Available online at www.sciencedirect.com
SCIENCE DIRECT
ELSEVIER
Continental Shelf Research 26 (2006) 1045–1060
CONTINENTAL SHELF RESEARCH
www.elsevier.com/locate/csr

Quantification of inlet-related hazards in barrier island systems. An example from the Ria Formosa (Portugal)

A. Vila-Concejo[a,*], A. Matias[a], A. Pacheco[a], Ó. Ferreira[b], J.A. Dias[b]

[a]*CIACOMAR/CIMA-IMAR. University of Algarve, Av. 16 de Junho s/n, 8700-311 Olhão, Portugal*
[b]*FCMA/CIMA-IMAR. University of Algarve, Campus Gambelas, 8000 Faro, Portugal*

Available online 24 April 2006

Abstract

Determination of inlet hazard areas (IHAs) is important for the management of barrier island systems such as the Ria Formosa. An IHA is an area of natural importance that can be easily destroyed by inlet-related processes and covers the land adjacent to inlets [CAMA, 2004. Handbook for Development in Coastal North Carolina. Division of Coastal Management from the North Carolina State Department of Environmental and Natural Resources. http://www.nccoastalmanagement.net/Handbook/contents.htm, (accessed 07.04)]. One parameter is defined in order to quantify the extension of the inlet-associated hazards within a barrier island system. This parameter, the minimum inlet hazard area (IHA_{min}), represents the extent of the minimum area that should be taken into account when analysing inlet-associated hazards and is determined using the following criteria: (a) inlet maximum width; (b) inlet migration path and (c) existence of frequently overwashed areas that can be related to present or historic inlets. The calculation of the IHA_{min} was applied to the Ria Formosa barrier island system (southern Portugal) for a time scale of decades. For the Ria Formosa the IHA_{min} represents approximately 45% of the total length of the system. Most of the occupied areas within the barrier chain are located inside the IHA_{min}. Changes in the configuration and number of inlets of the system would modify the total IHA_{min} calculated for the entire area. However, assuming that the typical migration patterns identified for the system do not change, the herein proposed methodology can still be applicable to calculate the new associated IHA_{min}. This study showed that other studies should be considered in future work including: (i) quantifying buffer distances on both sides of the IHA_{min} and (ii) analyses of the inland extent of the hazardous areas. The IHA_{min} is an easy-to-use parameter that could be quantified for other inlets located in other parts of the world.

Keywords: Inlet; Coastal hazards; Inlet hazard area; Inlet evolution; Management

1. Introduction

Barrier islands and associated tidal inlets are dynamic and sensitive areas of the coast. Their sandy composition, low elevation and exposure to storms and inlet processes make barriers vulnerable to erosion and destruction. The degree of vulnerability varies for different parts of the islands depending on various factors such as elevation, width, human development and proximity to inlets. Tidal inlets are one of the most dynamic parts of barrier island systems, and therefore the areas in the vicinity of inlets are in extreme risk. The average barrier length along a coast is controlled by the size

*Corresponding author. Tel.: +351 289 707 087; fax: +351 289 706 972.
E-mail address: aconcejo@ualg.pt (A. Vila-Concejo).

0278-4343/$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.csr.2005.12.014

and number of tidal inlets, which in turn are primarily a function of a region's tidal range and bay area (FitzGerald, 1988). The existence, or potential existence, of a tidal inlet in a given area is used as a geo-indicator for the assessing of coastal hazards (Bush et al., 1999). Barrier coasts near tidal inlets, or along their migration path, are subjected to erosion, overwash, flooding and breaching.

According to the Coastal Area Management Act (CAMA, 2004), the inlet hazard area (IHA) is an area of natural importance and environmental concern that may be easily destroyed by erosion or flooding. By definition, the IHA covers the lands next to inlets, where inlet shorelines can shift suddenly and dramatically. According to the same authors for each inlet along the North Carolina coast a hazard area map can be prepared according to inlet migration, previous inlet locations, narrow or low lands near the inlet and the influence of man-made structures.

The objective of this paper is to determine a parameter for the quantification of IHAs for different inlet types by assessing typical inlet parameters (i.e. width, migration path). Historic locations of inlets that no longer exist are also taken into account for inlet hazard quantification. The parameter defined within this paper is the minimum inlet hazard area (IHA_{min}) which is the minimum extent that should be taken into account when analysing inlet-related hazards. A study case is presented where several inlet types are analysed in order to quantify the IHA_{min}. The inlets of the Ria Formosa, a natural park located in southern Portugal (Fig. 1) are analysed in order to obtain the IHA_{min}. It is considered that the Ria Formosa represents an ideal location for testing the parameter because it consists of different types of inlets within a relatively short stretch of shoreline.

2. Inlet hazard determination

Inlet hazards are related to existing inlets but also include areas of continuous overwash that can be the site of barrier breaching (ephemeral or permanent). In terms of present inlets the associated risks are mainly related with inlet width variation, inlet migration and associated frequently overwashed areas. Overwash events leading to barrier breaching are more likely to occur where the barriers are narrow and low in elevation. This occurs in sediment-starved areas that can be related to the presence of an inlet. Additionally, special attention should be given to those areas where barrier breaching, leading to permanent historical inlets or to ephemeral inlets, has occurred.

Inlet hazards correspond to erosion, flooding or barrier breaching that occur in a given area because of the presence of an adjacent inlet. Moreover, a risk of barrier breaching and subsequent inlet formation (ephemeral or permanent) is also considered an inlet hazard. Therefore, in order to quantify the IHA in a given barrier island system the following factors should be taken into account: (a) inlet stability, which includes present inlets location, maximum inlet width (MIW) and inlet migration patterns and (b) frequently overwashed areas where barrier breaching could occur.

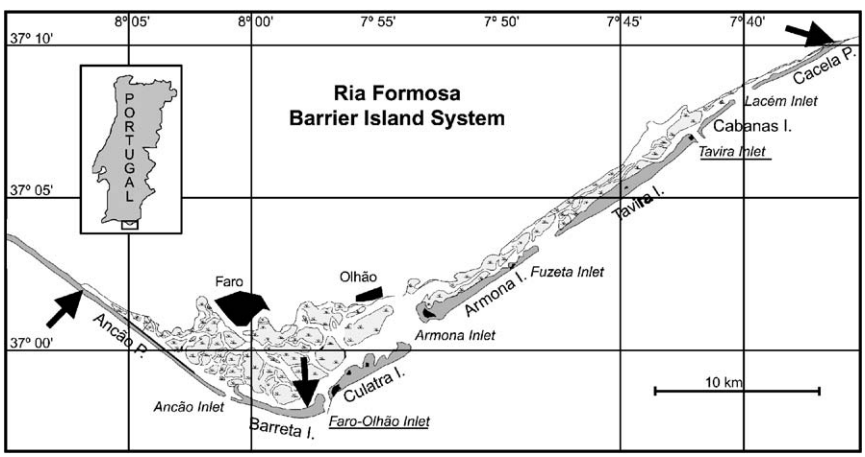

Fig. 1. Map showing the Ria Formosa barrier island system and its location inside Portugal. The names of the stabilised inlets are underlined. The arrows represent historical locations of inlets that are presently closed.