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Conservation challenges in human dominated seascapes: The harbour and coast of Ravenna

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ABSTRACT

Ravenna is the major coastal city of Emilia-Romagna region and one of the largest commercial seaports in Italy. Its harbour was established in the lagoon systems surrounding the city, which are comprised of the southern part of the Po Delta Park, inscribed in the World Heritage List. The Emilia-Romagna coast is an area of renowned environmental, cultural and economical value, and one of the world's leading holiday destinations. Human pressure on the coast has been historically intense, and environmental problems are varied and severe, including: 1) erosion and land subsidence (both natural and human-induced), which have led to proliferation of hard defence structures over 60% of an originally sandy coast and which is expected to become even more serious because of rising sea levels; 2) developments of settlements, industries, aquaculture, ports, tourism and recreation, which have led to the creation of vast built-up areas at the expense of natural habitats; 3) fragmentation, transformation (e.g. changes in sediment characteristics) and loss of native habitats and biodiversity; 4) eutrophication, poor water quality, algal blooms and spread of exotic species. Pockets of extensive coastal habitats of high naturalistic and environmental value still remain in the region, and one of the greatest challenges for local authorities is the identification of more sustainable defence measures, that combine coastal protection to nature conservation. We provide an up-to-date overview of the status and trends of the harbour of Ravenna and surrounding coastal areas, with the intents to identify future directions to improve the conservation and management of this valuable coastal region, and to provide a scientific support to local authorities in the urban redevelopment project for the regeneration of the harbour area for leisure and tourism.

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1. Introduction

The Emilia-Romagna coast borders part of the north-western Adriatic Sea. Its 130 km of coastline consists of a flat alluvial sandy system, with no natural rocky shores and almost uninterrupted except for the mouths of rivers, channels, lagoon systems and ports. It is an area of renowned environmental, cultural and economical value, and one of the world's leading holiday destinations. Human pressure on the coast has been historically intense, leading to severe urbanisation and overexploitation of natural resources (Airoidi and Beck, 2007; Lotze et al., 2011), and nowadays most wetlands and lagoons have been filled by sediments or reclaimed (Cencini, 1998).

Ravenna is the major coastal city of Emilia-Romagna and the largest harbour of Western Adriatic (Mauro, 2002). The harbour

was established in the lagoon systems surrounding the city. Its history dates back to the Roman Emperor Augustus who based one of his imperial fleets there. Nowadays it is still one of the largest commercial seaports in Italy, appointed by the European Commission as "Core port" of the Trans European Transport Network (TEN-T). It is structured as a major 'canal' port extending for 11 km from the centre of Ravenna to the tourist seacoast (Fig. 1(a)). The canal is directly connected to the surrounding lagoons (Fig. 1(b)), which are comprised of the southern part of the Po Delta Park, inscribed in the World Heritage List due to its outstanding planned cultural landscapes. The harbour evolution has also affected the surrounding coastal areas, as the construction of two large converging jetties (nowadays about 2400 m long each) to protect the harbour from siltation altered the sediment transport and shaped the nearby highly-tourist beaches.

Environmental and geomorphological problems are varied and severe in the area, leading to increasing concern for the degradation of the natural habitats, the contamination of sediments, the risks and social vulnerability to natural hazards of the local popu-

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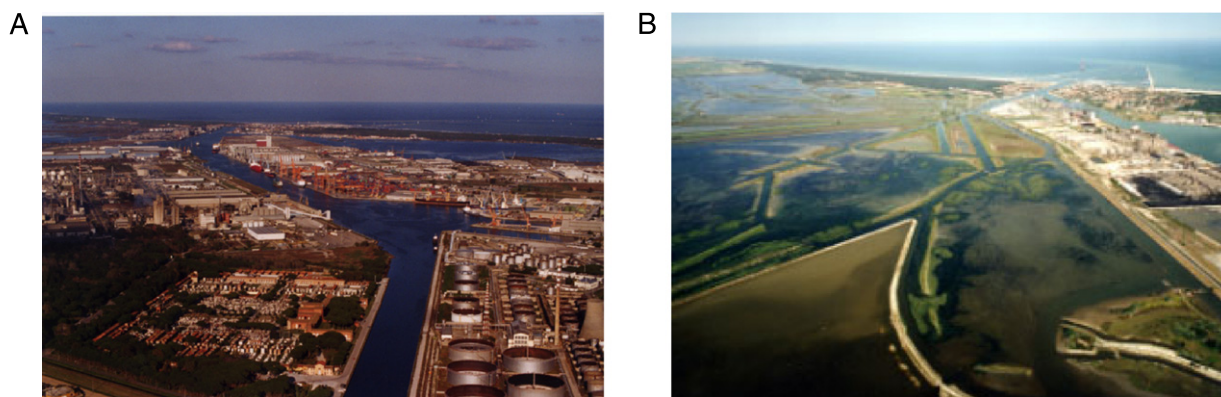


Fig. 1. (A) View of the 11 km long channel port of Ravenna and (B) larger view of the port and its surrounding lagoons and coastal areas (photos by Giorgio Benelli, with permission).

