraged as a way to avoid or reduce conflicts with other stakeholders.

Problem: Heterogeneous capabilities and limited exchanges of experience among countries. There is only a limited inter-country exchange of knowledge and experiences. Exchange is carried out mainly on scientific matters (assessment, rather than on management strategies). Much of the experience exchange is carried out on a personal (non- institutional) basis.

Information about by-catch and discards in the area is more readily available for the US than for the Mexican fisheries.

Information and experience exchanges regarding management strategies and instruments should be encouraged and those on assessment matters strengthened.

Problem: Incomplete information and understanding of ecosystem functioning. Most information, monitoring and management efforts are focused on a few resources of commercial importance. Yet, for some of them knowledge is not always complete.

Information on the ecologic role and value of non-harvested species is incomplete and in many cases the protection awarded to these species is based on their charismatic value, rather than on their role in ecosystem's integrity and resilience.

The role of habitat integrity on ecosystem's function, and thus, the effect of habitat loss or damage as a result of fishing operations or other human activities on fisheries production have yet to be integrated into assessments.

Besides the explicit incorporation in assessment of the ecosystem concerns mentioned above, the results of these assessments have to be incorporated in the decision-making process. This incorporation is incipient (US) or non-existent (Mexico).

Transboundary elements:

Several transboundary elements are identified regarding fisheries in the GoM LME:

1) Addressing overexploitation of fishery stocks

2) Overcapitalization and sub-optimal economic conditions in commercial fisheries. These are widespread problems in fisheries worldwide and the GoM is no exception.

3) Asymmetries in economies that result in the relative importance of socioeconomic conditions as drivers of the observed problems being different in both sides of the border.

4) Institutional coordination in management and research of commercial and recreational fisheries, is also different.

5) Incorporation of ecosystem-related issues in fisheries management has yet to be fully addressed

These three latter issues should be taken into account in identifying common management strategies. Capacity building and expansion of present systems for information exchanges are considered actions to be taken in this regard.

Socio–economics

4. SOCIO-ECONOMICS

There are two kinds of major socioeconomic problems: those related to the insufficient knowledge towards informed decision-making and those derived from the nature of the dynamics of the economic and social system in the whole GoM LME region.

Problem I: Incomplete and insufficient knowledge of the Gulf of Mexico ecosystem services. Ecosystem functions produce benefits, beyond those accounted by assigning prices to products of commercial economic activities. However, it has not been unambiguously defined how to assign market values to those benefits that explicitly account for the natural capital economy in decision-making. Decisions are incomplete if they do not include all the benefits and costs of the ecosystem that supports the economy.

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:

i) high primary productivity of emergent vascular plants as well as single celled benthic microalgae and habitat provision supporting the food webs leading to fish and wildlife;

ii) serving as a buffer against storm wave damage to the adjoining vegetation and human development on higher ground;

iii) shoreline stabilization and erosion protection;

iv) flood water storage;

v) water quality maintenance, including filtering out sediments, nutrients and pathogens;

vi) biodiversity preservation, especially of a suite of endemic, often threatened or endangered vertebrates;

vii) carbon storage as peat is accumulated, buried and stored, thus buffering greenhouse gas emissions; and

viii) socioeconomic benefits, such as sustaining the aesthetics of coastlines, maintaining a heritage and

Despite their high importance for many economic activities, coastal ecosystems are not in the traditional economic accountability.

historical culture, supporting ecotourism, serving as a living laboratory for nature education, and promoting psychological health and supporting fishing and waterfowl hunting.

Climate regulation (including greenhouse gases absorption, evapotranspiration and subsequent transport of stored heat energy, local humidity, cloud formation and buffering of temperature extremes), protection against effects of storms, waste absorption, erosion control and sediment retention and others are among these services.

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

In the US, 27% of domestic crude oil production comes from the Gulf, whereas Mexico produces up to 80% of its national oil in the Gulf.

In the US the infrastructure for oil and gas production in the Gulf of Mexico, including oil refineries, petrochemical and gas processing plants, supply services for offshore oil and gas production units, platform construction yards and pipeline yards, is concentrated in coastal Louisiana and Eastern Texas.

The Gulf region is in fact the economic zone where the oil production has its most important benefits: jobs and infrastructure have grown all along the coastal zone. But, at the same time, coastal landscape and marine ecosystems face major environmental impacts.

Commercial fishing is an important component of the GoM LME's economy. In the US during 2010, commercial fishermen landed 1.3 billion pounds of fish and shellfish worth approximately $635 million USD, whereas in Mexico 371 million pounds of catch were worth 344 million USD. Marine sport-fishing is another industry of regional importance, providing jobs and recreational activities. In 2010, an estimated 22 million fishing trips were taken which landed 147 million fish in the Gulf of Mexico. Approximately 31% of the estimated recreational fishing trips taken in the US in 2010, occurred in the Gulf.

The Gulf of Mexico LME contains major shipping lanes. Port facilities contribute to important sources of employment. The volume and value of shipping has increased in the Gulf region. In Mexico, two out of five ports that receive up to 80% of imports are found in the Gulf of Mexico. In the US, six of the top 10 leading shipping ports in the country are found in the Gulf. In the US Tourism and recreation provide over 620,000 jobs. In Mexico, the corresponding figure is 310,000 jobs.

Problem II: The Mexican Gulf region is experiencing social and economic changes in recent years. Primary sector activities have reduced their participation in the GDP, from 15-20 to 4-10%. Sectors whose growth could result in expanding employment (like tourism, services and trade) are not growing at the expected pace. Low-wage, informal employment and unemployment have grown markedly.

It was estimated in 2000 that 22% of the region's working population had no remunerated employment. Between 2000 and 2010, the formal economy should have created 1.8 million jobs, but it only generated 500,000. In Mexico, 60% of new jobs are created in two states (Tamaulipas and Quintana Roo, related to industry and tourism, respectively). The economy around oil exploitation in Campeche, although resulting in an economic boost for all sectors, has only a local effect. Poverty is a major problem in the Gulf's coastal states with 60-80% of its population classified as poor. People are settling in areas prone to be affected by meteorological events (floods, etc.) in absence of remunerated employment.

This explains four phenomena:

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.

Population growth and increased urban settlement has resulted in water-resources stress in the Yucatan Peninsula, coastal habitat destruction in Veracruz, Quintana Roo and Campeche.

In the US, coastal regions are among the most densely populated areas, and there has been a general shift of the US population to the nation's coasts over the last several decades. The US Gulf's population has increased by 103% since 1970 and by 150% since 1960. This is the second fastest-growing region in the US and is double the rate of increase for the US as a whole as more people seek for affordable living in the South and Southeast. Texas and Florida are the most rapidly-growing states.

