

1.2.3 Perspectives of the Mexican Consortium of Marine Research Institutes of the Gulf of Mexico and the Caribbean (CIIMAR-GOMC): Opportunities and Challenges for Regional Research Cooperation

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1.2.3.1 Abstract

The GOM LME encompasses a vast array of ecological connections. To be able to fully understand all processes with the aim to conserve its assets and for sustainable development of the region we need the expertise and input of scientists from the surrounding nations. Existing scientific programs should commit for a long term, close cooperation. The Consortium of Marine Research Institutes of the Gulf of México and Caribbean (CIIMAR-GOMC) of Mexico calls for a Regional Science Interim Commission. This Commission would serve as the appropriate space to discuss the long-term sustainability of the region, with science key to accomplishing this endeavor, and to enable cooperative programs that would improve socioeconomic conditions and resilience of coastal communities and livelihoods in the Gulf region.

1.2.3.2 Introduction

The GOM and Caribbean Sea of Mexico together represent one of the most important natural and productive regions of the three nations around the Gulf, due to the natural resources and many industries and sectors that have developed along its coasts. These are an integral part of the identities of the three nations and represent an important factor for the future development of the region. They feed the economy and help support regional development, providing jobs and opportunities, and mobilizing the user sectors of the Gulf and Caribbean.

This region provides goods and services for many sectors, but multiple challenges face this region. Pollution degrades coastal and marine habitats, reducing access to recreational sites and opportunities for trade, and threatening public health and safety. The loss of the coastal habitat impacts the stability of the marine populations, with important economic and cultural consequences. Overfishing threatens current opportunities for sustainable commercial fisheries, compromises food security, and impacts ecosystem function, reducing the possibility of stock recovery. The impacts of climate change, such as sea-level rise, increase the vulnerability of coastal communities to damage from extreme weather events such as hurricanes. In addition, these problems interact with one another, amplifying their impacts on the health of the ocean.

As coastal populations grow, there is and will be competition for space between well-established activities such as fishing, maritime transportation, military activities, and energy development, and emerging uses such as renewable energy and aquaculture. This competition creates conflicts between users and represents a challenge to decision makers. Inefficient government decision making affects the availability of economic opportunities and prevents intersectoral agreements and the necessary conservation of resources. It is very important that decisions are based on the best available scientific evidence and the informed opinions of the national research institutions established in the region.

The challenge for the three countries around the Gulf is how to use the established capabilities and opportunities to improve understanding of the oceans, seas, and coasts and their function, and how to make better use of these resources sustainably, while maintaining their health and resilience. Thus, advances in research, science, and technology, must be generated to improve understanding of the roles and services provided by the marine environment, how development alters those roles and services, and how these changes influence human activities and quality of life. Applying this knowledge will inform local management practices and help improve and maintain healthy ocean, seas, and coasts, which ultimately support job creation and new economic opportunities, allowing Mexico, Cuba and the United States to both benefit from and conserve valuable ocean resources.

Recognizing these challenges and opportunities, a central goal of existing consortia, such as the Mexican CIIMAR-GOMC, is to help solve the aforementioned challenges, building on innovative and robust science. Scientists around the Gulf recognize and emphasize the responsibility to provide information that will improve ocean and coastal resources. In addition, they also recognize the need to improve consideration of the importance of tackling these challenges not just by interested stakeholders, but by society as a whole, using common sense and solutions based on the best scientific evidence.

1.2.3.3 CIIMAR-GOMC's background

CIIMAR-GOMC was born in 2011 within the context of the Global Environment Facility (GEF)-funded binational program of Mexico and the United States "Integrated Assessment and Management of the Gulf of Mexico Large Marine Ecosystem." This was an initiative that was also presented at the State of the Gulf Summit held in Houston Texas in December 2011. The consortium was established through a Memorandum of Agreement (MOU) signed by nine academic and research institutes based in the five coastal states of Mexico that face the GOM and/or Caribbean and the Louisiana Universities Marine Consortium (LUMCON) on December 6, 2012 in Villahermosa, Tabasco, at the Universidad Juárez Autónoma de Tabasco (UJAT).

CIIMAR-GOMC's mission is to "Integrate, organize, and enhance the efforts of scientific research institutions to generate appropriate diagnostics and propose and implement sustainable solutions to environmental, social, and economic problems of the GOM region." CIIMAR-GOMC envisions that it will be "recognized as a high-level, scientifically authoritative organization committed to strengthening sustainable development and environmental integrity of the Gulf of Mexico."

