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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.

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 evolutional 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

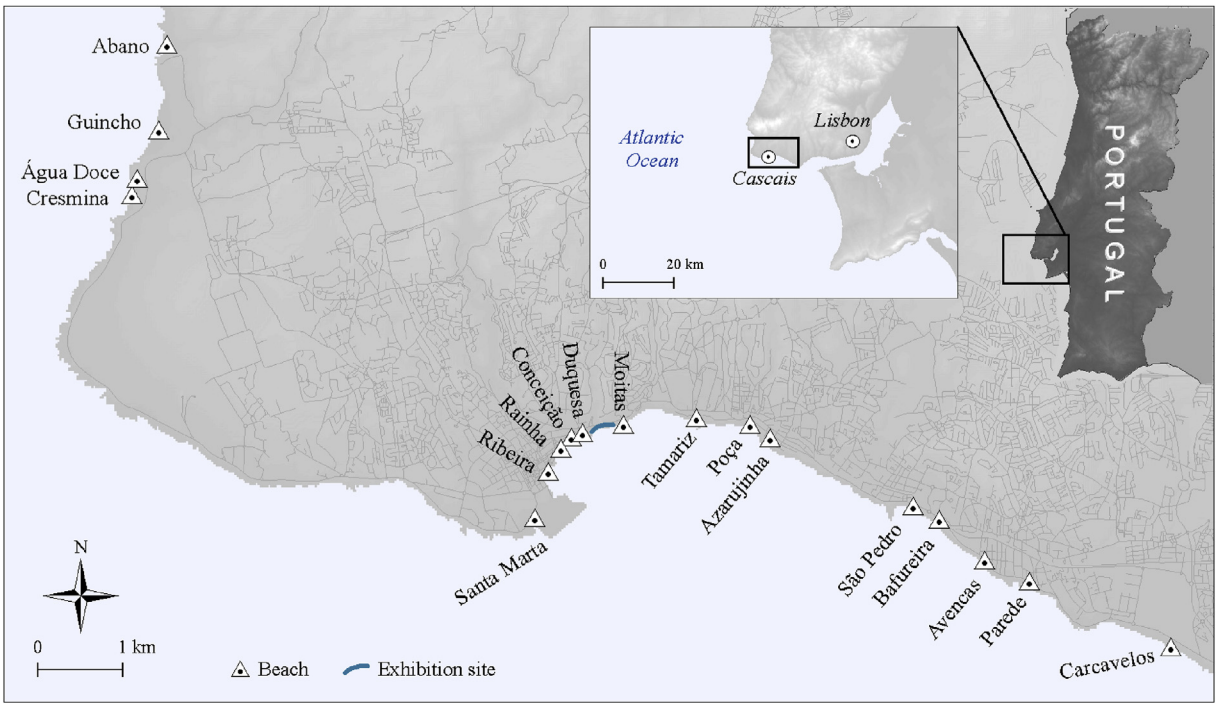

Fig. 1. Location of Cascais' beaches (Portugal).

beaches is expectable.

2.2. "The Beaches of Cascais: past and present" exhibition

The exhibition "The Beaches of Cascais: past and present" focused on the changes of the beaches along the Cascais coastline (Fig. 2). The concept of the exhibition was thought to maximize public engagement. This objective was accomplished by adopting the following strategies to frame the message:

Location: the exhibition took place outdoors, in an attractive and pleasant seaside promenade where hundreds of people walk every day. This setting allowed reaching a wider audience and communicating in "their own ground".

Storytelling: the narrative was mainly based upon the comparison of present-day photographs with the ones from the early to mid-20th century. Supporting the narrative format on photographs allowed the audience, with different backgrounds, to "find the answer on their own". Not suggesting the "correct answer" or imposing a solution makes easier for people to accept it and to retain their own findings.

Design: large panels with appealing design, supported by large-format printed photographs triggered public attention.

The exhibition was set up along the seaside promenade that starts at Cascais village and consisted of thirty large prints (2×1m). Each of twenty-eight prints showed the same beach as captured by old and recent photographs, with the images displayed side-by-side. One print displayed a map with the name and location of the beaches, and another one contained a brief description of beach dynamics.

