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Opportunities and constraints for managed retreat on exposed sandy shores: Examples from Emilia-Romagna, Italy

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ABSTRACT

Managed retreat is rarely implemented on exposed sandy coasts because of public interest in beach recreation and the great human-use value of existing beaches and dunes. The feasibility of retreat on the sandy coast of the Adriatic Sea in the Region of Emilia-Romagna was evaluated at a site with a single user facility (a beach concession) backed by public parkland. A conceptual scenario of changes to landforms and habitats was developed for the retreat option. Interviews with key stakeholders revealed perceptions of alternatives for addressing erosion and flooding by managed retreat or by protecting existing features in place.

The beach concession occupies a segment of shore between an eroding (-9.3 m yr^{-1}) washover barrier updrift and an accreting beach downdrift. Landward of the concession is a portion of the Po Delta Park, consisting of a brackish lagoon and marsh and an artificially-created freshwater lake. Shore protection projects have maintained the concession and the integrity of a dike protecting the lake. Allowing retreat to occur would cause (1) loss of the concession in its present location; (2) erosion of the dike, converting the lake to brackish habitat; and (3) migration of the shoreline to a pine forest, campground and residences that are now 500 m from the shoreline. Freshwater and pine forest habitat would be lost, but salt water wetland and pioneer coastal species would be restored. The beach and campground could still be used as the shoreline migrates inland, but with less fixed infrastructure. Landward facilities could be protected by a ring dike.

At issue is whether normally dynamic and short-term landforms and habitats should be protected as static features in perpetuity and whether human actions should be taken to protect human-created nature (lake, pine forest) against natural evolutionary processes. Stakeholders indicated that managed retreat should occur eventually but existing features should be protected now. The retreat option is compatible with Regional ICZM plans, but differs from the standard engineering designs actually suggested for implementation. The benefits of managed retreat on exposed sandy shores can only be presented in conceptual terms until demonstration projects provide concrete answers, so it is not surprising that the undocumented benefits of a more dynamic shoreline have little appeal relative to maintaining the status quo.

1. Introduction

Studies of human adaptation to climate change and sea level rise have proliferated with the growing awareness of the potential increased impact of damaging storms, the accompanying coastal erosion and inundation, and the increased levels of risk and economic cost that many coastal communities and ecosystems will face in the future (Abel et al., 2011; Roca and Villares, 2012; Niven and Bardsley, 2013). Greater attention is now being paid to the advantages of retreating from the coast as an adaptation strategy, rather than implementing defenses to resist shoreline change in situ (Morris, 2012; Berry et al., 2013), but implementation of actual adaptation responses by managers is limited, despite the increase in planning options (Niven and Bardsley, 2013). As a result, actions to retreat from the coast can be opportunistic (reactive) rather than proactive (Ledoux et al., 2005). Managed realignment schemes have

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been implemented on low energy coasts, where salt marshes are the dominant natural environment (French, 2006; Garbutt et al., 2006; Rupp-Armstrong and Nicholls, 2007), but examples are lacking on more exposed coasts fronted by beaches, where public interest in beach recreation is great and the land has greater human-use value. Stakeholder resistance can be great, even on low-energy coasts, because information about costs and benefits of managed retreat is lacking (Myatt et al., 2003a). Uncertainty about how climate-related changes will affect the coastal landscape and its use can lead to inaction, but providing scenarios can make future changes more meaningful (Lorenzoni and Hulme, 2009). The lack of examples of stakeholder gains and losses when converting stabilized exposed shores to dynamic beaches and dunes is likely to impede acceptance of the retreat alternative on exposed coasts. In the absence of after-action assessments of actual retreat, decisions may have to be made on feasibility assessments (e.g. Nordstrom and Jackson, 2013). Determining the potential for accommodating natural processes by allowing the shoreline to retreat involves (1) identifying the rationale for managed retreat; (2) using demonstration sites to document the feasibility of accommodating retreat; (3) identifying the kinds of geomorphic and ecological changes that will occur; and (4) identifying the advantages of allowing those changes to occur.

