



Upstream public engagement on coastal issues: Audience response to a science-based exhibition



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ABSTRACT

Public understanding of coastal dynamics and evolution is of vital importance in supporting the implementation of sustainable coastal management. However, successfully delivering scientific information to the general public is a challenging task. Here we describe “The Beaches of Cascais: past and present” science-based exhibition, aimed at upstream public engagement on coastal issues. Results from two surveys, conducted before and after the exhibition, provide valuable insights on the effectiveness of these types of initiatives as successful outreach platforms to raise public understanding about coastal evolution.

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1. Introduction

1.1. Public engagement on coastal sustainability

The coastal zone corresponds to the interface where land meets the ocean, offering a wide variety of valuable habitats and ecosystem services. The sustainable management of the coast poses great challenges, as it is one of the most dynamic and vulnerable Earth's environments (e.g., Agardy et al., 2005). Sea level rise and increasing human demand represent additional challenges to coastal management, further threatening coastal sustainability (Hinkel et al., 2015).

Achieving sustainability depends on the integration of scientific knowledge in the development of management strategies (Cvitanovic et al., 2015; Nursey-Bray et al., 2014; UNESCO, 2000). Scientists should be aware that scientific knowledge should not only reach policy-makers and managers, who are responsible for the definition and implementation of coastal policies, but also society in general, because the effectiveness of coastal measures very often depends on the interaction between society, and political leaderships and institutions (Carapuço and Taborda, 2015). The

growing influence of society in the definition of strategic coastal development must be recognized, and the research community should acknowledge this paradigm. In this sense, and in addition to build-up coastal science, scientists should upstream public engagement on coastal issues. Engagement is related with intentional interactions that provide opportunities of development of closer links with the public (Leshner, 2003), and is ground on empathy (Lorenzoni et al., 2007). Upstream public engagement implies to provide and foster bases for increasing democratic public involvement in coastal sciences by promoting awareness (Kurath and Gisler, 2009). Upstream public engagement requires scientists to be creative in the mix of formal and informal methods that are used to democratize science and infuse it with new forms of transferring scientific knowledge to the public (Wilsdon and Willis, 2004), no matter how challenging this task may be from a scientists' perspective.

Here, we describe a science-based exhibition focused on beach evolution aiming to raise public understanding on coastal issues - “The Beaches of Cascais: past and present” exhibition. The objective was to identify the main challenges found in communicating coastal dynamics and evolution concepts to society.

1.2. Challenges in reaching the public

Public understanding of coastal dynamics is fundamental in assuring that development is sustainable, i.e., it meets present

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needs without compromising the ability of future generations to meet their own needs (WCED, 1987). However, scientists face a number of challenges when trying to reach the general public. These challenges essentially gravitate around making communication effective, and are critical to foster science integration in the policy and management frameworks for the coast.

1.2.1. Communicating science

Communicating science implies rigorous reporting and, simultaneously, expressing scientific knowledge in a language and format comprehensible to non-scientific audiences. Moreover, it is often necessary to inspire and promote the receptivity of the public, who may not be tuned into science. Scientists must also consider the specificities of the audience regarding their background and predisposition to scientific information (Bubela et al., 2009).

Challenges in reaching the public can be overcome by fostering engagement and by using an adequate framing. Engagement fosters the acceptance and longevity of science-based policies, targeting coastal sustainability (Hines, 2010). Framing involves translating scientific outputs into a language that is understandable and can be easily followed by non-technical audiences. In this sense, framing is vital to turn scientific data into meaningful information for the target audience. Framing requires adopting proper channels of communication, i.e., the manner in which the message is delivered (Bubela et al., 2009). Channels of communication (e.g., books, exhibitions and websites) can be used individually or combined in order to support narratives and storytelling, and easily capture the audience's attention. They are designed to make the message more appealing and to achieve increased comprehension (Dahlstrom, 2014; Estrada and Davis, 2015).

