



# The small-scale shark fisheries in the southern Gulf of Mexico: Understanding their heterogeneity to improve their management



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## ABSTRACT

Fisheries targeting sharks in the southern Gulf of Mexico are generally restricted to a few months or fish in several months but participate in other fisheries. Sharks are also part of the by-catch in most fisheries that use gill nets or longlines. The fisheries targeting sharks include the following: (1) a gill net fishery for *Rhizoprionodon terraenovae* and *Sphyrna tiburo* in April–June and August–September, respectively, off of northern Campeche; (2) a gill net fishery for *Carcharhinus leucas* in November–March off of central and southern Campeche; (3) a longline fishery for *C. leucas*, *Carcharhinus plumbeus* and *Sphyrna lewini* throughout the year off of the Tabasco state; (4) a longline fishery for *C. leucas* by medium-sized boats from the state of Yucatan; and (5) a fishery with gill nets for *Carcharhinus limbatus* off of the central coast of Tabasco in April–May. The decline in shark catches over the last two decades in Mexico prompted a series of management measures, including the restricted issuance of fishing licenses, gear regulations and closed seasons. Fishery management includes all shark species, but does not consider species-specific differences in life history, the regional seasonality of the target fisheries, or differences in the gear types that are used to target small or large sharks. We recommend the establishment of separate management measures for small and large shark fisheries because, in addition to differences in the biological productivity of the target species, these two fisheries differ in the type of gear used and the seasonality and region in which the fishing occurs. The fishery for *R. terraenovae* off of northern Campeche has characteristics (same period and area over many years, catch composition dominated by adults and the target species accounts for 80–90% of the catch) that enable population assessments and the evaluation of the efficacy of management measures. Further restrictions on the use of gear types that target large sharks are recommended due to the vulnerability of those species (e.g., *C. leucas*).

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## 1. Introduction

Small-scale fishing boats in Mexico account for approximately 97% of the country's marine fleet (Fernández et al., 2011). The coastal fisheries in Latin America are often highly dependent on local resources, making them highly vulnerable to collapse (Salas et al., 2011). Additionally, some characteristics of these fisheries, such as those involving multiple species, multiple gear types, landing sites widely dispersed along coasts, and an intricate relationship between fishers and money-lending fish traders (Chuenpagdee et al., 2011) make both the assessment and management of these fisheries extremely challenging.

The small-scale shark fishery in Mexico has been recognized as part of a multi-species fishery that operates on the basis of the

seasonal abundance of sharks and teleost species. In some coastal communities, sharks represent a subsistence fishery between more profitable fishing seasons for teleosts (Castillo-Géniz et al., 1998), mollusks and crustaceans (Pérez-Jiménez et al., 2012). This fishery is very heterogeneous because the type of vessels and gears used vary regionally (Bonfil, 1997) and seasonally. Bonfil (1997) predicted that the high levels of exploitation in 1980s combined with the absence of management strategies would lead to a decrease in shark populations. Additionally, Castillo-Géniz et al. (1998) found that shark stocks harvested in Mexican waters were at risk during the 1990s due to an increasing demand for shark fishing licenses as well as a lack of regulatory actions. The Mexican Atlantic shark fishery experienced a 35% decline in catches from 1999 to 2008 (Diario Oficial de la Federación, 2012a). Unfortunately, there is still a lack of knowledge regarding the status of the populations and the catch trends for individual species.

The first management strategy established in Mexico for shark fisheries was a moratorium on the issuance of fishing permits in

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1993 as a precautionary measure to prevent the overfishing of shark populations (*Diario Oficial de la Federación, 2012a*). Additional measures were established by the Mexican Official Standard for elasmobranchs in 2007. Management measures for shark fisheries in the Atlantic coast include gear restrictions, spatiotemporal closures (in nursery areas) and prohibitions on the capture of select elasmobranch species: sawfishes *Pristis* spp, the whale shark *Rhincodon typus*, the basking shark *Cetorhinus maximus*, the white shark *Carcharodon carcharias* and devil rays of the genus *Mobula* and *Manta* (*Diario Oficial de la Federación, 2007*).

The most recent measure established by CONAPESCA (National Commission of Aquaculture and Fisheries) was the closure of the fishing season for all fisheries in which sharks are targeted or in which sharks are caught as by-catch. In 2012 and 2013, the closed season lasted May and June along the entire Mexican Atlantic coast, as well as August for the state of Campeche and a portion of the state of Tabasco (*Diario Oficial de la Federación, 2012b*). In 2014, due to a request from fishermen in the state of Campeche, the closed season was modified to May and June in the states of Veracruz, Tamaulipas (western Gulf of Mexico) and Quintana Roo (Caribbean Sea) and from May 15 to June 15 and August in the states of Tabasco, Campeche and Yucatan (*Diario Oficial de la Federación, 2014*).