Primary disadvantages of retreat are that the loss of private properties and income from commercial establishments and the need to eliminate or relocate existing infrastructure may be expensive, and the social costs may be considered unacceptable to stakeholders (Niven and Bardsley, 2013). The retreat option should be most feasible where there are few structures or stakeholders directly affected and the costs of compensating owners are minimized (Rupp-Armstrong and Nicholls, 2007). This study was conducted to assess the potential for exercising the retreat option at an open-coast (sandy-beach) site which seems well suited. The site (Fig. 1) is on the coast of the Adriatic Sea at Lido di Spina, Province of Ferrara in the Region of Emilia-Romagna. The site is backed by parkland in the Po Delta Park. A single user facility exists at the beach. Our procedure includes identifying (1) the existing management context and key stakeholders; (2) the shore processes and beach/dune characteristics; (3) the physical changes to landforms and habitats that are expected to occur if artificial shore protection methods cease; (4) the advantages and limitations of allowing these changes to occur; and (5) the reasons why implementing the retreat option is difficult, even where conditions would appear suitable.

2. Methods

Existing reports and data sets prepared by the regional government were used to identify key processes responsible for coastal change and future plans for shore protection projects (synthesized in Preti et al., 2009). A topographic chart dated 1893-94 and air photos taken in 1943 and 2008 were used to determine shoreline changes in the past. Topographic profiles contracted by the regional authority in 2006 and 2012 were used to determine recent rates of change and present characteristics of beaches and dunes. Aerial images from Google Earth were used to identify and measure distances from the shoreline and beach/dune contact to human infrastructure. These distances and rates of shoreline change from the profiles were used to estimate when infrastructure would become subject to erosion. Elevations of key features landward of the topographic profiles were determined from LiDAR data taken in 2004 and 2012. The potential for future changes was discussed with key stakeholders in interviews conducted as part of the Risc-kit European Project (Van Dongeren et al., 2014) for the Porto Garibaldi-Reno River area. Interviews were conducted as open ended discussions about several key questions centered on coastal risk induced by extreme storm events. The retreat option for the Spina area was mentioned as a possible future alternative. Eight stakeholders were interviewed as representative of public and private sectors. One person each was interviewed in the Regional Land and Coast Protection Service, the Regional Technical River Basin Service, the National Forestry Commission, the Po Delta Park, and the Association of Local Entrepreneurs. Private interests were represented by a local fisherman and two beach concessionaires, including the manager holding the concession for the key beach facility.

3. Study area

3.1. The regional setting

The Emilia-Romagna coast is low-lying and fronted by sandy beaches. Wave energies are normally low, but storms from the south and southeast (Scirocco) and northeast result in high waves and storm-surge levels. The highest storm-surge levels are associated with Scirocco winds, and surge anomalies of up to 0.6 m with a 1 in 2 yr return period can occur (Masina and Ciavola, 2011). Strong northeast winds occasionally follow when the surge levels are still high, like the event that occurred on 24 September 2004, which

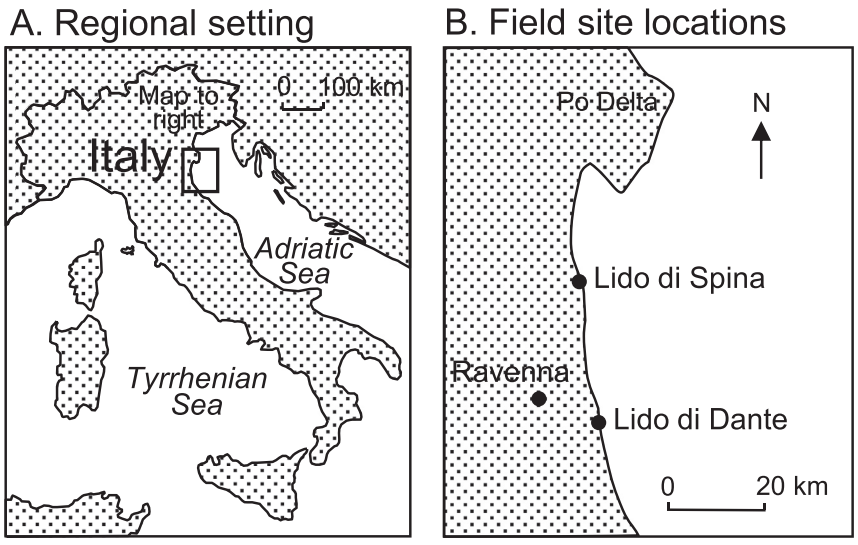

Fig. 1. Study area.