CIIMAR-GOMC promotes multidisciplinary research and facilitates its use by society, which is necessary for the transfer of knowledge. This implies that relevant fields of knowledge must be developed to address environmental and social challenges. The institutions that participate in CIIMAR-GOMC have great infrastructure and suitable human resources to face the challenges of the twenty-first century.

CIIMAR-GOMC has become a self-supporting organization that has exceeded initial expectations. It has developed its own trademark and gained the recognition at the highest levels of governmental agencies dealing with marine issues in the GOM region, as well as academic institutions around the Gulf. There are 34 national member institutes and organizations and over 100 international academic and research institutions that are primarily based in the United States, Europe, and Latin America. The consortium has strengthened communication and cooperation with local, regional, state, and federal authorities and with international organizations, and has promoted strategies based on a multidisciplinary ecosystems approach.

The future of a healthy and resilient Gulf will require a comprehensive and integrated plan that focuses on restoring functional integrity and ecosystem services. For many decades, the GOM LME has been subjected to a variety of negative impacts, for example oil spills such as the Ixtoc 1 spill (1979–1980) and more recently the *Deepwater Horizon* (DWH) oil spill (2010). In formulating this plan, scientists and

decision makers in Mexico, the United States, and Cuba must understand that because of the the highly dynamic nature of the Gulf's environment, adaptive management must be instituted so that the plan is responsive to changing conditions. A bi- or tri-national or regional framework will lead to longer-term, more successful results. This is one of the added values of creating CIIMAR-GOMC.

CIIMAR-GOMC has made it possible to define priorities and strategic components needed to support scientific research and technological development in the southern GOM LME. These are vital for a better understanding of marine environment functions and their relationship with human activities. CIIMAR-GOMC provides information on the best local management practices for the valuable resources in the oceans under Mexican jurisdiction and supports the creation of new employment and economic opportunities, in addition to broadening food safety and security.

1.2.3.4 Crosscutting and International Collaboration

To enhance CIIMAR-GOMC's performance and cooperation with the northern Gulf region, Memoranda of Agreement (MOA) were signed with several US academic institutes and government organizations, including LUMCON as an initial signatory member in 2012. The Northern Gulf Institute (NGI) of Mississippi State University became a signatory member in 2013. NGI was born from the cooperation between NOAA and five additional academic institutions. NGI conducts research on four major subjects: ecosystem management, integration and visualization of geospatial data, coastal risks, and effects of weather on regional ecosystems. NGI also promotes extensive collaboration and provides an observation platform for area mapping and improving evaluation of impacts on living marine resources.

The Gulf of Mexico University Research Collaborative (GOMURC) was established in 2014 and is composed by 80 public and private universities in the United States. CIIMAR-GOMC is committed to working closely with its counterpart in the United States and this collaboration will boost scientific research on transboundary issues in the GOM due to the extensive connectivity of its geographical features.

The Gulf of Mexico Coastal Ocean Observing System (GCOOS) signed an MOA with CIIMAR in February 2015, and the two groups are working closely on several Gulf monitoring issues. The goal of the collaboration between the US Integrated Ocean Observing System (IOOS) and CIIMAR-GOMC is to develop a Mexican Integrated Coastal and Ocean Observation System (Mex-ICOOS). Another key relationship has been established with BOEM to promote bilateral workshops, and information transfer activities in the Gulf. In addition, the UN, through the UNESCO Intergovernmental Oceanographic Commission, has endorsed CIIMAR-GOMC and is supporting its work and advocacy for the sustainable management of oceans and coasts of the GOM LME.

CIIMAR-GOMC has also established a close relationship with other northern Gulf organizations like the Gulf of Mexico Alliance (GOMA), the Environment Protection Agency's (EPA) Gulf of Mexico Program, the National Aeronautics and Space Administration's (NASA) Develop Program, and HRI. These entities have attended several workshops in Mexico, and, with CIIMAR-GOMC, these organizations have participated in the biannual HRI "State of the Gulf of Mexico Summit" since 2011. A noteworthy collaboration that CIIMAR-GOMC has established that is of specific domestic and regional interest is for construction of Mex-ICOOS, a vital observatory that will produce information to help reduce risks and increase resilience of the marine and coastal environment due to climate change. This collaboration includes entities in Mexico, the United States, and Europe. CIIMAR-GOMC continues to seek opportunities to establish relationships and agreements to address the Mexico-US binational regional priorities in the GOM. With time, CIIMAR-GOMC will pursue similar agreements with Cuba and other countries of the region.