These population shifts have resulted in infrastructure building and urbanization, which has contributed to losses of affected coastal habitats. Coastal wetlands such as marshes and swamps were drained for agricultural and urban expansion purposes. Secondary effects of urbanization, such as dredging and damming have led to severe losses in palustrine aquatic bed around the US Gulf coast. The US Gulf of Mexico coastal region contains more than 40% of national wetland habitat area, but is responsible for 80% of national wetland losses in the last 200 years.

In Mexican Gulf's coastal states, the population that lives in poverty represents over 40% and in some cases over 50%. In US counties, population under poverty represents no more than 18.7% (Texas). The comparative

between the two countries shows the structural gap that makes the difference between them. Unequal development is the main reason that explains the growing migration from Mexico to the US economy. In the next years migration will be the main link between both countries.

According to states' projections in the United States, an additional 2.2 million people will be living in the coastal counties of the Gulf by the year 2025. In Mexico, population projections for 2030 show a bigger growth: 3.2 million. In the future, American counties probably will be populated by 14 million, and Mexican states maybe will be inhabited by 19.1 million. Most of this increment will be in urban zones.

Transboundary elements: Although most of the changes in economic activities and settlement patterns have only local or national immediate impacts, in the medium and long 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. These ultimately have ecosystem-wide effects.

Habitat destruction and the depletion of fishery resources are factors that increase the vulnerability of the region to events like climate or socio-economic change diminishing resilience in human communities and ecosystems. It is therefore necessary to consider alternatives that expand opportunities for economic development that generates employment and investment in programs that sponsor a regulated use of natural resources and promote the protection of threatened ecosystems (coastal lagoons, mangroves, seagrass beds, sand dunes).

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5. GOVERNANCE

Managing the environmental connections that link all Gulf of Mexico's surrounding areas is a big challenge in terms of international relations and policy. According to the Intergovernmental Ocean Commission (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”. Governance within nations of the Gulf is complex due to differing and sometimes overlapping authorities at federal, state and local levels. Moreover, cultural considerations of history, language, politics, religion, and socioeconomics complicate efforts to better integrate governance mechanisms among the three nations that share the Gulf.

1. USA and Mexico's Ocean Policy at a Glance

The traditional approach to managing coastal and ocean areas in the US has been at sector specific, isolated levels with little cooperation or collaboration across local, state, tribal, federal, or international boundaries. Fragmented laws with overlapping and unclear jurisdictions and disjointed policies have presented management difficulties for decades. The Marine Resources and Engineering Development Act in 1966, the Coastal Zone Management Act, the Marine Sanctuaries Act, and the Magnuson-Stevens Fisheries Conservation and Management Act are some of the most important pieces of legislation.

However, there is currently no regulatory entity that has oversight authority over the whole ocean. Regulatory authority over marine resources in the US generally has to comply with multiple federal statutes depending on the resources in question. Fisheries, marine mammals, oil and gas, dredged materials, renewable energy, among others, have sector and resource specific statutory schemes and jurisdictions between the states and federal government. To enhance a more integrated approach to ocean management, two National Ocean Policy Commissions were established: The Pew Commission and later the United States Commission on Ocean Policy (USCOP). These efforts provided key platforms for the development of comprehensive and coordinated national ocean policy by putting together the famous Ocean Blueprint Report and the consolidation of the Gulf of Mexico Alliance and its two Action Plans.

Most recently the Obama administration created the Interagency Ocean Policy Task Force which has produced a series of documents and recommendations in the aftermath of the Deepwater Horizon-BP oil spill) including important changes such as: The establishment of a new National Ocean Council (NOC), strengthening the decision -making and dispute-resolution processes, engaging State, tribal, and local authorities to address coastal issues, strengthening coordination between the NOC and other federal agencies such as the Department of Energy, National Security Council, Environmental Protection Agency, and others.

In Mexico, any coastal and ocean planning initiative is based on Article 27 of the Mexican Constitution in accordance with relevant provisions of the United Nations Convention on the Law of the Sea (UNCLOS 1982). However, the General Law of Ecological Equilibrium and Environmental Protection (LGEEPA- Ley General del Equilibrio Ecológico y de Protección al Ambiente) enacted in 1988 and periodically revised (most recently in 2008) represents an important piece of legislation defining a framework for environmental law. LGEEPA remains the keystone legislation that will serve as the foundation for all current integrated coastal management efforts. Until very recently Mexico's coastal zone was governed by a multitude of single sectoral laws and agencies. This situation changed in 2010 as a result of the creation of the Inter-secretarial Commission for the Integrated Management of Oceans and Coasts, best known as CIMARES. Constituted by the Ministries of the Interior, Foreign Affairs, Navy, Social Development, Energy, Economy, Agriculture, Rural Development, Food and Fishing, Transport and Communications, Tourism, and Natural Resources; CIMARES represents the most important landmark in terms of multi-level governance mechanisms to enhance ocean policy in Mexico.

Further instruments have supported these initiatives for integrated management of coastal and marine zones in Mexico. For example: the National Environmental Policy for Sustainable Development of the Oceans and Coasts best known as PANDSOC, but also other collaborative agreements such as the Trilateral Security and Prosperity Partnership of North America (ASPAN/TSPPNA) signed Between Canada, USA and Mexico in 2005; the Advisory Council for the Sustainable Use and Protection of Mangroves and Coastal Wetlands, the Regional Action Program for the Yucatan, and the Strategy on Coastal Wetlands and Mangrove Conservation have been crucial in pursuing a national policy to protect and manage Mexican coastal areas.

All in all within both countries there is insufficient coordination between governmental agencies. Despite the creation of CIMARES with its six working groups and sub-commissions, insufficient law enforcement and the lack of control over coastlines and water makes integrated management effort quite difficult to undertake. Similar problems exist with the new US Ocean Policy. The coordination and institutional mechanisms necessary to effectively implement the policy are in their infancy and are untested. Moreover, whether sufficient political support and adequate funding will be available in the future remains unclear.

2. Landmarks on Regional Collaboration

Despite the fact that the three surrounding countries of the Gulf (i.e. US, Mexico and Cuba) have had long history of cooperation and partnerships (which has been most common between US and Mexico through scientific institutions and very specific cases between the US and Cuba or Cuba and Mexico); a vast range of organizations, institutions and government agreements have been created in the past to work together on issues such as fisheries, migratory species, and research priorities only to mention a few. Organizations such as The Gulf of Mexico Fishery Management Council (GMFMC), The Gulf States Marine Fisheries Commission (GSMFC), the International Commission for the Conservation of Atlantic Tunas (ICCAT), the MEX-US-Gulf Bilateral Oil Spill Response Agreement and the Gulf of Mexico Program under the Environmental Protection Agency's (EPA)

New and innovative schemes for regional collaboration certainly represent alternatives and arrangements to be considered when confronting trans-disciplinary, multi-stakeholder and multi-national problems.

mandate among others, reveal the great importance that the Gulf countries have had in the past to work together. Today, cooperation has expanded considerably and no longer focuses exclusively on topics concerning fisheries and their management issues.