Old photographs were entirely retrieved from the Cascais' Historical Municipal Archive ("*Arquivo Histórico Municipal de Cascais*") because of authorship-related issues. Two photographs from each beach were selected, based on the oldest age and the largest beach coverage, ensuring the needed print quality. For Guincho, Azarujinha, Bafureira and Carcavelos only one photograph was selected because it was the only fulfilling the aforementioned requisites. There were no available old photographic records for Água Doce and Moitas beaches.

The present-day photographs were taken by a professional photographer working for the Municipality of Cascais (on the 21st and 22nd of May 2015). Photographs were acquired during a field survey, led by the authors of this work and aiming to reproduce, as closely as possible, the broad image captured in the older records. The photographs were taken at a similar stage of the tide and from the same point of view of older pictures, except where the original location was no longer accessible, either because of cliff retreat or coastal development.

Photographs displayed in the panels were complemented by short bilingual texts (Portuguese and English) describing the geomorphological and geographical setting of each beach, as well as noticeable architectural and social features. Texts avoided references to evolutionary trends allowing for the audience to infer their own conclusions about the beach system behavior.

The panels were installed on the 4th of June 2015, and the opening of the exhibition took place the next day. The exhibition remained available to residents and those visiting Cascais coast and beaches until the end of September 2015.

"The Beaches of Cascais: past and present" allowed for visitors to: i) interpret coastal change, and eventually challenge the general assumption that all beaches are eroding; ii) understand that beaches experience seasonal to interannual reversible changes that should not be assumed as long-term evolution terms. Assessing to what extent the generalized opinion shifted from "erosion" to "stability" was used as an indicator of successful receptivity and assimilation of information conveyed by the exhibition to the public.

3. Methods

3.1. Drifting from assumptions to understanding

Two surveys were conducted in order to assess public

Fig. 2. Images illustrating the exhibition "The Beaches of Cascais: past and present".

understanding about the evolution of Cascais' beaches. The first survey took place just before the exhibition, and the second survey after people watched the exhibition. Surveys were conducted anonymously and were based upon short and simple questionnaires in Portuguese and English. Conduction a survey prior to the exposition had the purpose of assessing public perception on beach evolution without any preconceived opinion on beaches size and amount of sand stored in the beaches.

A total of 682 answers were obtained (n = 341 in the first and second surveys). Questionnaires and responses are available for download at http://beachphotomonitoring.campus.ciencias.ulisboa.pt/exhibition.html.

3.2. Evaluating of the impact of the exhibition

The first survey took place between May 12th and June 3rd, 2015 (Table 1). A five-question questionnaire was made available online at the website of the Municipal Council of Cascais ("*Câmara Municipal de Cascais*"), and was also publicized through the websites of the Faculty of Sciences of the University of Lisbon ("*Faculdade de Ciências da Universidade de Lisboa*"), the Portuguese Environmental Agency ("*Agência Portuguesa do Ambiente*"), and internet social media.

The first two questions were related with the participants' characteristics: their age and if they were living or visiting Cascais. Two questions followed aiming to assess the public's familiarity with the coast of Cascais: participants were requested to indicate their favorite beach and how many beaches exist in the Cascais municipality. The last question was a closed-format and multiple-choice question about the perception on the evolution of the beaches of Cascais: increasing, stable or decreasing.

The second survey took place during the exhibition, between June 22nd and August 13th, 2015 (Table 1). This survey consisted of face-to-face interviews carried out at the exhibition site, targeting people that were observing the panels. A team of volunteers, *Marézinhas*, clearly identified as working for the Municipal Council of Cascais ("*Câmara Municipal de Cascais*"), conducted the interviews.

In this survey the level of detail of questions targeting the perception on the state of the beaches was increased. This change was supported by the fact that the participants were *in situ*, and watching photographs of the target beaches. Because beach

Table 1
Information related with the surveys conducted in the scope of the "The Beaches of Cascais: past and present" exhibition.