1.2.3.4.1 Examples of the Institutional Work of CIIMAR-GOMC Members

The consortium is supporting various projects through the leadership and participation of its member institutions and, in some cases, with the participation of civil society and local, state, and federal governments. Some examples are presented below.

The Universidad Juárez Autónoma de Tabasco (UJAT) has given shape, content, and cohesion to the consortium through its responsibility for coordinating, designing, conducting, guiding, and promoting its work. At the same time, the UJAT carries out its own investigations pertaining to marine and coastal resources of the region, particularly aquatic pollution and toxicology, coastal planning and organization, the development of aquaculture, and the implementation of regional public policies. The consortium coordination work demands a huge effort to build new local, domestic, and transboundary relationships and to strengthen the existing relationships, as well as to define the future research foci that align with the needs of the country. Likewise, UJAT has been the driving force in fostering the bilateral Mexico-US Forum for Higher Education and Scientific Research (FOBESII). UJAT has pushed for innovative programs to research pollution in the GOM and the Grijalva-Usumacinta Watershed via its partnership with NASA and provides support to other regional projects (e. g., tidal observation program). UJAT received the EPA's Gulf Guardian Award in 2015 in recognition of its work in building the capacity of the CIIMAR-GOMC consortium.

The Center for Research and Development of Port, Maritime, and Coastal Engineering (CIDIPORT) of the Universidad Autónoma de Tamaulipas (UAT) serves a growing demand for projects and services linked to regional (domestic and international) port sector development and for specialized studies in coastal and maritime engineering and oceanographic research using its research vessel UAT-I CIDIPORT.

The Institute of Engineering at the Universidad Nacional Autónoma de México II-UNAM, located in Sisal, Yucatán, has one of the most advanced facilities to study coastal areas. The academic unit of the institute at Sisal was created in June of 2009. It is composed of the Laboratory of Engineering and Coastal Processes (LIPC) research group. The research focus of the LIPC is the study of coastal physical processes that develop at the interface between sea, land, and air, including the open sea, continental shelves, beaches, estuaries, and semi-enclosed water bodies. The objective of the fundamental and applied research undertaken by the LIPC is to contribute to knowledge that will support both conservation and sustainable exploitation of diverse and fragile coastal environments. In particular, field experiments, physical modeling, and numerical modeling address topics such as generation and transformation of waves, propagation and transformation of tides when approaching the coast, sedimentary transport, coastal erosion, and other phenomena. The LIPC is integrated with the Faculty of Sciences and the Faculty of Chemistry research groups on the Sisal campus of UNAM which also focus on studies of the coastal zone.

The Marine Sciences and Fisheries Institute of the Universidad Veracruzana (UV) collaborates in drafting public policy proposals related to fishing and carrying out the comprehensive fisheries management studies for several commercial marine species of the GOM.

The Instituto Politécnico Nacional (IPN) supports the creation of Mex-ICOOS and has undertaken the task of convincing the relevant government bodies to carry out the operational implementation of the project. The Research Center in Applied Science and Advanced Technology-Unit Altamira of the Instituto Politécnico Nacional (IPN-CICATA-UA) has modeled waves and evaluated sea level and sea surface temperature in the GOM associated with climate change scenarios. These studies have contributed to the Tamaulipas State Program for Climate Change and the ECCO-Cities Report for the south coast of Tamaulipas funded by the Tamaulipas government and UNEP. IPN-CICATA-UA also carries out field observations of oyster reefs, waves, currents, and eutrophication studies in freshwater lagoons associated

with the Tamesí River, Pánuco estuary and adjacent coastal zone, as well as providing field support for recovery/deployment/emergency missions of CICESE's Kongsberg sea gliders that study Loop Current eddies that propagate and dissipate along the Tamaulipas and northern Veracruz coastline. It is also part of the Mexican Centre for Innovation in Ocean Energy, currently conducting regional studies of potential wave energy and saline gradient energy.

The Universidad Autónoma de Baja California (UABC) created the National Center of Oceanographic Data (CENDO). CENDO is a tool used to disseminate environmental oceanographic products generated from national and/or international historical records. The UABC has implemented the Regional Coastal Oceanographic Observatory (OORCO) that provides users with realtime data and information for planning and developing marine activities. Currently UABC OORCO is committed to the implementation of the Southern Gulf Network of High Frequency Radars covering the entire Mexican coast. This project is a subcomponent of the SENER-CONACYT Gulf research project administered under the CIGOM under the leadership of CICESE based in Ensenada, Baja California.