The Gulf of Mexico Alliance (GOMA), the Gulf of Mexico Large Marine Ecosystem Project (GoM LME), Tri-national Initiative for Marine Science and Conservation in the Gulf of Mexico and Western Caribbean, the Bi-national US-Mexico group under GOMA's Habitat Conservation and Restoration team and the International Workshops Series on Governance for the Gulf of Mexico (started by the Harte Research Institute for Gulf of Mexico Studies at Texas A&M University, Corpus Christi [HRI-TAMUCC], and supported by other Mexican and Cuban institutions) are clear proof of new and innovative schemes for regional collaboration. All these certainly represent alternatives and arrangements to be considered when confronting trans-disciplinary, multi-stakeholder and multi-national problems.

3. International Treaties and the Sovereignty Question

For decades, the treaties and institutions set up between the United States and Mexico to deal with transboundary and binational issues have served as models of cooperation around the world. Transboundary impacts (within the LME context,) represent all those common problems requiring common strategies; problems that originate in one country but that will impact the whole LME due to the connectivity entailed (such as overfishing, the use of coastal resources, oil pollution discharge, etc.)

Despite the good examples in cooperation, some unresolved environmental questions could result in bi-national strife in the near future. The question of national sovereignty will continue to play a large role when confronting issues that require transboundary solutions such as water availability, energy development and electricity, proper handling and disposal of hazardous waste streams and invasive marine species. Of particular concern may be the challenges associated with integrating port and fisheries management with coastal development and commercial fishing; and addressing legal and political impediments to the efficient development and conservation of transboundary hydrocarbons in the deepest portions of the Gulf, especially along the US-Mexico maritime boundary and within the so-called Western Gap Region.

The following section names important international agreements that Mexico and the US currently use to refer to when dealing with transboundary issues. However it does not imply that both nations are States Parties to each of these instruments.

a) Under International Maritime Organization (IMO)

International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, International Convention for the Prevention of Pollution from Ships (MARPOL), International Convention for the Safety of Life at Sea (SOLAS) and International Convention on Maritime Search and Rescue (SAR).

b) Under United Nations

United Nations Law of the Sea Convention (LOS) (which US has not ratified, yet it complies with because it represents customary international law); Ramsar Convention (UNESCO), Montreal Protocol (Ozone layer), Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Disposal, Biodiversity Convention, Climate Change (Kyoto Protocol – where the US is not a part), and the Cartagena Convention on Biotechnology and Biodiversity (which also the US has signed but not yet ratified).

c) Other conventions signed between US and Mexico relevant to the GoM:

International Boundary and Water Commission; Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter; Cooperation Agreement on Marine Pollution by Oil Spills and Other Harmful Substances (with updated amendments); Cooperation Agreements on Treatment and Disposal of Wastewater within Border Cities (such as Tijuana, Rio Bravo and Nuevo Laredo); Convention for the Protection of Migratory Birds and Game Mammals; International Agreement on Dolphin Conservation and North American Agreement On Environmental Cooperation (CEC-NAFTA); to mention the most relevant.

4. Institutional Performance and Good Governance for Integrated Coastal Management (ICM).

ICM is defined as a continuous dynamic process by which decisions are made for the sustainable use, development and protection of coastal and marine areas and resources. Sustainable development appears as one of the key goals of ICM.

Hence this multidimensional characteristic urges ICM to analyze implications of development, conflicting uses, and interrelationships among physical processes and human activities, promoting harmonization between sectoral coastal and ocean activities. The ICO's proposal of 15 governance indicators is turning into a popular tool which could potentially be used as a regional framework to assess good practices on coastal management issues.

These indicators have incorporated criteria that could be valuable to measure progress as their aim is to evaluate the existence and functioning of coordinating mechanisms, the existence and functioning of conflict resolution mechanisms, the sustained availability and allocation of human, technical and financial resources for ICOM; existence, dissemination and application of ICOM-related scientific research and information, the use of economic instruments in support to ICOM, among others. Yet, this is a new framework worth of further analysis and scrutiny among the Gulf countries.

5. Key Actors and Stakeholders in the Gulf of Mexico

In Mexico, as in the United States, there are numerous institutions, universities, NGOs, and government agencies whose work focuses on marine and coastal priorities. Those relevant to the region are cited in Annex 1.

6. The Cuban Question

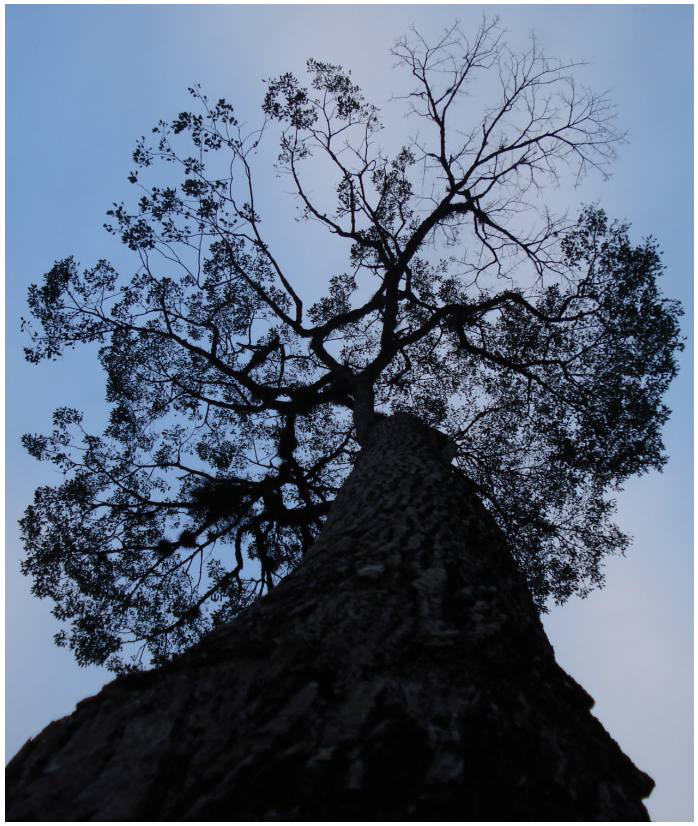
Certainly, the GoM-LME embraces the three surrounding countries sharing deep-rooted environmental connectivity; therefore the need for Cuba to become an active partner in the action plan is evident. Cuba's direct involvement is indeed crucial to the successful implementation of integrated management initiatives in the region setting aside all political obstacles that would prevent the three countries from working for environmental protection and conservation purposes. In this regard, Cuban scientists and high ranked environmental managers have been recently participating in several tri and binational working groups aiming to share success stories on management skills and models as well as research studies and sharing of important data. The dialogue has been very productive and their experiences on management, resources allocation and scientific data collection have been of great value in many of these international meetings. Cuban participation is beginning to be more and more common after President Obama's new Open Door Policy, which allows Cubans to

travel to the US with scientific and education purposes.