The lack of records regarding catch and fishing efforts by species, as well as the heterogeneity of the shark fisheries makes management implementation and enforcement extremely difficult. According to *Hernández and Kempton (2003)*, traditional management measures (license and gear restrictions, closed seasons, size limits and catch quotas) have failed to prevent the overexploitation of more than 80% of the fisheries in Mexico. *Reeves et al. (2008)* stated that it is necessary to develop tools and approaches for using information on fisher activity as well as data on exploited populations in formulating management strategies. Thus, it is necessary to increase the knowledge on fleet dynamics and to identify the shark fisheries that can be feasibly managed.

The primary objective of this study was to describe the shark fisheries in the southern Gulf of Mexico and discusses strategies

for their assessment and management. The small-scale fisheries were described (i.e., effort, gears, areas, catch composition) using fishery-dependent surveys; fleet and trade dynamics were assessed via stakeholder interviews.

## 2. Methods

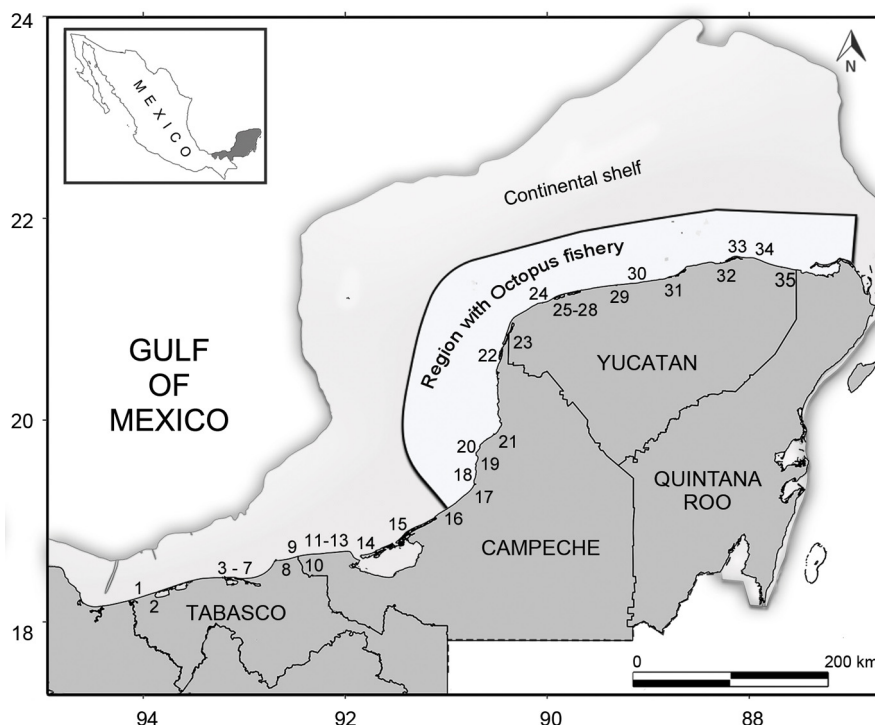
Following methods suggested by *FAO (2001)* and *Morgan and Burgess (2005)*, we characterized shark fisheries by establishing a monitoring program for landings along a series of ports in the states of Tabasco, Campeche and Yucatan, southern Gulf of Mexico (*Fig. 1*). We also interviewed stakeholders (e.g., fishermen and permit holders) to complement the fishery-dependent surveys.

### 2.1. Fisheries and seasonality

We define a fishery as a group of boats using similar gear to target the same assemblage of species or stocks during the same time of year and in roughly the same region (*Reeves et al., 2008*). The term “fishing resource” is used either for single species or groups of species (e.g., octopus, mackerels, and sharks).

Most of the fishermen used small outboard motor boats 7.5–9 m in length, made of fiberglass. Additionally, there are small inboard motor boats 8–10 m in length, made of fiberglass or wood and medium-sized inboard motor boats 15–18 m length, made of fiberglass or wood. The Mexican Official Standard for elasmobranchs (*Diario Oficial de la Federación, 2007*) indicates that the small-scale fleet is composed of boats 10.5 m long or smaller and that the medium size fleet is composed of boats that are 10–27 m long.

During 2011 and 2013, we carried out weekly or monthly visits to 35 communities in the states of Tabasco, Campeche and Yucatan (*Fig. 1*) to characterize year-round fishery activity by monitoring landings. Additional information was recorded using questionnaires for fishermen, permit holders and the managers of storage plants in which the catch is usually stored prior to trade. Most of the permit holders own a storage plant, boats and gear, and



**Fig. 1.** Fishing communities in the southern Gulf of Mexico. The numbers along the coastline (from 1 to 35) represent communities (the names of which are included in *Table 2*).

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