1.2.2. Dealing with public perception

When addressing the dynamics of beach systems, science communication faces additional challenges. For many people, beaches are places of memories built during childhood and emotional memories play an important role in the public response in later stages of life (Zadra and Clore, 2011). The true dimension of the beach of our infancy is very often different from what we perceived it to be. In one's early stage of existence, objects that we found gigantic back then, were in fact considerably smaller (Banakou et al., 2013). This illusion is due to the size of the physical world being perceived in relation to the size of the perceiver's body (Linkenauger et al., 2010). For example, as a person grows and gets taller, fewer steps and less effort are required to cover a certain distance (van der Hoort et al., 2011). The sense of our own body affects how we visually experience the world and plays an important role in perceiving our surroundings and their dimensions. Traditionally, our infancy memories recall us of larger and wider beaches. This leads to a sense of feeling that beaches are usually getting smaller as we grow.

Furthermore, to this size-illusion effect adds the human tendency to generalize and overvalue negative things (Baumeister et al., 2001) and the notion that "it was better in the good old days". Media can also magnify this negative bias, as it often emphasizes bad news (e.g., beach erosion *versus* beach accretion). Research and its outputs are also generally focused on erosional behavior as it dominates the evolutionary trend of coastlines worldwide and because retreating coastlines are more prone to risk (e.g., Pilkey, 2008).

Society perception of coastal evolution is built upon all the aforementioned biases, so it is natural that there is a generalized assumption that all beaches are eroding – even if they are not. In fact, coastline evolution depends on many factors, including the oceanographic and geomorphological settings, sediment budget and human intervention. Therefore, and contrary to what is often

deeply rooted in public perception, many coastal stretches are, in fact, (meta)stable or under accretion.

2. A science-based exhibition as a platform for public engagement

In this study we describe and evaluate the performance of an outdoor science-based exhibition. This exhibition was selected as an outreach platform and designed to trigger public's attention and foster engagement on coastal issues. The exhibition focused on the evolution of the beaches of Cascais (Portugal) that have been mostly stable in the last decades and, in some cases, increased in area. Photographs taken from the early to mid-20th century and recent ones were used to exhibit coastal evolution, aiming to shift the public generalized perception that all beaches are eroding.

2.1. Study area

Cascais is a cosmopolitan and highly touristic area located in the west coast of Portugal (Fig. 1). Since the mid-19th century the beaches along the Cascais coastline, the so-called Portuguese Sunshine Coast ("*Costa do Sol*"), have been very popular amongst those who live in Cascais and Lisbon areas, and also from tourists all over the world. Today, most of Cascais' eighteen beaches still preserve much of their original charm, and remain one of the icons of this municipality.

Beaches of Cascais correspond mainly to small pocket sand beaches. These beaches are usually limited landward by low cliffs or manmade structures, aiming to protect sea front property or infrastructures (e.g., roads) and are used for recreation purposes (e.g., seaside promenade). Cascais coastline can be divided in two littoral segments with different orientation and contrasting wave exposure: a western segment, more exposed to the prevailing northwest waves generated in the Northeast Atlantic Ocean, where the beaches of Abano, Guincho, Água Doce and Cresmina are included; and a southern segment, sheltered from the prevailing wave regime, and thus experiencing a milder wave climate, encompassing the beaches from Santa Marta to Carcavelos (Fig. 1).

Analysis of aerial photographs, maps and historical postcards dated from the early 20th century to the present allowed deducing the past evolution of Cascais' beaches. In the vast majority of these beaches it was possible to identify changes in the position of the shoreline, herein taken as the high water swash line according to the criteria proposed by Boak and Turner (2005), related to seasonal to interannual variations in oceanographic forcing, but excluding any noticeable long-term trend. Beach areas updrift of groins are exception to this, and Moitas, Tamariz and Avencas beaches have experienced accretion following the constructing of groins and localized beach nourishment (Hamm et al., 2002). Accretion in relation to groin construction lasted until the saturation of their retention potential (Carapuço et al., 2012). The long-term stability of Cascais beaches is out of phase with many other Portuguese sandy coastal stretches, which show significant erosion from the early 20th century onwards (Lira et al., 2016). This makes Cascais beaches an ideal case study to evaluate the effectiveness of outreach initiatives aiming to raise public understanding on coastal issues and coastal change in particular. Notwithstanding present beach stability, and as a word of caution, it must be noted that the behavior of Cascais beaches throughout the last 100 years should not be straightforwardly used to forecast their evolution into the near future. There is an increasing consensus that an accelerating sea-level rise (SLR) scenario due to global warming will have significant impacts on the coastal zone (Church et al., 2013). For example, the work of Taborda and Ribeiro (2015) suggest that, in relation to acceleration of SLR, a reduction in the area of all Cascais

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