

Sediment granulometry and salinity drive spatial and seasonal variability of an estuarine demersal fish assemblage dominated by juvenile fish

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ABSTRACT

Abiotic factors are known to structure estuarine fish communities; however, their effects on the ichthyofauna are not yet clear. The objective of this study was to evaluate abundance and composition, by species and size, of the demersal ichthyofauna in a Mexican Central Pacific lagoon, and correlate its spatial and seasonal variations with selected abiotic factors. Eight sampling campaigns were conducted in representative months of the dry and rainy seasons between April 2015 and February 2017. Salinity, temperature and sediment granulometry were recorded. A total of 10 093 individuals of 64 species were collected and measured for total length. Of the 22 most abundant species, 19 were mainly juveniles (> 50%). *Diapterus brevirostris*, *Achirus mazatlanus*, *Centropomus robalito* and *Lutjanus argentiventris* comprised more than 80% of the total collection. PERMANOVA yielded significant differences in fish community composition between sites and months, and *post hoc* tests resulted in four homogenous, significantly different groups of sites based on fish assemblage composition. These groups of sites lie well ordered along a west-east axis inside the lagoon. Two well separated seasonal groups of months were defined, namely dry season (February, April) and rainy season (July, October). The spatial changes in abundance and composition of the fish fauna were primarily explained by the Site factor in a spatial scale, while the Month factor influenced to a lesser degree the community structure on a seasonal scale. Redundancy analysis showed the type of sediment, the bottom salinity and the organic matter content were highly correlated with the composition and abundance of ichthyofauna in the lagoon. One species group (dominated by *D. brevirostris*, *C. robalito* and *A. mazatlanus*) was found to be highly positively correlated with percentage of mud and organic matter but negatively correlated with bottom salinity. Another species group (dominated by *Diodon holocanthus*, *Eucinostomus dowii*, *Sphoeroides annulatus* and *Chaetodon humeralis*) was highly correlated with percentage of sand and bottom salinity. A high number of juveniles in the catches also validates the Barra de Navidad lagoon as a probable nursery area.

1. Introduction

Coastal lagoons are primarily characterized as being transitional sites between the terrestrial and marine environment, with particular flora and fauna due to the environmental characteristics that prevail in these ecosystems (Arceo, 2005). These systems are relatively unpredictable and in many cases, inhospitable environments (Mendoza et al., 2009; Nicolas et al., 2010; Padilla-Serrato et al., 2016). Castro-

Aguirre et al. (1999) described lagoons as places where it is possible to find organisms in various life stages, especially fish, which are capable of effectively colonizing these ecosystems with extremely variable hydrological conditions (Padilla-Serrato et al., 2016).

Coastal lagoons are also considered potential nursery areas for ichthyofauna, as they provide freshwater, estuarine and marine fish species with food and refuge from predators (Nagelkerken et al., 2000; Raz and Huidobro, 2002; Minello et al., 2003; González-Sansón et al.,