Survey	When	How	Questions
First [before the exhibition]	May 12th to June 3rd, 2015	Online questionnaire	1. Do you live in Cascais? yes; no 2. *Age:* less then 18; 18–30; 31–50; more than 50 3. Which is your favorite beach in Cascais? 4. How many beaches are there in Cascais? 5. In your opinion, the beaches of Cascais are: - increasing (beaches have been gaining sand)? - stable (beaches have the same size and the same amount of sand as before)? - decreasing (beaches have been losing sand)?
Second [after people watched the exhibition]	June 22nd to August 13th, 2015	Face-to-face interviews	1. Do you live in Cascais? yes; no 2. *Age:* less then 18; 18–30; 31–50; more than 50 3. *In your opinion, the beaches of Cascais are:*- all increasing (all beaches have been gaining sand)? - the majority is increasing (most of the beaches have been gaining sand)? - stable (beaches have the same size and the same amount of sand as before)? - the majority is decreasing (most of the beaches have been losing sand)? - are all decreasing (all beaches have been losing sand)? 4. In your opinion, the use of old and actual photographs to illustrate beach evolution is: an adequate option; neutral option; an inadequate option. Why? 5. What other type of information about the Cascais beaches would you like to have access to?

behavior was heterogeneous, this made the three response options made available in the first phase somewhat limitative. Thus, five options of response for the same question were made available in the second survey (see Table 1). Two other items were added in the second questionnaires. Participants were asked if the use of old and present-day photographs was an adequate framing option to illustrate beach evolution, and why. Participants were also requested to express their opinion concerning other type of information on the Cascais beaches that they would like to have access to. Both latter questions created the opportunity for participants to express their opinion and share ideas.

Results of the surveys were compiled in electronic format and organized for data analysis. Data management and processing was done using IBM® SPSS® Statistics and ESRI® ArcGIS applications.

4. Results

4.1. Before the exhibition: Appraising assumptions

Regarding the first survey 68% participants lived in Cascais and 32% were visitors. The majority (49.6%) were 31–50 years old followed by those older than 50 (25.5%); 23.5% of the participants were between 18 and 30 years old, and only 1.5% were under 18. Guincho was voted the favorite beach of Cascais, followed by Carcavelos (Fig. 3). These beaches are the widest of Cascais municipality and are very popular for surf and other water-related sports. Less favorite beaches, Água Doce and Santa Marta, correspond to very small beaches, only reachable during low tide.

About 36% of the respondents answered that the number of beaches in Cascais ranges from 15 to 20, followed by 35% that responded 10 to 15 beaches. As the Cascais coastline encompasses 18 beaches, these results show that the majority of the audience had a fair perception about the beaches.

Concerning beach evolution, the majority of the audience (57.8%) believed that the beaches in this municipality were decreasing (meaning that beaches have been losing sand); 38.7% answered that Cascais' beaches were stable, and only a small percentage (3.5%) answered that beaches were increasing (Fig. 4).

Results presented in Fig. 4 are in agreement with the general perception of technical staff of the Municipality of Cascais. In turn, this perception was grounded in the opinion of locals who often mention and sometimes complain to authorities that the beaches of Cascais are getting smaller. Furthermore, these results are also in line with empirical observations of the authors of this work, which have been conducting fieldwork activities in the beaches of Cascais since 2010, and are often (mistakenly) alerted by beach users that beaches are under erosion, and that counterbalancing action is required.

4.2. After the exhibition: assessing understanding

In the second survey 60.4% of the participants were living in Cascais and 39.6% visitors. Almost half of the participants were over 50 years old (49.3%), and 21.4% were between 31 and 50 years old. About 15.2% of the responders were under 18 years, and 14.1% between 18 and 30 years.

After watching "The Beaches of Cascais: past and present" exhibition, the opinion of the audience concerning the evolution of the beaches of Cascais was as follows: 36.1% answered that the beaches were increasing (all increasing - 15%; and majority increasing - 21.1%); 34.9% responded that beaches were stable; and 29% that beaches were decreasing (all decreasing - 5.3% and majority decreasing - 23.8%). This opinion is shared by those living and visiting Cascais and amongst respondents with different ages.

