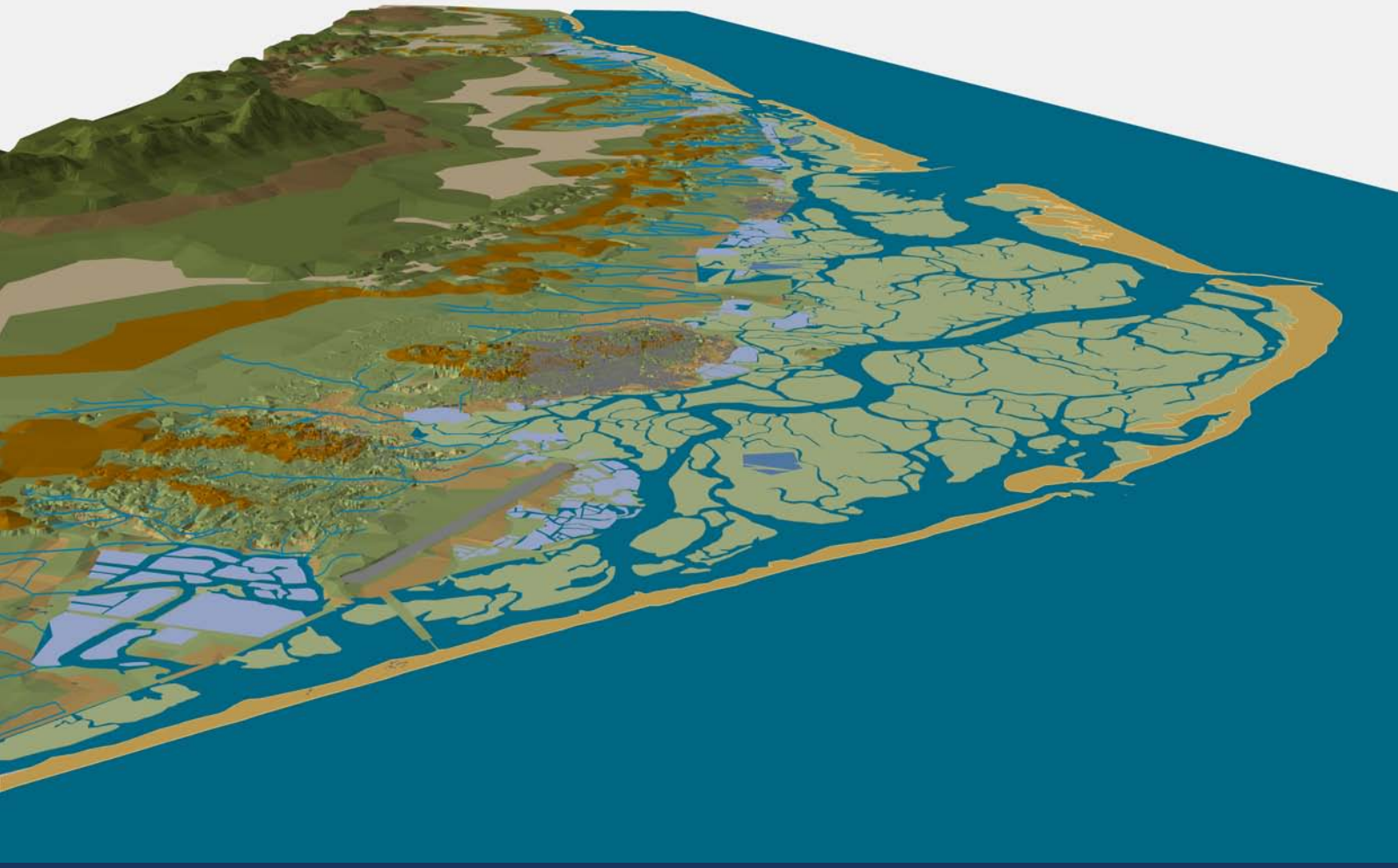

RIA FORMOSA

Challenges of a coastal lagoon in a changing environment

Edited by
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1. Introduction

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Ria Formosa is one of the most important weatlands of the Portuguese territory. Its rarity and ecological value led to the creation of the Ria Formosa Natural Park (law-Decree 373/87, 9th December). Ria Formosa hosts a remarkable diversity of habitats and biodiversity. It is of fundamental importance for several species of migratory birds and, some species in decline find here the optimal conditions for nesting. This is the case of the species *Porphyrio porphirio* that is the symbol of the Ria Formosa Natural Park. Due to protective measures of this species, its population has increased in recent years.