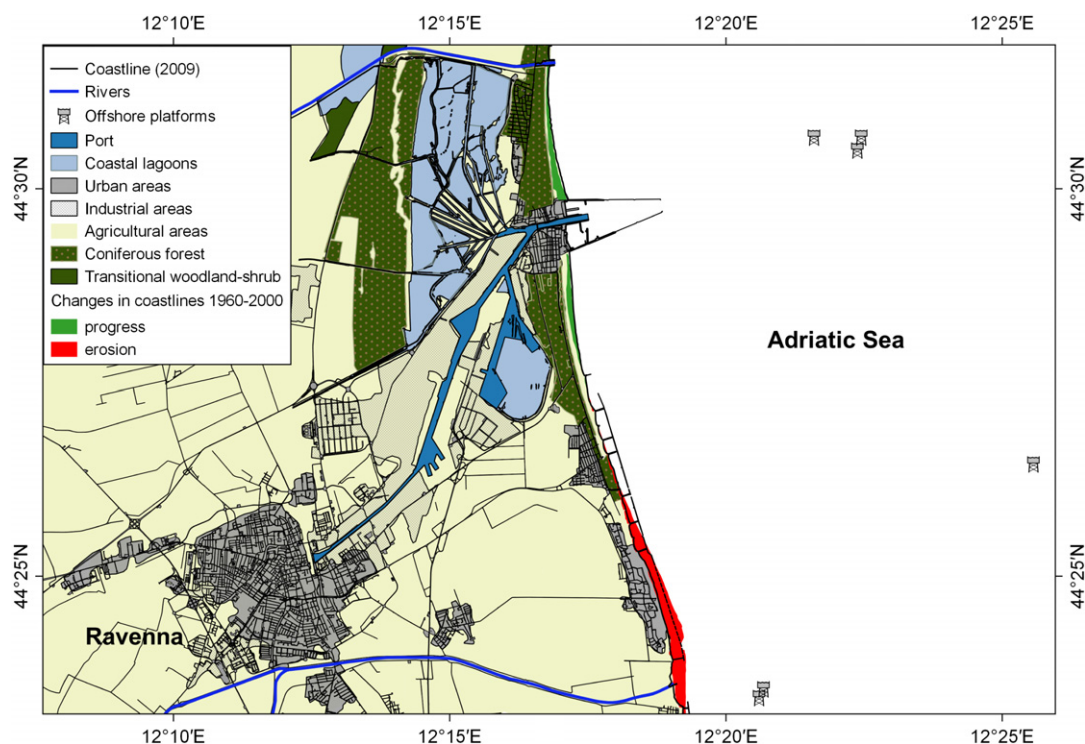


Fig. 2. Port of Ravenna and surrounding areas. Land cover modified from CORINE, 2006; coastal erosion data from the national geoportal of the Italian Environmental Ministry; road and hydrographic networks from Emilia-Romagna Region geoportal; offshore platforms from the nautical map of the Hydrographic Institute (Mercator projection, datum WGS84).

lation, and the management challenges faced in such a highly urbanised context subject to multiple anthropogenic uses (Fig. 2). In the past years considerable monitoring efforts have produced baseline descriptions of the status of the coastal lagoons, and identified conservation priorities (CIRSA - Università di Bologna in Ravenna and Comune di Ravenna, 2003). Research has also been carried out in the port and coastal areas, mainly related to coast defence, water and air quality, aquaculture and fishery, and offshore activities (Bacchiocchi and Airoidi, 2003; Bertasi et al., 2007; Luciali et al., 2007; Zanuttigh et al., 2015).

The aim of the present paper is to produce an up-to-date, integrated overview of the status and trends of the harbour of Ravenna and surrounding coastal areas, with the intent to identify future directions to improve the conservation and management of this valuable coastal region and provide a scientific support to local authorities in the urban redevelopment project for the regeneration of the harbour area for leisure and tourism. We will start by introducing the environmental and socio-economic

settings, we will next summarise some of the major threats to native ecosystems and conservation challenges, and then we will discuss how to address some of these ecological issues based on two case studies from the region.

2. Environmental setting

2.1. Geo-physical and hydrological setting

The area of the port of Ravenna, with its beaches and surrounding lagoons, is an alluvial system within the Po River Valley, strongly influenced by recent changes in the sea level, by the sediment load of many rivers, and many human hydraulic interventions. In the last 5–6000 ys, the coast has advanced about 20 km, through the alternation of littoral sandbars and backwaters, gradually filled and partially buried. The oldest sandbars are now buried a few metres deep because of natural subsidence (approximately

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