Transboundary elements: Overall the need to elevate marine environmental protection issues on government's agendas in order to bring about formal agreements and improvement of environmental legislation region-wide has become evidently essential. The suggestion is to take the high-level aspects of institutional vision and leadership out of the existing conservation agendas and place it explicitly on the agenda of the GoM-LME's Strategic Action Plan (SAP). The latter is indeed significant as it pursues to give stakeholders a chance to coordinate their actions, learn from each other and create working synergies. The inclusion of new stakeholders in the process will be a part of a more collaborative governance regime in the Gulf.

Finally, the promotion and creation of a Mexican Gulf Coastal States Alliance appears to be a pending issue as well. This mechanism will be utterly useful to analyze benefits and obstacles in working bi-national coastal management issues as well as to understand implications of legally binding international treaties related to environmental protection affecting both countries.

The integration of knowledge to incorporate national policies in a Strategic Action Plan could become a common goal and thereafter build upon this knowledge and successful experiences to consolidate the so-called National Action Plans for USA and Mexico with long term perspectives.



Transboundary impacts (within the LME context,) represent all those common problems requiring common strategies; problems that originate in one country but that will impact the whole LME due to the connectivity entailed.

6. 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.

Problem: Widespread effects of Climate Change. The IPCC has concluded that warming of the climate is unequivocal. Furthermore, even with full mitigation policies, average global temperatures will rise substantially over the next century, with 'business as usual projections' of temperature increases ranging from 2 to 5 degrees Celsius. This increase in temperature will be associated with complex effects on other aspects of climate, such as sea level rise, rainfall patterns and the frequency and intensity of storms, and with consequent effects on natural ecosystems and human activity.

Climate change is transforming ecosystems at extraordinary rates and scales. This warming has already caused significant and widespread changes in dominant plant types as the ecosystems of the continent reorganize in response to climate warming and associated changes in the water cycle.

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. 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.

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. June 2010 is the fifth straight record warm month in the tropical Atlantic.

The July heat index—a measure of human comfort based on combining temperature and humidity— is projected to increase with global warming more in the South than in any other region of the United States. Over that same time period, the annual precipitation has increased some 20-30% and the past ten years appear to be getting wetter. Compared with the previous 24 years (1971-1994), there were twice as many hurricanes in the Atlantic, including two and a half times more major hurricanes (reaching Category 3 strength). A precipitation response to El Niño (ENSO) events in the western and central Gulf Coast has been documented.

Warm episodes of the ENSO have been more frequent, persistent and intense since the mid-1970s, compared with the previous 100 years. Recent data show that the North Atlantic Oscillation (NAO) combines with El Niño to drive weather patterns. During positive phases of the NAO, the westerly winds are strengthened and moved northward, causing increased precipitation and temperatures over northern Europe and the southeastern US. Additionally, the Atlantic Multidecadal Oscillation

Climate change impacts, such as warming temperatures and changes in greenhouse gases concentrations are likely to increase opportunities for certain invasive species.

(AMO) has been linked with Sahel drought, Brazilian rainfall rates, North American climate, and Atlantic hurricane frequency.

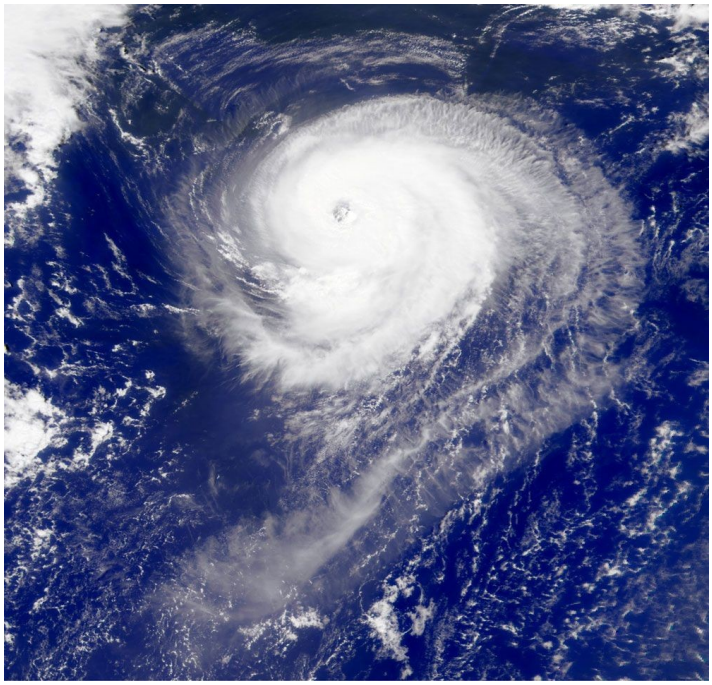
The productivity, distribution and seasonality of fisheries, and the quality and availability of the habitats that support them, are sensitive to these climate change effects. In addition, many fishery-dependent communities and aquaculture operations are in regions highly exposed to climate change. The same can be said about important economic activities like tourism or oil and gas exploitation. With the magnitude of hurricanes Katrina and Rita more than 100 platforms and 500 pipelines were destroyed causing more than 500 oil spills. Coastal settlements are vulnerable to these effects as well.

Moreover, there is some evidence on how climate change is compounding the already noticeable effects of invasive species. Climate change impacts, such as warming temperatures and changes in greenhouse gases concentrations, are likely to increase opportunities for certain invasive species.

A most serious consequence 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 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.

Transboundary elements: Climate change and associated effects such as ocean temperature and sea level rise, acidification, and changes in storm and rainfall patterns will be felt at the scale of the Gulf of Mexico LME. The design and implementation of common policies and strategies that incorporate climate change will be a critical part of the implementation of ecosystem-based management.



7. ENVIRONMENTAL EDUCATION AND OUTREACH

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.

Ecosystem-based Management represents a paradigm shift away from a sector by sector approach that claims for a better overall understanding of marine ecosystems and of the transboundary nature of governance, fisheries, climate change, and water pollution. Environmental Education and Public Participation (EE & PP) seeks to support the EBM concept with a focus on improved understanding of the role of the five modules identified in the LME and the combined effects of natural variability and human activities driving habitat destruction, degraded benthos, overfishing, ocean warming, increased acidification, and nutrient over-enrichment, among others.

EE & PP also considers the necessity of informed societies that can promote the sustainable management of natural resources through an 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.

Since 1983 the Mexican government started to promote environmental education. Different efforts to push environmental education have been developed by governments and civil society. Nowadays, there are legal mechanisms that support environmental education actions for achieving sustainable development in Mexico. An example of this is the National Commitment for Education for Sustainability that was signed in 2005 with the main objective to establish the institutional conditions to develop a national strategy of education for sustainability. Several factors have set the baselines to start working through a national strategy. However, a national vision is still in process of construction and a regional vision for the Gulf of Mexico is only a starting initiative.