The natural system named Ria Formosa is a shallow coastal lagoon (average depth of 2 m) protected from the direct impact of marine waves by a barrier-island system formed by five islands and two peninsulas facing the sea along ca. 55 km (Figure 1.1). The Ria Formosa barrier islands are narrow and elongated morphosedimentary features that diverge NW and NE orientated from the Cape St. Maria (Figure 1.1). St. Maria de Hárune, later on renamed as St. Maria de Fárão, were the names of the city of Faro, after the Arab domination, during which was Ibne-Hárune (Guerreiro and Magalhães, 1983). The lagoon with extensive marshes and tidal channels (total area of 18000 ha) maintains connections with the sea through six inlets, which guarantees daily renewal of water and nutrients at the pace of tides.

The maintenance of efficient inlets is of fundamental importance for the biodiversity and ecosystem services preservation. Due to the highly dynamic of the hydrosedimentary processes, the inlets tend to migrate eastward drived by the alongshore drift. This was why the Ancão and Fuseta inlets were relocated. At the east and west ends, the barrier-island system connects with the mainland through two peninsulas (spits), respectively the Cacela and Ancão peninsulas. The remarkable morho-hydrodynamism of the overall system, is also expressed on the landward migration of the backbarrier provoking a shrinking of the lagoonal area (e.g., Andrade et al., 2004; Ferreira et al., 2016; Kombiadou et al., 2018). Dunes are important forms of the Ria Formosa, which sedimentary dynamic is the main mechanism for the barrier-islands evolution (Ferreira et al., 2016).

One of the great questions about the barrier-islands of the Ria Formosa lagoon, is the origin of such amount of sand necessary to form them. Even today the source of the sands remains open. The fluvial origin of the sediments is discarded since there are no important rivers that flow to the system (Dias et al., 2004; Andrade et al., 2004). However, in the geological past, the rivers and streams, had different shapes and sizes from what we are observing today. Thus, some of the sand of the barrier islands can be inherited from those distant times thereafter reworked by waves and currents. The scarcity of fluvial sediment contribution is one feature that distinguishes the Ria formosa from other coastal lagoon worldwide. In addition, those low fluvial inputs combined with the groundwater discharges into the

lagoon and the high rate of water renewal through the inlets are responsible for the high values of salinity of the lagoonal water (mean salinity = 35.25 g/kg; Newton and Muge, 2003) and for other chemical characteristics of the system (Bebianno, 1995; Andrade et al., 2004; Leote et al., 2008).

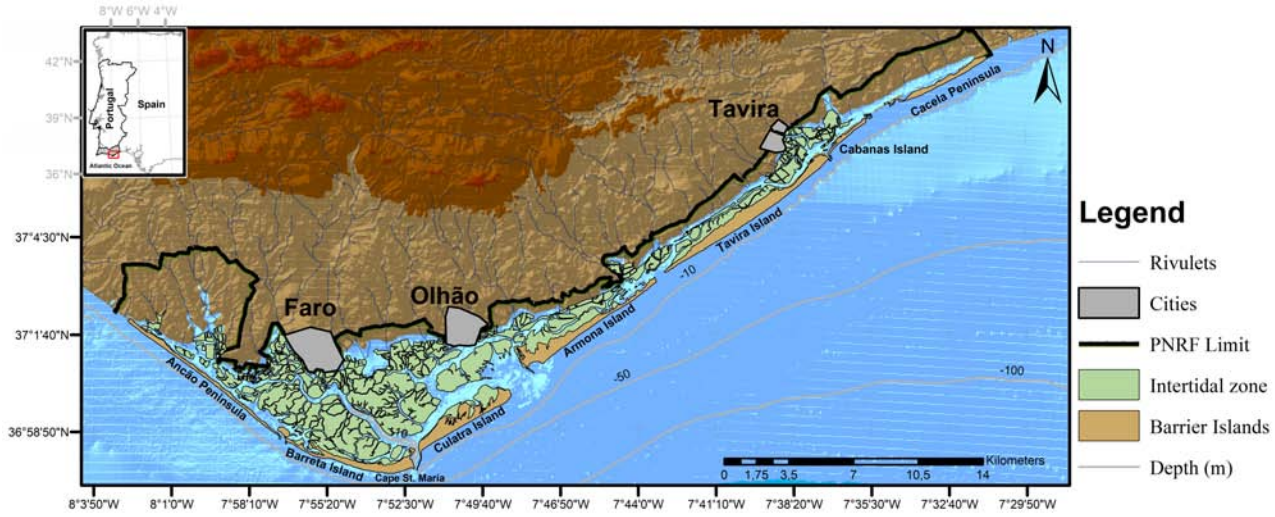

Figure 1.1.
Ria Formosa lagoon and barrier island system (Credits: Sónia Oliveira).

Regardless the questions about the source of the sand that forms the barrier islands, the most accepted conceptual model of the genesis of the Ria Formosa, points the mean sea level rise as the main forcer (e.g., Pilkey et al., 1989). During the Last Glacial Maximum (LGM) ca. 18000 years ago, the mean sea level was 120 m lower than the present. Several sandy bodies roughly parallel to the past coastline were formed and migrated landward to form islands, as the mean sea level rose after the LGM. Those islands reached their current position ca. 7000 years ago (Sousa et al., 2014; 2018) (Figure 1.2). Since then, the barrier morphology and evolution were mainly controlled by waves, tides, extreme events (e.g., storms and tsunami) and mean sea level rise.

