Fisheries assessment within the Gulf of Mexico Large Marine Ecosystem

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ABSTRACT

The status of main fisheries along the Mexican portion of the Gulf of Mexico Large Marine Ecosystem (GoM-LME) was assessed considering the resources' most relevant aspects, the fisheries fleet, the fisheries market and the problems that they currently face, with the aim of increasing the stakeholders knowledge, to move towards the implementation of an ecosystem management approach in the region. Several recommendations are made for improving the recovery and sustainability of GoM-LME fisheries. With regard to the tuna fishery, the fishery status is completely exploited. Northern brown shrimp and Atlantic seabob fisheries are within the maximum sustainable yield level, whereas the status of northern pink, red-spotted shrimp and brown rock shrimp fisheries are considered as deteriorated. Striped and white mullet fisheries are completely exploited as well as that of shark and skates. The snook fishery is exploited to the maximum sustainable level. Several initiatives are presented based on an ecosystem approach that has been generated to reinforce traditional management plans in order to avoid further deterioration of these resources. Some economic alternatives are identified to increase the profitability of the fisheries of the GoM-LME along the Mexican coast.

1. Introduction

Aquatic ecosystems are still being degraded as a consequence of human activities, thus affecting the capacity of ecosystems to provide important goods and services including food security from fisheries. Among other aspects, this has impacted marine resources of commercial relevance, which are decreased in several parts of the world (Defeo, 2015). Fisheries degradation, already acknowledged by several authors worldwide (Pauly et al., 1998; Hutchings and Reynolds, 2004; Caddy and Seijo, 2005, Salas, et. al. 2007), undermines the availability of a highly-demanded food by a constantly growing population as well as the survival of fishing communities as their economy is based on this activity.

The relative scarcity of the fishery resource plays a fundamental role in the value chain, which is defined by the following components: production, promotion, marketing and consuming, and the interactions between them to produce a good or service (Porter, 1985). As fishing is a renewable natural resource that can't be extracted without limitation, the treatment of its value chain must be particularly careful because of the removal effect that may have on resources. Therefore, it is necessary to maximize the value of each unit extracted (Galarza and Kamiche, 2015). Following this reasoning, it is necessary to transform the fishery resources into goods that can be bought by different types of consumers (Scheffczyk, 2008). To do so, artisanal fishermen require training and infrastructure that allow them to increase the value of the extracted resources and the empowerment to change their perception of

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marginalization to small business. The fishermen cooperatives must have working capital, covering operating costs and moreover generating a surplus that allows investment in infrastructure improvements and expanded services. In the past, the Mexican government implemented some programs to promote fish processing and added value, but with less success than expected, probably because they were isolated actions, sidestepping the whole value chain, without proper training for fishermen, nor action follow-up and without taking into account the real needs of fishermen. However, since the recent socialization of public policy aid fisheries instruments with the productive sector, there is openness and willingness of the authorities and fishermen to work together including the academic sector.

The wide range of multisectoral factors supporting fisheries development leads to the need for addressing its assessment and management from an ecosystems approach. Based on this focusing, the appropriate balance between conservation and utilization of biological diversity must be assured. Among the types of information to be taken into account are the knowledge, innovations and practices of scientific, indigenous and local communities, engaged in multiple sectors. This demands that adjustments are to be made regarding institutional and government regulations assuring a well-founded, balanced and clear decision making process regarding the balance and participation of all stakeholders (Guerrero et. al., 2006).

This work provides an analysis of the status kept by some of the main fisheries along the Mexican area within the GoM-LME, pointing out both issues and initiatives suggested to avoid further degradation while increasing their profitability.

2. Materials and methods

The Gulf of Mexico's Exclusive Economic Zone (EEZ) comprises the belt of 200 nautical miles characterized by an extensive continental shelf possessing the biogeographical conditions favoring a wide diversity of habitats within which a high variety of marine fauna coexists.

A bibliographic review was carried out in order to establish the status of fisheries along the Mexican area in the GoM-LME, supported by a query of historical records regarding the reported fishery statistics contained in official sources, including the interaction established by the authors of this work with the fishing sector through implementation of joint projects, field work, workshops, and meetings.

In the case of tuna, shrimp and sharks and rays fisheries the current status was obtained from the National Fisheries Chart (DOF, 2012). If the required information was available, sustainable catch levels were estimated using the annual commercial catch series reported from 1986 to 2011 as input data. The latter was applied to striped and white mullets and snook resources. In order to estimate the maximum sustainable catch yield (MSCY), the analytical approach proposed by Martell and Froese (2012) was applied for fisheries characterized by a scarce amount of data. Such an approach applies a simple method to calculate MSCY based on Schaefer's surplus production model (1954). Results are presented in graphics in the form of phase plots to enable a practical understanding about overfishing warning (light gray), major concern status (dark gray) and 95% confidence interval for each MSCY estimation per fishery resource in their respective fishing areas.

From the fishery status analysis, the management efforts pursued by the Mexican authorities regarding fishery issues, and from the new trends for fishery resources management worldwide, some proposals presented are intended to contribute to enhance fishery profitability as well as reduce their level of degradation.

3. Results and discussion

Fishing represents one of the main economic activities being developed in Mexico. During recent years, fishing production at the national level has been kept at approximately 1.6 million tons per year, generating $ 19.9 billion Mexican pesos. An average of 217 thousand tons are produced in the Gulf of Mexico, which is 13.6% of the total volume per year, representing an income of about $ 4.6 billion Mexican pesos (CONAPESCA, 2013). According to Díaz de León and collaborators (2001), there are 264 potentially exploitable species within this region and Fernandez and collaborators (2011) report the existence of 2 molluscs cephalopods, 7 crustaceans, 21 fish, 18 sharks and rays as target species.

However, catch volumes are focused on 46 species and the highest economic value is concentrated on 7 species (Fig. 1). The 5 fisheries possessing higher relevance in the region, either because of their volume and/or value or their demand in the market, are presented below (dark gray in Fig. 1).

4. Tuna fishery

Tuna fishing constitutes the most autonomous and technologically-aided fishing activity developed in the Mexican EEZ in the Gulf of Mexico. This is exclusively carried out using 50–60 km longlines and an average of 673 hooks. Target species is *Thunnus albacares* (yellowfin tuna), representing approximately 67% of total catch, incidentally, swordfish (14%), other fishes (10%), sharks (4%) and other tuna species (5%) are also caught (DOF 2015). There is an increasing catch trend from 1988 to 2016 reporting 1098 t in 2013. Veracruz contributes with 96% of this production through landings at the Tuxpam port (Fig. 2). A perfectly systemized Observer On-board Program was implemented, allowing a timely tracking of this activity. As tuna species are considered straddling stocks, the decisions regarding their management are made within the International Commission for the Conservation of Atlantic Tunas (ICCAT) and Mexico is represented by the National Fishing Institute (NFI), which is the institution in Mexico responsible for planning and conducting scientific research regarding fishing and aquaculture. According to the Federation's Official Journal (DOF, from its abbreviation in Spanish) (2012), that publishes the National Fishing Chart, tuna fishery status in the Atlantic Ocean is