In the US, as a result of a regional vision that seeks to achieve a resilient and healthy GoM, coastal states are part of the Gulf of Mexico Alliance (GOMA) with the objective to achieve a better integration of resources,

More programs that promote ocean research activities and issues are required in the GoM LME

knowledge and experience to address priority issues in the region. Environmental Education is one of the priority areas in GOMA and they have identified the following focus areas: Community Education and Outreach, Public Awareness, K through 20 Environmental Literacy, and Economic Value Communication. These activities respond to the objective of improving the health of the Gulf, engaging local audiences in issues that directly affect them and developing sustainable coastal communities. Several institutions and organizations are working together in these programs and this has allowed specific activities in US coastal states of the GoM since 2006.

Problem: Several environmental education and public

participation activities and programs need a regional vision for addressing priority issues identified in the region. Some institutions and organizations are working to address aspects such as wetlands restoration, habitat conservation, ecotourism, water management, and conservation of species at risk in the region, among others. Nevertheless a better understanding of marine and coastal ecosystems is needed. There is also a need to identify priority issues and possible funding that can be used through joint bi-national efforts in the region.

Problem: 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 to be able to take the most suitable decisions for the sustainable management of the GoM LME.

Problem: There are only a few institutions in Mexico that foster research on marine and coastal ecosystems. More programs to promote research activities in regard to ocean issues in the GoM LME are required.

Transboundary elements: 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.

1. Insufficient water processing infrastructure included in sectoral planning
2. Incomplete pollution control
3. Ecosystem concerns not sufficiently considered in planning and management
4. Planning and management done in a per-sector basis without proper accounting of externalities and natural limits of resources
5. Capacity building not in pace with the need to address ecosystem, social or economic concerns
6. Insufficient control of traded or cultured species
7. Insufficient control of involuntary invasive species transport
8. More precise legal and technical definitions are needed to adopt the Ecosystem-Based Management approach as a common strategy.
9. Fishing effort entry controls not effective enough

MAIN ROOT CAUSES

The UN Conference on Environment and Development, in 1992, stressed that environmental problems should be dealt with at their roots, using a "holistic approach", beyond sectoral or political boundaries.

The task is to develop strategies holistically; and design responses which act within the sectoral and geographical boundaries of society. Beyond the underlying social and economic causes and sectoral pressures are the root causes of environmental degradation.

The immediate causes are usually the direct technical causes of the problem. They are predominantly tangible (e.g. enhanced nutrient inputs), and with distinct areas of impact examples of immediate causes for transboundary problems are modification of stream flow or chemical pollution. Root causes are often related to failures/ deficits in governance, management, socio-economy, technology, infrastructure, uncertainties in assessment or management that are in turn the cause of those tech-nical problems.

The following root causes are proposed for the perceived major problems:

Action Areas

Both Mexico and the United States have in place an institutional and regulatory framework to address environmental and natural resources concerns. In recent years, both countries have been advancing towards the development and implementation of management schemes that incorporate more fully those concerns. In addition, a research and monitoring structure exists to provide scientific inputs to management. However, the relative development of the members of those frameworks, within and between both countries, is unequal. In addition, despite existing bi-national agreements between Mexico and the US, the shared resources of the GoM are, in many cases, unsustainably exploited. There are currently no agreed bi-national programs for managing the GoM resources from an ecosystem-based perspective.

The transition towards the ecosystem-based management of the GoM LME will depend on a greater convergence of policy tools including long-term joint programs and actions, along with capacity-building initiatives. The proposed Action Areas are seen as a way

to attain that convergence and increase the capacity to address the perceived major challenges by acting upon the perceived root causes. The proposed action areas are as follows:

1. Capacity building

Detection of human capital gaps and definition of common strategies to address them. Detection of material needs to reinforce research/monitoring and management capabilities and common strategies to address them.

2. Strengthening of the institutional framework.

Development and strengthening of institutions and their legal mandates and instruments to address the detected concerns.

3. Development and strengthening of inter-sectoral planning mechanisms.

Analysis of needs to strengthen present inter-sectoral planning bodies and their legal mandates and instruments or development of new bodies.

4. Support for development of necessary infrastructure.

Analysis of needs and technical alternatives to address the detected concerns. This can include the search and procurement of financial resources to fill the gaps detected.

5. **Provision for actions and incentives to reduce nutrient run-off from agriculture.**

Analysis of technological alternatives and incentives schemes and the economic, legal, and institutional frameworks to develop and implement them. As in the last case, the actions can include the search and procurement of financial resources.

6. Development of a common institutional know-how basis on Ecosystem-Based Management.

Development of common management criteria and objectives. Definition of a road map to incorporate these into management schemes and instruments.

7. Provision for better definitions of property and use rights of fisheries resources.

Analysis of alternative modes of property and use rights and a road map to implement them.

8. Development of common strategies to face the effects of Climate Change.

Detection of needs to reinforce research/monitoring and management capabilities (including institutional framework and legal instruments) and definition of joint strategies and actions to address them.

Despite existing bi-national agreements between Mexico and the US, the shared resources of the GoM are, in many cases, unsustainably exploited.

Perceived Major Problem	Transboundary Elements	Major Root Causes	Action Areas
Habitat Alteration and/or Loss	While most sources and impacts are localized, the problems are common to both countries and require collective action to address	1,2,3,4,5	1,2,3,4,6
Eutrophication and hypoxia		1,2,3,4,5	1,2,3,4,5,6
Effects from hydrocarbons, pesticides, metals, emergent pollutants		1,2,3,4,5	1,2,3,4,6
Floating Marine Debris, especially plastics		1,2,3,4,5	1,2,3,4,6
Invasive Species	Many invasive species (specially marine ones) distribute themselves across national borders, requiring joint strategies and cooperation and actions	2,6,7	1,2,3,6
Non-integrated / conflicting / inadequate fisheries management strategies and capabilities among countries	Some species stocks are exploited by both countries. Overexploitation, overcapitalization are common concerns	3,4,5,9	1,2,3,4,6,7
Perceived Major Problem	Transboundary Elements	Major Root Causes	Action Areas
Climate Change effects	The effects of Climate Change are global in nature. Both countries' coastal areas in the Gulf share a relatively flat topography, rapid rates of land subsidence, extensive shoreline development, and exposure to major storms.	3,4	1,2,3,6,8
Incomplete information and understanding of ecosystem functioning	Ecosystem-wide connectivity require involvement from both countries	1,2,3,5	1,2,4,6
Difficulty in assigning value for ecosystem services	Currently, the inadequacy of the evaluations of ecosystems services make it challenging to make decisions about proper trade-offs when considering management actions around the Gulf.	1,3,4,5,8	1,2,3,6
A way to promote sustainability and ecosystem-related concerns as a cross-cutting issue in planning and management has yet to be found	As a path for management of a shared ecosystem in a sustainable way, these concerns should be more fully incorporated into planning and management with common objectives and approaches between the two countries	3,4,5,8	1,2,3,6
Perceived Major Problem	Transboundary Elements	Major Root Causes	Action Areas
Insufficient coordination between governmental agencies	In different degree, within each country, this is a problem shared by both countries. Equivalent agencies in each country could exchange information and experiences to a higher degree.	3,4,5,8	1,2,3,6
Shortage of specialists to support assessment/monitoring and decision making (like population dynamics experts, ecosystem modelers, environmental and resource economists, etc)	Although in different degrees this shortage occurs in both countries. A proper information exchange and the definition of joint or harmonized management strategies are predicated on a strong human capital in both countries.	3,5	1,2,3
EBM concepts have yet to be explained and disseminated	Ecosystem Based Management has yet to be established and implemented in a standardized way within and among countries.	2,3,4,5,8	1,2,3,6