Barrier islands are among the most vulnerable natural systems to the mean sea level rise, extreme events, and anthropic activities. In this way, a sustainable coastal management is required to mitigate these effects. The Ria Formosa lagoon has been a very attractive area for human occupation, since the Paleolithic period, due to mild conditions, and living and non-living resources availability. While the first settlements in the 19th and early 20th centuries were fishermen, since the 1960s the increasing occupation by buildings and parkings have contributed to the sedimentary imbalance of the barrier island system. This situation is particularly worrisome at the Faro beach, peninsula of Ancão (Ceia et al., 2010).

Beaches, dunes and marshes lead to different habitats therefore to high biodiversity in the Ria Formosa. A high percentage (ca. 90%- Andrade et al., 2004) of the lagoon area is composed by intertidal morphosedimentary forms (Figure 1.1). According to the elevation of these forms, the environmental variables such as sediment, salinity, thermal amplitudes, insolation and time of submergence are quite different determining a well defined phytozonation (Arnaud-Fasseta et al., 2006; Oliveira, 2014).

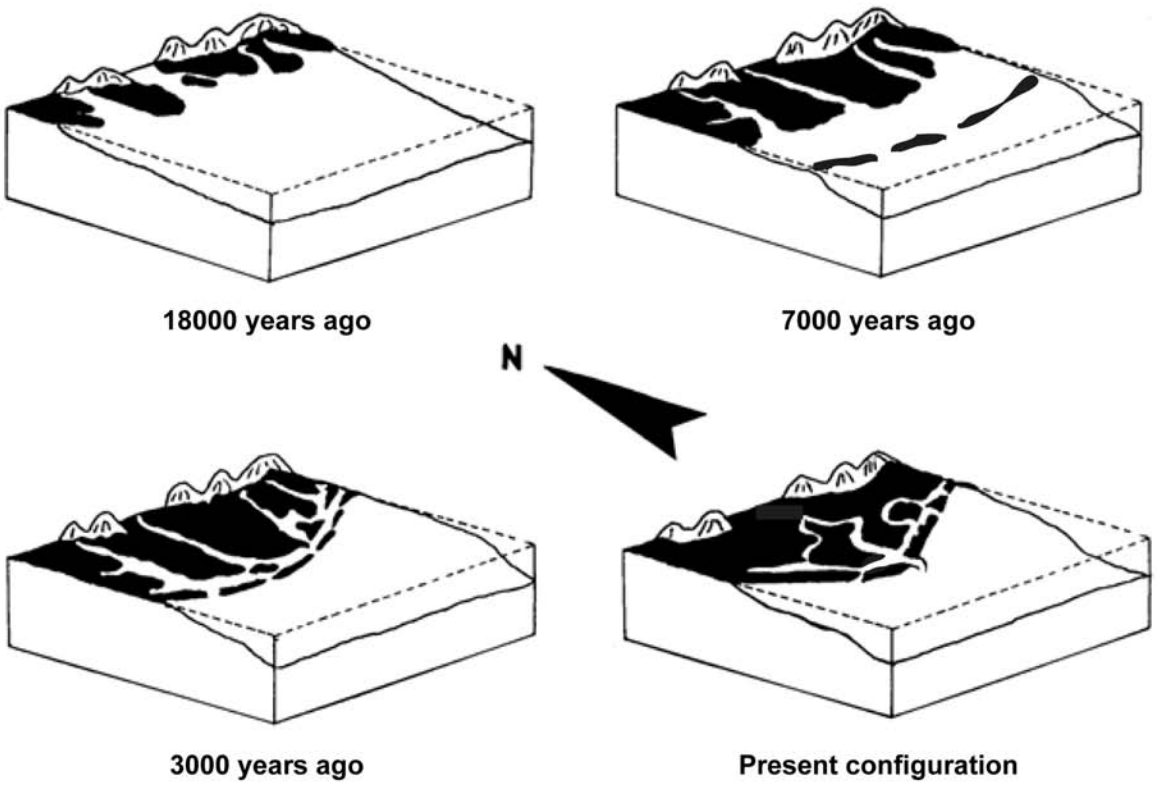

Figure 1.2.
Conceptual diagram of the evolution of the Ria Formosa lagoon.

The ecological, morphological, hydrological and socioeconomic values of the Ria Formosa lagoon are dynamically interconnected (see http://www.cima.ualg.pt/cimaualg/index.php/pt/ciencia-para-a-sociedade/aplicacoes-didaticas) and will be further explored along this book.

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