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Mapping fishing grounds from fleet operation records and local knowledge: The Pacific calico scallop (*Argopecten ventricosus*) fishery in Bahia Magdalena, Mexican Pacific

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ABSTRACT

For ecosystem-based fisheries management, the identification of different strategies for the spatial and temporal use of resources is key. Such strategies are related to the fleet operation dynamics and can be identified from catch data per season and fishing area, for each target species. In Mexico, such data are reported in fishing trip tickets; in this article, we use these data to map the Pacific calico scallop (*Argopecten ventricosus*) fishery in the Magdalena-Almejas Bay region, Baja California Sur. Three distinctive zones were identified within the bay based on physiographic features. Fishing zones were defined based on catch size, economic value and record frequency between 1998 and 2010. The zones were validated through a survey of fishermen's local knowledge. The resulting maps display fishing activity patterns related to temporal variations in scallop availability.

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1. Introduction

Despite the important role that small-scale coastal fisheries play in the world economy and in the rural development of coastal areas, this activity has been poorly documented, especially in comparison to large fleet dynamics (Salas et al., 2007). Therefore, several authors agree on the need to further investigate how fisheries operate in time and space to better support the formulation of management plans and planning programs.

One of the main issues to address is the heterogeneity of coastal fisheries, as these encompass such a high diversity of boats, fishing systems and resources, all of which hinder their analysis, management and monitoring (Franquesa et al., 2001; Tzanatos et al., 2006). In addition, the information available is scarce and often scattered, unsuitable for integration and analyzed by means of geographic information systems (GIS), which would help understand the set of physical, geomorphological and ecological conditions of the resource being exploited, together with the human activities involved in its exploitation (Nishida and Booth, 2001).

Strategies and tactics adopted by fishing fleets are related to resource availability and trade conditions; these can lead to fleet interactions in space and time (Ulrich et al., 2001; Wilen, 2004; Sanchirico and Wilen, 2005). Therefore, it is crucial to understand the fleet dynamics and its implications for the management of multiple interests arising from different economic, social and ecological values (Fletcher et al., 2005; Pelletier and Mahévas, 2005; Salas et al., 2007; Carocci et al., 2009).

Fishery mapping is a useful tool for displaying, understanding and communicating the spatial and temporal dynamics of regional fleets. Mapping allows the identification of fishing areas, use patterns and intensities, thus facilitating the construction of indicators useful for designing and implementing management measures (Caddy and Garcia, 1986; Carocci et al., 2009). In addition, the use of GIS contributes to understand the ecological conditions of exploited resources and human activities (Nishida and Booth, 2001). Spatial and temporal data on catch size and effort are necessary to construct thematic maps; such data are usually collected from logbooks and satellite tracking of fleet operations (Ulrich et al., 2001; Rijnsdorp et al., 2000; Accadia and Franquesa, 2006).

In Mexico, fisheries management measures include restrictions on fishing effort via permits and closed seasons; spatial restrictions have been enforced for some fisheries (SAGARPA, 2012). However,

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for most of the small-scale fishery regulations, distinctions are made between the various coastal Mexican states, but not at the region or within-state level, as discussed in this document. Thus, it is essential to develop methods for constructing fishing maps using the data available. In general, there is limited knowledge on fleet dynamics, due to the paucity of fishing effort data. Some studies have identified fishing areas based on official data (Mexicano-Cíntora et al., 2009; Erisman et al., 2011; Ramírez-Rodríguez, 2011; Ramírez-Rodriguez and Ojeda-Ruiz, 2011). In some others, fisheries monitoring data along with information gathered from local fishermen have been used for developing spatial models (Jiménez-Badillo, 2011; Moreno-Báez et al., 2010, 2012; Maullie et al., 2013, 2014).

In this work we intend to construct fishing maps by combining data recorded in official fishing trip tickets, supplemented with information in technical and scientific publications and the fishermen's local knowledge, to identify fishing zones and recent production trends in fisheries in the study zone. As a case study to illustrate the method, we use the Pacific calico scallop (*Argopecten ventricosus*) fishery at the Magdalena-Almejas Bay (MAB), an important fishing area at the southwestern coast of the Baja California Peninsula, Mexico (Fig. 1).