The CONACYT research center ECOSUR, with four campuses in southern Mexico, is a center of excellence, and its Chetumal campus conducts studies in the Caribbean and GOM, some in close collaboration with NOAA, as well as institutes in Spain, and Cuba.

Universidad Autónoma de Campeche (UAC), Institute of Ecology, Fisheries, and Oceanography of the Gulf of Mexico (EPOMEX) was founded in 1990. The mission of the institute has been to promote the application of scientific knowledge to conserve the marine and coastal resources of Mexico. Through research, education, and dissemination of science, EPOMEX builds strategic alliances with different sectors to improve ecosystem function and increase biodiversity to support the well-being of future generations. The academic staff of EPOMEX partners with governmental and non-governmental organizations to contribute both to management and policy that will directly benefit society. EPOMEX offers educational opportunities at different levels (e.g., short courses, workshops, seminars, undergraduate courses), as well as its multidisciplinary master of science degree in Management of the Coastal-Marine Zone. EPOMEX also provides research grants that encourage students to relate their research to the pressing problems of society.

Instituto Mexicano del Transporte (IMT), under the Ministry of Communications and Transport (SCT), contains the Coordination of Port Engineering and Geospatial Systems (CPEGS). Its new Maritime Hydraulic Laboratory (MHL) began operating in July 2001 at IMT facilities in the State of Queretaro. CPEGS is comprised of the following workgroups: Laboratory of Marine Hydraulics, Computational Hydraulics, Hydraulic Port and Coastal Projects, Field Studies, Oceanographic Equipment Calibration Laboratory, Laboratory of Vessel Maneuver Simulations, Environmental Port Hydraulics Laboratory (in development), Instruments and Mechanisms, and Workshops. CPEGS functions include conducting applied research studies in maritime hydraulics, development of port and coastal engineering projects, and provision of related technological services to the federal, state, and municipal governments and private companies.

In 2004, the IMT began to operate the National Oceanographic and Weather Stations Network (RENEOM) to provide the Mexican maritime sector with information about oceanographic and weather conditions in Mexican ports. RENEOM consists of measuring buoys, tide gauges, and weather stations in 44 strategic locations along the Mexican coast where they measure the characteristics of waves, water surface temperature, sea level variations, and meteorological variables. Argos and GOES satellite systems are used to transmit measurements of ocean conditions, which are used mainly by Mexican port authorities and port users but are also consulted by the general public. With the RENEOM project, IMT became part of the National Tsunami Warning System of Mexico (SINAT) and has strengthened linkages with universities and research centers.

Instituto Mexicano de Tecnología del Agua, (IMTA) is a government lab focused on research and innovation of water technology. IMTA has carried out several projects in the GOM related to climate change, sea levels, hydrodynamics of coastal lagoons, numerical modeling, water quality, and meteorology. One project funded by IMTA that is currently underway is to investigate sea level and coastal erosion in the southern coastal plains of the GOM. The goal of the study is to determine vulnerability of the coastal region due to climate change and to look for evidence of land subsidence associated with exploitation of oil fields in the coastal plains of the GOM. Collaborating with IMTA on this project to understand the coastal dynamics of the southern coast of the GOM are CICESE, CICIMAR-IPN and UAM-Iztapalapa.

In the Caribbean, the Universidad de Quintana Roo (UQROO) has described reef systems, determined sediment characteristics in MPAs, carried out a trophic and ecological characterization of the Bay of Chetumal, and analyzed the population's vulnerability to extreme hydrometeorological phenomena and climate change, in addition to many other studies.

The Universidad Autónoma Metropolitana-Campus Iztapalapa (UAM-Iztapalapa) conducts research in the lagoons, and other coastal and marine areas of the GOM and Caribbean Sea related to pollutants, hydrometeorological phenomena, and hydrological and physicochemical dynamics. It has done monitoring studies of dynamic coastal processes in coastal areas of Campeche, Tabasco, and the Caribbean Sea, mainly with regard to erosion related to changes in sea level and increases in the frequencies and intensities of hurricanes.

The Southeast Global Change and Sustainability Center (CCGSS) conducts research to determine factors related to contamination, hypoxia, and eutrophication in the southern GOM and the associated Grijalva and Usumacinta River basins.