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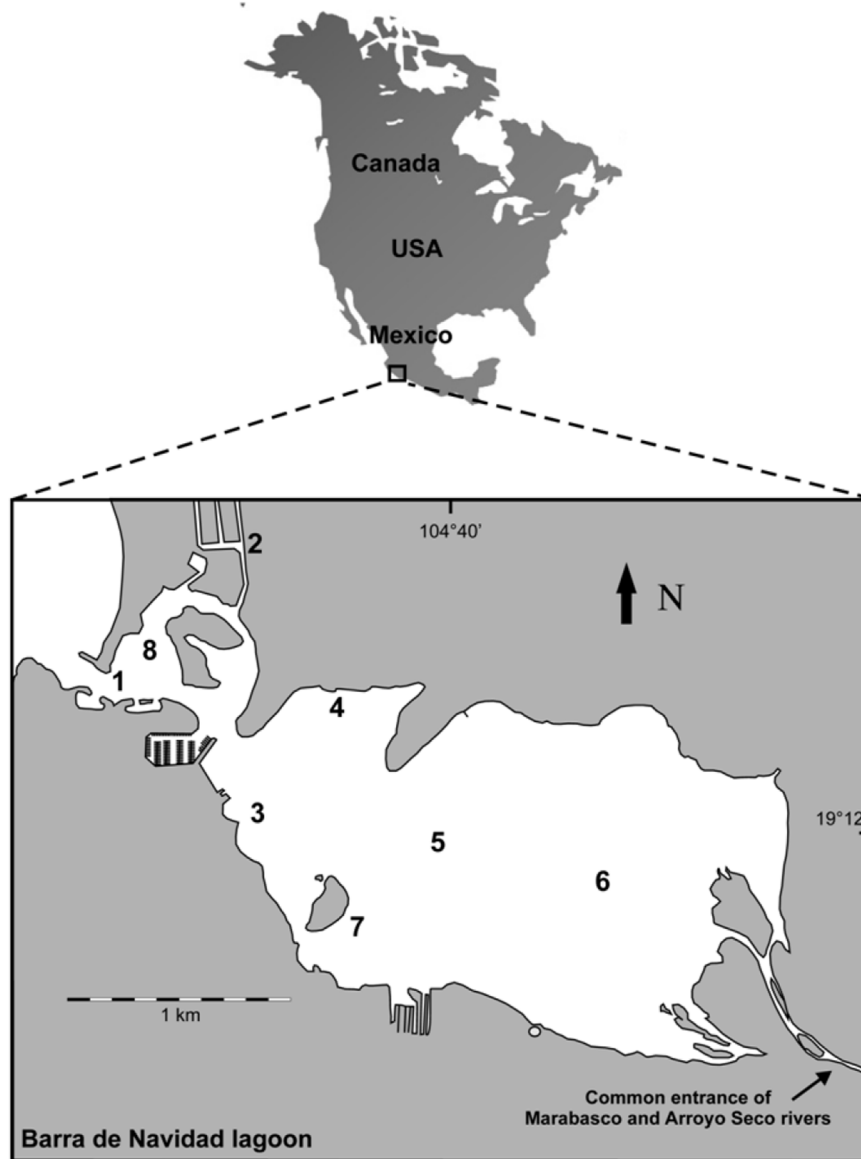


Fig. 1. Map of Barra de Navidad lagoon (BN). Numbers identify sampling sites.

2014a). Estuarine systems are recognized for their significant role in the early life stage development of a large number of fish species of commercial or ecological importance, supporting adult populations in other habitats and sustaining the performance of local fisheries (Parrish, 1989; Baran and Hambrey, 1998; Mumby et al., 2004).

Understanding the characteristics of each estuarine system with respect to the life cycle of fishes requires specific attention to the species present as juveniles, and of the spatial and temporal variations of their abundance in relation to physical and chemical variables of the water (González-Sansón et al., 2016). There is a variety of research referring to the spatial and/or temporal variations of the abundance and composition of ichthyofauna in estuarine environments in different countries as USA (Akin et al., 2003), Brazil (Barletta et al., 2003), Colombia (Rueda and Defeo, 2003), Australia (Hoeksema and Potter, 2006), Italy (Maci and Basset, 2009) and India (Chaudhuri et al., 2013). Estuarine fish assemblages have also been studied in several places of Mexico (Castillo-Rivera et al., 2003, 2010; Cabral-Solis and Espino-Bar, 2004; Caballero-Vázquez et al., 2005; González et al., 2005; Ramos-Miranda et al., 2005; Velázquez et al., 2008; Rodríguez et al., 2011; Padilla-Serrato et al., 2017). Additionally, some studies have analyzed the response of the ichthyofauna to abiotic factors such as the

heterogeneity of the lagoon system, salinity, temperature, dissolved oxygen concentrations, and the type of substrate (Álvarez-Rubio et al., 1984; Acevedo, 1997; Raz and Huidobro, 2002; Díaz et al., 2006; Benítez et al., 2007; Rodríguez et al., 2011; Reis-Filho and Santos, 2014; Padilla-Serrato et al., 2017). Barletta et al. (2005) proposed that the seasonal fluctuation of the gradient of salinity is responsible for the fish assemblage's movement in the tropical estuarine ecosystem. In 2008, these authors corroborate that in the estuary located in the tropical/subtropical transition zone (Barletta et al., 2008). After that, new research evaluated the seasonal and spatial fluctuation of density and biomass of the most important species in an estuary located at Northeast Brazil (Dantas et al., 2010, 2012; Ramos et al., 2012, 2016; Ferreira et al., 2016; Lima et al., 2014). The different ontogenetic phase of these species utilize different portion of estuary to complete their life cycles according to the salt wedge gradient in the estuary. The type of substrate (including sediment size distribution (i.e. granulometry) and organic matter), has received little consideration in studies of ichthyofaunal composition in estuarine environments and it is more recent that greater attention has been paid to these factors in the structuring of fish communities in coastal lagoon systems. There are studies that mention the relationship between sediment characteristics and the

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