The use of old and present-day photographs to illustrate beach evolution was considered adequate by a large majority (93.3%) of the participants, with only 2.6% considering this media inadequate. "*Allowing observing beach evolution*", "*Beautiful and useful*", and "*It presents additional information related with other issues (historical, architectural)*" are examples of comments on this issue, indicating that photographs performed well as a language supporting the narrative.

The majority of the responders also commented that the information portrayed by the exhibition was adequate and support the idea that the goal of the exhibition was attained. Nevertheless, some people made comments, which fall outside the scope of the exhibition, mentioning that they would like to have easier access to information on quality issues (water and sand quality parameters) and to the history of the beaches of Cascais (heritage, architecture). Nonetheless, these too were found useful in the communication process between managers, scientists and public, also providing useful feedback to authorities.

The fact that the population sampled in the two surveys was different, preclude a straightforward interpretation of the before and after the exhibition survey results. However, results were so unexpectedly dissimilar that their comparison is presented (Fig. 5).

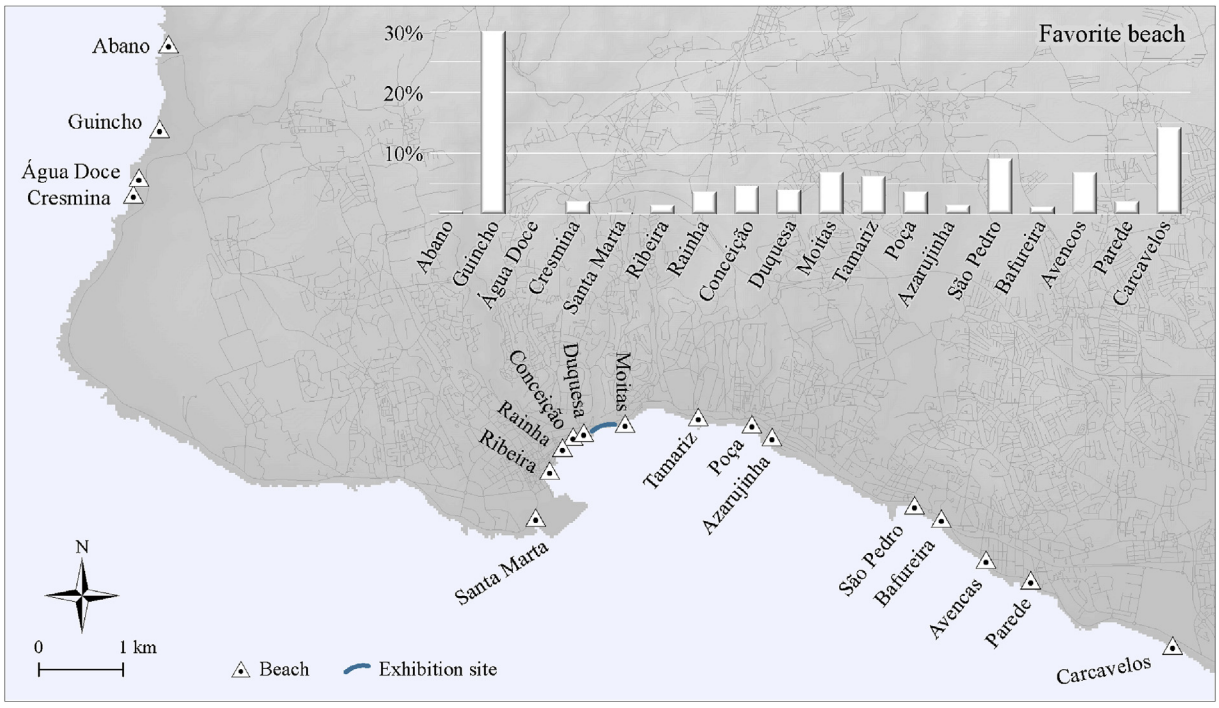

Fig. 3. Favorite Cascais beach according to the results of the survey.