The calico scallop, an important resource in BMA, is caught manually by semi-autonomous diving (hookah) at 5–25 m depth (Maeda-Martínez et al., 1993). It total catch at MAB peaked at

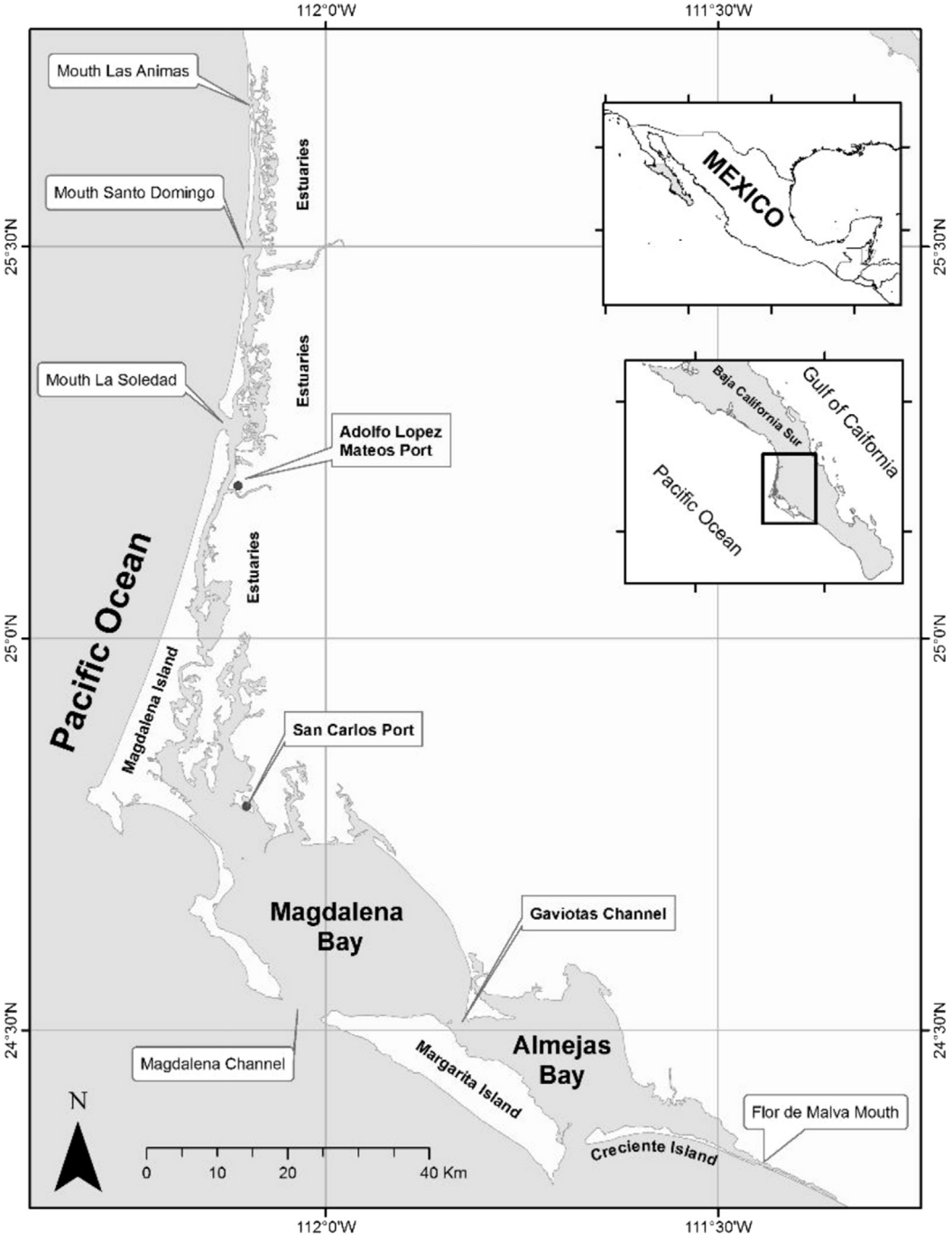

Fig. 1. Magdalena-Almejas bay (MAB), BCS Mexico.

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