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Small scale fisheries operative units in the west central region of the Gulf of California, Mexico

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ABSTRACT

The multispecific and multigear character of small scale fisheries is complex and often difficult to understand, especially when basic data necessary for evaluation are scarce. In this study the distribution of spatial and temporal fishing pressure of operative fishery units OU was analysed. Each unit was integrated per vessel which, through similar forms of operation, takes advantage of the same species in the central region of the Gulf of California. The identification of the OU is based on a survey about the forms of operation and they were complemented with the catch data per species collected by the National Commission of Aquaculture and Fishing from 1998 to 2010. A hierarchical cluster analysis was applied and nine OUs were determined, which included: jig-caught jumbo squid; amberjacks with surface fishing nets; octopus with diving gear; groupers with hooks; shark with surface fishing nets; stingrays with bottom-set net; triggerfishes, mojarras, ocean whitefish and hogfish with hooks; weakfish, snappers, parrotfishes and grunts with bottom-set nets; Pacific sierra with surface fishing nets. The interaction processes between OUs are described through thematic maps in relation to the use of fishing areas and pressure by overlapping activities. It is proposed that when the fishermen have more than one fishing permit, they should choose what OU to work. Furthermore, if the permit is for finfish fishing they need to decide in what operative unit it is best to participate, accounting for factors such as abundance, price and distance to the fishing location. All of the OUs are relevant for the economy of the fishermen of the region and their interaction is necessary for maintaining fishery production.

1. Introduction

The study of coastal fisheries is principally based on the biological attributes of exploited populations, but few consider aspects of the distribution of the fishing effort. The omission of these aspects can promote the development of inefficiencies in management strategies (Hilborn, 1985; Salas et al., 2004; Forcada et al., 2010; Monroy et al., 2010). Management measures should establish regulations for the control of fishing (Caddy, 2011) and therefore the monitoring of the dynamics of fishing units contributes to fisheries management (Katsanevakis et al., 2010; Castro et al., 2012). The study of the dynamics and adaptability within operating fisheries is very important, particularly in response to evolving management strategies of fisheries at the regional level (Ulrich et al., 2001; Davie and Lordan, 2011).

The fleet dynamic refers to the way in which the fishermen distribute the fishing effort to make their operation more efficient in terms of the capture of fish in relation to time and space (FAO, 2003; Branch et al., 2006). The exploitation pattern for a stock arises from the combination of the three choice parameters: fishing ground, gear, and target assemblage (Andersen et al., 2012). The process can be analysed through the identification of operational units like fisheries and métiers. According with ICES (2003), a fishery is a group of vessel voyages targeting the same (assemblage of) species and/or stocks, using similar gear, during the same period of the year and within the same area; a fishery can encompass more than one mesh size range (ICES, 2004). A métier is a homogeneous subdivision of a fishery by vessel type.

The general idea of aggregating voyages into métiers or fisheries is that landings can be allocated to operational units, which reflect the true nature of fishing activities and facilitate the analysis of fisheries performance and its effects on resources and the ecosystem. The identification of métiers require large historical datasets on species composition or catches data by specific gear. If the available data do not allow groupings of voyages to be performed at the métier level, then this should be done at some higher (fishery) level (ICES, 2006).

The operation of different units within a given region generates direct interactions that occur when vessels work at the same time in the same area. This is specially complex in mixed fisheries that exploit a number of species (multispecies) either simultaneously or sequentially

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Fig. 1. Location of the Santa Rosalía-Mulegé corridor in the east coast of Baja California Sur, Mexico.

using distinct gears and carrying out different types of fishing activity (multifleets), depending on the time of the year (Pelletier and Mahévas, 2005). The vessels can compete for the resource or for the fishing area which can affect overall catch rates and economic performance (Salas et al., 2004; Poos and Rijnsdorp, 2007; Rijnsdorp et al., 2008; Ojeda-Ruíz and Ramírez-Rodríguez, 2014).

Since the identification and measurement of these interactions is complex, it is necessary that studies of fleet operation take into consideration operational units. In this study, we aimed to identify operational units within the small-scale fisheries of the Santa Rosalía-Mulegé (SR-MG) corridor in the east center of the Gulf of California. We proposed that these units would provide a basis to analyse the fishery interactions with the view to improving information available for management decisions in the region.

2. Methodology

The SR-MG corridor is located in the occidental region of the Gulf of California, to the northeast of the state of Baja California Sur, Mexico. The coast forms part of the municipality of Mulegé, between 28°20′ and 26°50′ North, and 112°55′ and 111°50’ West (Fig. 1). The principal productive activities in the region are fishing and mining. The fishermen of the corridor, like in the rest of Mexico, are organized in economic units that require fishing permits that authorise the fishing of a particular species or a group of species, the number of vessels and the type of fishing gears that can be utilized. The methods of fishery management in Mexico need to comply with the General Law of Sustainable Aquaculture and Fishing (SAGARPA, 2007), the official standards and the National Fishery Chart (SAGARPA, 2012), documents that for some of the most valuable resources establish rules on catch, effort, seasons, gears and sizes, but do not consider mixed and multispecies fisheries.

The available fishery data on economic units, vessels, fishermen, infrastructure and associated fishery services in the corridor are scarce, and basically refers to fish-trip tickets or official records which includes the date, the number of vessels involved, the type of fishing gear, fishing and landing sites, and the catch per species in kg. Ramírez-Rodríguez and Hernández-Herrera (2000) indicated the importance of the production of jumbo squid, groupers, amberjacks, Pacific sierra, sharks, octopus and clams. González-Máynez et al. (2013) stresses the importance of the jumbo squid (*Dosidicus gigas*) for the jobs and income that it generates and the difficulty of fishery management due to the high fluctuations in its availability. Since information is scarce, this study is based on the analysis of trip-tickets collected by the National Commission of Aquaculture and Fisheries between 1998 and 2010 and in data collected from the interviews of fishermen conducted in 2014.

A “snowball” sampling method was applied to the interviews (Neis et al., 1999). Data was successfully collected from 55 fishermen of the approximately 400 in the region; 60% of the respondents live in Santa Rosalía, 30% in San Bruno and 10% in Mulegé. The questions yielded information on the type of operation in relation to the target species, the fishing gear, seasons, costs and prices. In addition, the interviews explored the relative importance of the fisheries and their possible interactions by asking respondents to identify fishing zones and landing areas on a map of the study area (Close and Hall, 2006). The spatial information was digitalized and included in a system of geographical information based on QGIS software (http://www.qgis.org). The data from the interviews was organized into opinion percentages per