General remarks and the way forward

9. GENERAL REMARKS AND THE WAY FORWARD

This version of the TDA document has been prepared upon information review of the preliminary TDA, as well as from several bi-national Mexico-US workshops, seminars, and forums where authorities, experts and stakeholders at large addressed the LME modules, project outcomes and all regional priority issues; the different Thematic Reports prepared by the GoM LME Project's experts and consultants, and from consensus and recommendations that arose from a workshop held on July 19-21, 2011.

The TDA process also included the results of surveys and personal interviews to experts, authorities and representatives of civil society in the US and Mexico, a process that provided a feedback to the preliminary TDA.

Challenges of an integrated assessment and management of the GoM LME and the way forward

The Gulf of Mexico LME as a region requires a decisive multinational effort to further enhance the sustainable use of resources as well as to ensure the provision of goods and services to the Gulf's bordering nations. Though a difficult task, the way forward to such challenges relies on our adoption and understanding of a complex alternative vision that is spatial, multi-disciplinary, multi-criterial, multi-sectorial, and multi scale. Such an integrated vision must take into account biological and physical components alike. This paradigm shift will enable the integration of conservation science with a social dimension that also considers nature's portions under human management (territorial use).

The biodiversity of the Gulf's ecosystems is tightly connected to local economic prosperity, culture and human welfare, supporting human communities and livelihoods as well as ecosystems. Human residents in the Gulf are increasingly vulnerable to the consequences of global climate change. Thus the countries in the Gulf of Mexico should recognize the need for stronger engagement with coastal communities.

Enhancing ways to inform the population about the effects of climate change and engaging them in mitigation and adaptation issues to respond to it, and developing programs that will help monitor the Gulf ecosystems to achieve a balance between human and natural uses are issues that need urgent consideration.

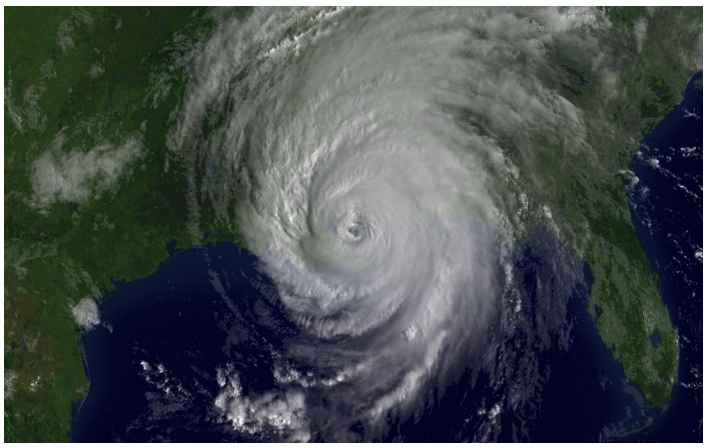
The historical and contemporary stresses on ecosystems depict the need for an ecosystem-based management

and synergistic actions. The Gulf´s Strategic Action Plan (SAP) must include not only an understanding of its basic history and natural processes but also a realistic and scientific assessment of recent damage from oil spills and other accumulated stressors and impacts, as well as defined goals and policies that accurately reflect these realities, such as the current fragmented governance framework and its need for a more open communication.

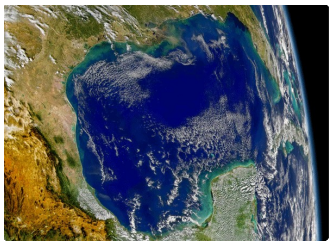
Mexico and the United States should proactively work in the definition of overarching actions that reflect the exigency for rigorous assessment, defined goals and cooperation with human communities, treating the Gulf as a holistic ecosystem that must accommodate a suite of multi-sectorial interests and sometimes, competing uses.

We need to account for historical baselines, expected future dynamics and ecosystem interactions to develop a responsible and effective Strategic Action Plan. Mexico and the US need to recognize the current condition and functions of the Gulf's ecosystems and the nature or root causes of their degradation as the basis for defining realistic actions and goals.

Both countries also need to be realistic about the time frames and resources required to achieve goals in the light of extreme and enormous spatial scale of interventions that may be needed, and the inevitable future consequences of climate change, sea level rise and extreme meteorological conditions.



Mexico and the US should take into account the highly dynamic nature of the Gulf's environment which will require adaptive management as conditions change.



In spite of the priority transboundary issues mentioned in the present TDA document, Mexico and the US need to acknowledge that the future of a healthy and resilient Gulf will require a comprehensive and integrated plan that focuses on rebuilding the functional integrity and services of entire ecosystems that have been disturbed as a consequence of long-term degradation and recent negative impacts such as the DWH oil spill, thus responding to the systematic degradation that has progressively compromised the Gulf's ecosystems.

Mexico and the US should take into account the highly dynamic nature of the Gulf's environment which will require adaptive management as conditions change. A new bi-national or regional institutional arrangement or framework would probably lead to longer-term successful results. Thus, planning of SAP and ensuring its implementation phase through the Gulf of Mexico LME project is mandatory.

Considering the major three objectives of the Gulf of Mexico Large Marine Ecosystem Project the following paragraphs represent a summary of main challenges and vision to the future.

1. Reducing Pollution

As mentioned in the previous chapters nutrient loading, sedimentation and discharges of other pollutants into the Gulf has increased over the past 200 years as a consequence of more intense human occupation,

development, and use of land in the Mississippi River watershed and other rivers entering the Gulf such as the Coatzacoalcos, Grijalva, and Usumacinta Rivers in the southern Gulf.

The concentration of nitrate and phosphorus in river systems that feed into the Gulf, increased three- to fivefold between the early 1900s and the 1990s and may continue to rise with increasing demands for food and, more recently, for corn and other crops used in ethanol production in the Midwest US, as well as land use change for agriculture crops and cattle in the Mexican coastal watersheds. The concentrations of pollutants such as heavy metals have increased in sediments and these increases are probably associated with oil drilling activities in the Gulf. Although nutrient enrichment is not the primary cause of wetland loss in the Gulf, it appears to contribute to it.