The Mérida Unit of the Interdisciplinary and Advanced Studies Center (CINVESTAV) has generated information on coastal ecosystem health by studying trophic processes in reef ecosystems, contaminants in the marine environment, and geospatial analyses of coastal areas. The Department of Marine Resources was created in 1980 with the objective of developing the main thematic axis of the Mérida Unit, study of coastal and marine ecosystems, to help guide the development of the region. Its mission is to “establish high-level human resources and carry out cutting-edge scientific and technological research to contribute to the management and rational use of the coastal ecosystems of the Gulf of Mexico and the Caribbean Sea, for the benefit of the society.”

1.2.3.5 Opportunities and Challenges

During the GOMWIR workshop held in Houston, the CIIMAR-GOMC presented an initiative to create a “Gulf of Mexico Regional Interim Commission for Science.” The Interim Commission would engage scientists and experts from the three nations, Cuba, Mexico and the United States, involved in any relevant research and any academic organization. The draft ideas for the Interim Commission include:

- **Strengthen national, regional, and international cooperation**
 - Strengthening existing regional alliances and building new relationships according to identified needs and priorities will contribute to the protection of the oceans, coasts, and basins associated with the GOM by supporting the science and actions needed in the face of limited resources.
 - The objective is to increase communication between the marine and coastal resource users, to facilitate alignment of goals and projects, to increase the use of existing resources for science and technological development, and to improve coordination in the region with a common vision of the GOM.
- **Support priorities and issues of regional importance**

- There is a need for data sharing among and between the authorities and organizations responsible for providing data on the marine environment.
- The goal is to identify existing resources in the region so that cooperation can be expanded beyond the current organization of regional alliances and existing partnerships. This includes increasing data collection and analysis to advance regional efforts and compiling available data and scientific literature for use to meet common regional goals and to identify best management practices.
- **Involvement and engagement of local and regional communities**
 - Existing regional consortia can work with local communities in each country in the GOM and the Caribbean, to help regional and local planning groups to prioritize use of scientific methods. A focus would be on integrating ecosystem knowledge and scientific data collected by community groups.
 - The Interim Commission would promote involvement of local communities and landowners, so that their rights would be safeguarded. In addition, the Interim Commission would work to establish agreements for appropriate management in each region of the GOM and Caribbean Sea.

The Interim Commission would work on the following issues:

- **Sustain a regional and transboundary vision**
 - Strengthen a common GOM ecosystem- based vision
 - Build actions under the ecosystem-based approach and the GOM's transboundary nature
 - Foster regional activities and enhance trinational capabilities to document the transboundary elements that sustain goods and services of the region
 - Develop mechanisms with science-based indicators to track ecosystem health and transboundary elements
- **Strengthen regional governance**
 - Promote participation of coastal states in regional activities, research programs, observing actions, database development, and data management in science-based, decision-making processes
 - Foster tri-national participation in scientific regional activities and ad hoc joint research actions
 - Strengthen education and public participation
- **Propose ad hoc bi- and trinational research actions**
 - Implement strategic research actions developed under the ecosystem-based approach using existing organizations, consortia, and academic institutes
 - Focus on appropriate research topics or foci of great interest among the three nations
 - Strengthen the Gulf's regional research database and determine critical information gaps and research needs among the three nations so that research can be conducted collaboratively
 - Promote technological innovation and increase research capabilities among the three nations
 - Develop short- and long-term priority actions and needs and identify potential participants
- **Create a common ocean and coastal observing system**
 - Enhance the integrated ocean and coastal observing system for the GOM
 - Promote ad hoc ocean and coastal observing systems
 - Establish a network of existing observing assets
 - Define priority research needs and identify the observing assets needed
 - Stimulate regional cooperation and supply equipment, technology, and training as appropriate

- **Develop a long-term trilateral research program**
 - Consult with national scientists and experts to determine priority topics and issues that should be addressed in a long-term research program. Potential topics may include:
 - Harmful algal blooms
 - LMR stock assessments
 - Conservation of ecosystems and biodiversity
 - Resilience of coastal communities
 - Invasive species
 - Alternative energy resources
 - Ocean observing systems
- **Support informed decision making**
 - Promote baseline studies and complementary QA/QC data and use of standard indicators
 - Foster ad hoc joint studies, research, and monitoring
 - Translate science to support decision-making processes
 - Develop informative newsletters and use other available mechanisms to rapidly enhance science communication
 - Enhance national capabilities to create data-based information centers to support informed decision making
 - Design appropriate communications tools and mechanisms to disseminate science results that can be used to engage civil society and stakeholders at large