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US-Mexico joint Gulf of Mexico large marine ecosystem based assessment and management: Experience in community involvement and mangrove wetland restoration in Términos lagoon, Mexico

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ABSTRACT

The purpose of this article is to present the Mexican experience related to the US-Mexico joint Gulf of Mexico Large Marine Ecosystem-Based Assessment and Management Project, particularly the community involvement and mangrove wetland restoration, and the challenges for its replication and up-scaling. Results focus on community engagement, environmental education and social participation, strategies for hydrological restoration of mangrove, and difficulties and recommendations for the implementation of the Strategic Action Program. The main conclusions are that the community-based hydrologic restoration approach, is a good way to ensure long-term restoration of wetlands. Changing from mangrove plantations to the hydrological restoration of wetlands, and construction of human capacities resulted in a more efficient strategy for ecosystem restoration and had influenced the forest environmental policy. The involvement of government and education institutions as execution agencies will contribute to a more efficient appropriation of the project and LME approach. The development of economic alternatives and the ecological monitoring are some of the identified challenges within the implementation phase of the Strategic Action Program.

1. Introduction

The Gulf of Mexico Large Marine Ecosystem is a semi-enclosed oceanic basin of about 615,000 mi^2 (1.6 million km^2) shared by Mexico, the U.S., and Cuba (UNIDO, 2011). The Mexican territorial sea and its exclusive economic zone includes five Large Marine

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Table 1
Total coverage and estimated disturbed area of the mangroves in the Gulf of Mexico.

State	Mangrove area (ha)	Disturbed area (ha)	Disturbed percentage (%)
Campeche	197,620	1236	0.625
Quintana Roo	128,049	2039	1.592
Yucatan	91,356	1788	1.957
Tabasco	44,590	100	0.224
Veracruz	37,841	339	0.896
Tamaulipas	3095	1.0	0.032
Total	502,551	5503	1.095

Ecosystems (LME), all of them with different ecosystem health and pollution challenges, as well as particular productivity, fishery, biodiversity, socioeconomic and governance features (Sherman and Hempel, 2008). The Gulf of Mexico is a semi-enclosed sea, located between the tropical and subtropical North Atlantic latitudes, and includes a wide variety of marine habitats. As one of the 66 LMEs in the world, it is one of the most economically important water bodies within the Mexican and US Exclusive Economic Zones. Total fisheries catch in the Gulf peaked 1,480,729 metric tons (around 73% of the total GoM's catch is taken by US fleets) in 1987, while in 2008, around 768,500 t were harvested, not accounting for the large amount of discards (UNIDO, 2011). A very high diversity of marine habitats that includes tropical and temperate ecotones, estuaries, mangrove wetlands, shallow inshore waters with soft bottoms, rocky bottoms and reef communities, and a large extension of deep sea, sustains an ample diversity of living marine resources (LMR). More than 300 species sustain local fisheries (including fish, crustaceans, mollusks, echinoderms and other invertebrates) but also LMR with unique ecosystem value in the trophic structure, such as sea birds, marine mammals, and sea turtles. The Gulf Coast region is especially vulnerable to a changing climate because of its relatively flat topography, rapid rates of land subsidence, water engineering systems, extensive shoreline development, exposure to major storms, and coastal wetlands degradation (Yáñez-Arancibia et al., 1998).

Mexico has a broad experience in Marine Governance (Azuz-Adeath et al., 2014) and Marine Spatial Planning and Policy, which includes the Large Marine Ecosystems Approach (Díaz de León and Díaz-Mondragón, 2013). Also, Mexico is one of the top five countries in the world with large areas of mangroves (Giri et al., 2011). The estimated national extent of mangroves is about 7755.55 km^2 (Troche-Souza et al., 2016). The main mangrove wetland areas present in the south and southeast regions of Mexico, particularly in the Gulf of Mexico and Mexican Caribbean (see Table 1), are about of 5200 km^2 (65.7% of the total mangrove area in Mexico) (CONABIO, 2013).

The impacts on ecological process and the loss of goods and environmental services (e.g. natural barrier protection, carbon sequestration, biodiversity, habitat and water quality) of coastal wetland, such as the mangroves, are common in several locations of the Gulf of Mexico region (GoM) (Giri et al., 2011). Changes in hydrology, erosion, dam construction, urban growth, land use changes for agriculture and livestock activities, gas oil and petroleum industry, chemical pollution, wetlands drainage and the rise of the sea level, are problems shared by Mexico and the United States. Several organizations around the world adopt strategies to restorer degrades sites, they need to have a firsthand knowledge of the socioeconomic as well as ecological factors that promote and hinder restoration efforts. It has been suggested that community involvement maybe a key factor in increasing the potential for successful mangrove restoration (Stone et al., 2008).

1.1. Gulf of Mexico large marine ecosystem project

The US-Mexico joint Gulf of Mexico Large Marine Ecosystem Based Assessment and Management Project (GoM LME Project) started officially in 2009. It was financed by the Global Environmental Fund, under the coordination of the United Nations Industrial Development Organization (UNIDO) as an implementing agency. The governments of United Mexican States (Mexico) and the United States of America (U.S.) appointed to the Ministry of the Environment and Natural Resources (SEMARNAT, by its acronym in Spanish) of Mexico, and the National Oceanic and Atmospheric Administration (NOAA), respectively, as the Technical National Focal Points for the project.

After a transboundary diagnostic analysis (TDA) was conducted using the LME approach, the conclusions were that the main transboundary issues are the pollution control of coastal waters, fishery stocks recovery, habitat restoration, climate change effects, and governance (UNIDO, 2011). Addressing some of these issues, pilot or demonstrative projects (PP's) were also conducted at the Términos lagoon. Such PP's included mangrove restoration, social involvement and organization, assessments of brown shrimp and grouper fish fisheries, and coastal monitoring. Based on the TDA, both countries negotiated a policy document known as the Strategic Action Program (SAP) (UNIDO, 2014). The SAP aims to promote shared policy goals, as well as legal and institutional actions to address priority transboundary problems previously identified by both NOAA and SEMARNAT in the TDA. After formalization of the SAP by both countries, a new project called “Implementation of the Strategic Action Program of the Gulf of Mexico Large Marine Ecosystem” was approved for its implementation. This process took about three years since the formulation until its acceptance by the Global Environmental Fund (GEF). Approval for the purpose of formulating the Full-Scale Project was granted with a Project Preparation Grant (PPG).

In this new project, the implementation of strategies for mangrove conservation and restoration was a major priority in the GoM region. Implementation of the PP´s of mangrove restoration for the GoM LME Project occurred in the Términos lagoon (Zaldívar-