Like wetlands, other shoreline habitats have been impacted with significant degradation and loss from nutrient enrichment in the decades before the DWH oil spill. Nutrient loading can cause massive blooms of phytoplankton, microalgae and macroalgae, leading to harmful algal bloom events associated to economic losses as well. Sea grasses habitat losses in the US over the past 50 years have been estimated at 20 to 100 percent for most northern Gulf estuaries. Coral reefs in the Gulf have experienced coral bleaching and disease outbreaks attributed to anthropogenic stressors in the past few decades, resulting in losses in total coral cover on some reefs.

Recognizing that nutrient loading is likely to continue to increase in the coming years, both countries should make a joint effort to prepare strategic actions to consistently and systematically reduce the input of excessive nutrients into the Gulf.

Dead zones and hypoxia

The extent of hypoxia on the Gulf's northern continental shelf turn its "dead zone" in the second-largest manifestation of anthropogenic coastal eutrophication in the world. Unfortunately in recent years Mexican scientists have shown results of other similar zones in the Southern Gulf around the Campeche Sound.

We need to account for historical baselines, expected future dynamics and ecosystem interactions to develop a responsible and effective Strategic Action Plan.

Since the systematic mapping and monitoring of the hypoxia area in bottom waters began in 1985 the dead zone size has ranged between 40 to 22,000 km^2 and averaged 16,700 km^2 from 2000 to 2007. The current US Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico endorsed by federal agencies, states and tribal governments calls for a long-term adaptive strategy coupling management actions with enhanced monitoring, modeling and research.

Both countries need to focus not only in the locally identified impacts but also in its transboundary effects. Mexico and the US need to agree and prepare joint actions to reduce significantly the hypoxic conditions along the Gulf of Mexico. There is a particularly strong need in Mexico to establish robust, long-term monitoring programs, allocate tools, and enhance capacity-building to ensure the reduction of hypoxia impacts, as well as the need for bi-national efforts to develop regional environmental indicators.

Oil Pollution

The Ixtoc I oil spill in 1979 released 3.3 million barrels of oil, then in 2010 the Deepwater Horizon (DWH) Macondo

Scientists and experts from the US and Mexico should work together and bring in their experience to identify strategies and specific actions that will sustain the Gulf's health, resiliency and economy.

252 well blow-out released 4.9 million barrels of petroleum hydrocarbons, the largest into the marine environment than any previous oil spill affecting marine life, damaging deep sea and shoreline habitats, and causing closures of economically valuable fisheries in the Gulf of Mexico. Beyond the direct effects that were captured by media, it is likely that there are subtle, delayed, indirect and potentially synergistic impacts of these widely dispersed toxic hydrocarbons and chemical dispersants on marine life.

On October 5, 2001, the US government released its Gulf Coastal Restoration Strategy, a written document that is visionary and strategic. It is clear that there is a need not only to repair the damage left behind by the oil but also to go well beyond that to restore the anthropogenically stressed and declining Gulf ecosystems. Furthermore, the US Gulf Coastal Restoration Strategy should be taken into account while preparing the Gulf of Mexico Large Marine Ecosystem SAP with Mexico.

The Gulf of Mexico Large Marine Ecosystem Project demonstrated its utility as a bi-national effort by helping in the preparation of the one meeting held in August 4th 2010 at the Ministry of the Interior in Washington, DC. For this TDA document, we assembled the transboundary elements that lead to a stronger long-term relationship in the Gulf. Scientists and experts from the US and Mexico should work together and bring in their experience to identify strategies and specific actions that will sustain the Gulf's health, resiliency and economy. The SAP should be built under informed, adaptive, ecosystem-based actions in order to enhance Gulf's health and resiliency. It should also consider the context of resilience of resources, human communities and the economy into the long term.

2. Recovering depleted living marine resources

Many of the commercial living marine resources extracted from the Gulf of Mexico have been depleted. Many communities throughout the Gulf of Mexico persist only because of these commercial fisheries. As a result, management goals focused on single outcomes (such as maximization of short-term yield for one species of fish) often unintentionally lead to reductions in the quality of other services by decreasing ecosystem diversity over space and time. These exploitation schemes not only reduce the overall value of services provided, but they also can create societal conflict.

Mexico and the US have a long tradition of meeting for the past 20 years in the MEXUS Gulf Fisheries, exchanging information and expertise to better manage commercial fisheries and other non-commercial resources as well. However, the lack of an ecosystem-based approach and long term vision, unbalanced tools, and at time non-informed decisions have had an impact in the fishing populations and their economy, leading to social conflicts.

Ecosystem-based management aims to ensure long-term sustainable delivery of services and define an ecosystem's ability to recover from acute and chronic impacts. Although ecosystem-based management appears to be largely focused on direct effects of industrial fishing activities, it is critically important that it addresses indirect effects, bycatch, illegal unreported and unregulated (IUU) fishing, environmental change and the full suite of sectors. In other words, such vision must take into account biological, social, and physical components alike enabling the integration of science with a new dimension that also considers nature's portions under human management.

Trophic cascades can be induced by depletion of top consumers in the ecosystem, resulting in release from predation of populations down the food chain, which may themselves be important predators.

The US and Mexico must focus in a fundamental change, in other words, an approach that includes proactive, precautionary management with long-term sustainability. Focus should be on monitoring ecosystem indicators and management effectiveness, under an adaptive management approach.

Cross-cultural, cross-jurisdictional, and international collaboration are needed to develop an integrated approach to ecosystem assessment using system models, *inter alia*, Atlantis, a model to evaluate suites of management scenarios, Ecopath, and Ecosim to evaluate a range of management options and to find emergent properties that help forecast risk of fisheries declines.

One difficult, yet necessary task is that both countries must work cooperatively in the use of models to evaluate ecosystem level effects of different management strategies. Fisheries management actions in the Gulf will require innovative local and international cooperation and actions.

3. Restoring coastal and marine ecosystems

Coastal development, population growth, and migration are among the main stressors to coastal habitats and ecosystems. With population growth other sectors such as agriculture, urban development, oil industry and port facilities have increased their spatial accommodation in coastal and maritime areas, often without appropriate planning or coastal zone management tools but accompanied by the destruction of coastal mangrove forests, wetlands, and other ecosystems. Federal governments in both countries have placed similar programs to cope with massive flooding, either in Florida (US) or Tabasco (Mexico), using millions of dollars for flood protection for the growing urban areas.

Because of the high rate of development, many of the functions of the ecosystems around the Gulf of Mexico are no longer taking place. Erosion has become a major problem on the coast. Loss of mangroves on the shore are some of the consequences of channel dredging and impacts of subsidence caused by groundwater extraction. With sea level rise now threatening to flood many places in both countries deforestation and loss of coastal wetlands have posed serious threats to human populations in coastal areas, increases in storm water runoff and transport of nutrients and sediments into the Gulf.

With the above, Mexico and the US must consider truly integrated restoration efforts around the Gulf of Mexico, with mirror projects in both sides of the Gulf, exchange of expertise, building indicators and a full orientation to engage public society and coastal communities at large. Both countries must prepare a set of strategic, jointly defined actions towards ecological restoration focusing on the long-term sustainability and resilience of ecosystems and human communities.

4. Mitigation and adaptation to climate change and sea level rise

Climate change occurring globally has direct impacts in the Gulf of Mexico, while global levels of carbon dioxide and other greenhouse gases in the atmosphere are predicted to continue increasing atmospheric and sea surface temperatures, acidification of the oceans, rate of sea level rise and frequency of intense storm events.

Although the rate of global sea level rise projections for the Gulf of Mexico are rapid, the most alarming expected consequences of climate change for the Gulf Coast are

the combined effects of relative sea level rise at an already high and escalating rate and more frequent severe hurricanes.

Human settlements may be lost as rising sea levels will erase wetlands, some barrier islands, sea grass meadows, oyster reefs and coral reefs. Many Gulf wetlands are already being submerged and subsequently lost. Increased water depth will result in decreased light availability to sea grasses and hermatypic corals and increased turbidity for oysters, probably resulting in increased mortality and decreased growth rate.

More frequent intense storms, storm-surge flooding will be more extensive and damaging to infrastructure, threatening massive loss of property and life. Several examples in both countries have occurred in recent years.

Ocean acidification and increased sea surface temperature are stressors that interact to affect calcification in marine organisms, such as corals, oysters and a host of other taxa with external or internal skeletons of calcium carbonate. These results indicate that coral reefs already subjected to overfishing of herbivorous fishes and to nutrient loading are likely to be even more vulnerable to increasing carbon dioxide.

The effects of climate change and sea level rise on the Gulf of Mexico Large Marine Ecosystem goes far from the TDA presented here. Mexico and the US must reinforce their partnership, coordination and keep an open dialogue to conduct scientifically sound ecosystem restoration efforts, using the Strategic Action Plan, their main tool to base their long-term cooperation. Mexico and the US must build a critical SAP, implementing these strategies towards resiliency of coastal and maritime ecosystems, human communities, and infrastructure.

It is clear that there are huge economic costs due to climate change and defenses against sea level rise. The Gulf of Mexico neighbor countries must work together to reduce and mitigate risks, human life losses, and property and infrastructure damages.

5. Education and Science

A major challenge and another crosscutting issue in the Gulf of Mexico region is the education and scientific research. A major gap between the Gulf sharing nations must be addressed during the preparation of the Strategic Action Plan and special efforts must be done to truly develop both education and science aspects.

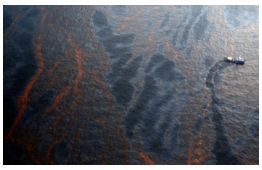
In order to support informed decision making and adaptive management of marine and coastal resources, Mexico and the US must work in the development of priority research issues for the Gulf and to address the major cultural and country differences and the educational gaps.

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.






Annex 1. Key Actors and Stakeholders in the Gulf of Mexico

In Mexico

⇒ CONANP-The National Commission for Natural Protected Areas
⇒ PEMEX - Petróleos Mexicanos, decentralized agency in charge of exploration and exploitation of oil resources.
⇒ SAGARPA- The Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food
⇒ CONAPESCA National Commission of Aquaculture responsible for monitoring compliance with the laws on fisheries and aquaculture, as well as conducting surveillance to prevent the introduction of unauthorized flora and fauna into federal water bodies
⇒ SCT - The Secretariat of Communications and Transportation, federal agency responsible of seaports management and maritime routes. Also the authority to prevent sea water pollution.
⇒ SEMAR- The Ministry of the Navy, is responsible for exercising sovereignty in the territorial sea. It runs operations for the protection of marine ecosystems and endangered species, to prevent and combat pollution of the seas and coasts, and promote scientific research of the seas and coasts.
⇒ SEMARNAT -The Ministry of Environment and Natural Resources
⇒ CONAGUA - National Commission of Water -is an administrative body within SEMARNAT
⇒ PROFEPA -The Federal Agency of Environmental Protection (special mandate), cares for protection of species through coastal state delegations in each coastal state, it guides inspection and surveillance efforts in coordination with the Mexican Navy, CONANP, CONAPESCA, and the State Governments in their respective areas of authority.
⇒ INE- The National Institute of Ecology

In the US

Federal:

⇒ EPA- Environmental Protection Agency
⇒ Gulf of Mexico Program
⇒ NOAA-National Oceanic and Atmospheric Administration
⇒ National Marine Fisheries Service (NMFS)
⇒ National Ocean Service (Office of Ocean and Coastal Resource Management (OCRM), National Centers for Coastal Ocean Science (NCCOS), Office of National Marine Sanctuaries (ONMS), and Coastal Services Center (CSC).
⇒ Department of the Interior
⇒ Fish and Wildlife Service (FWS) established to conserve, protect, and enhance fish, wildlife, plants, and their habitats.
⇒ Department of the Army responsible for constructing and maintaining public works projects, including dredging, flood prevention, and shore protection projects.
⇒ Department of Agriculture (UDSDA)
⇒ Natural Resources Conservation Service (NRCS)

State:

⇒ Alabama Department of Conservation and Natural Resources (ADCNR)
⇒ Alabama Department of Environmental Management (ADEM)
⇒ Alabama Department of Economic and Community Affairs'
⇒ Florida Department of Environmental Protection
⇒ Florida Fish and Wildlife Commission
⇒ Louisiana Department of Natural Resources (LDNR)
⇒ Louisiana Governor's Coastal Protection and Restoration Authority (LCPRA)
⇒ Louisiana Department of Wildlife and Fisheries
⇒ Louisiana Department of Environmental Quality
⇒ Louisiana Universities Marine Consortium (LUMCON)
⇒ Mississippi Department of Marine Resources (MDMR)
⇒ Mississippi Department of Environmental Quality
⇒ Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP)
⇒ Texas Commission on Environmental Quality (TCEQ)
⇒ Texas Parks and Wildlife Department (TPW)
⇒ Texas General Land Office (TGLO)
⇒ Texas Railroad Commission regulates oil and gas development in the state.

Regional:

⇒ Gulf of Mexico Alliance (GOMA)
⇒ Gulf of Mexico Foundation (GOF)
⇒ Gulf of Mexico Coastal Ocean Observing System (GCOOS)
⇒ Gulf of Mexico Fishery Management Council (Gulf FMC)
⇒ Gulf States Marine Fisheries Commission
⇒ Harte Research Institute for Gulf of Mexico Studies at TAMUCC
⇒ Northern Gulf Institute

Others:

Gulf coastal communities in both countries

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