In fact, there is a noticeable difference in public opinion regarding perception of trends in beach change: people enquired before the exhibition believed that beaches are decreasing (57.8%), while most people that watch the exhibition considered that beaches are stable or increasing (34.9% and 36.1%, respectively). Taking the opinion of the first surveyed audience as representative of the general public's opinion, the difference detected could also suggest effective and successful transfer of science-based information to the general public.

5. Conclusions and outlook

Communicating beach dynamics to the public is a difficult task. Challenges arise, not only in relation with the need to capture and to maintain the public's attention to scientific issues, but also in dealing with people's assumptions. “The Beaches of Cascais: past and present” exhibition was designed to upstream public engagement on coastal issues and, in particular, beach changes. The exhibition concept considered location, storytelling and design as the three key-framing strategies in overcoming the challenges faced by communicating science to the public. Results indicate that the “The Beaches of Cascais: past and present” exhibition was an

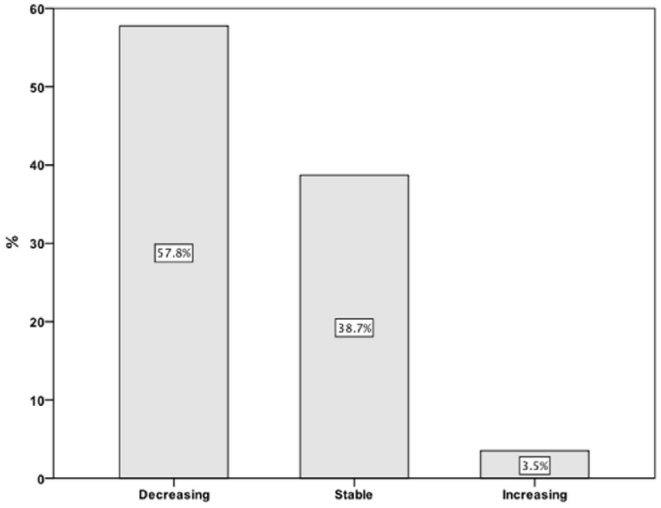

Fig. 4. People's opinion concerning the evolution of the beaches of Cascais before the exhibition.

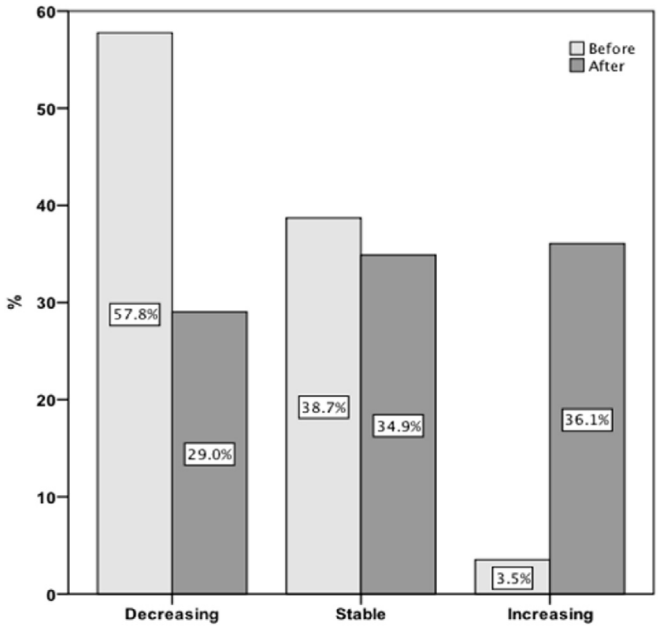

Fig. 5. People's opinion concerning the evolution of the beaches of Cascais before and after the exhibition.

effective way to communicate with the general public and that this exhibition was a valuable outreach initiative as it contributed to raise public understanding about the coastal system. Furthermore, this initiative provided valuable insights into possible forms to communicate to the general public more complex issues hampered by uncertainty, such as the impacts of climate change-driven rise in sea level and how best to engage them. In our opinion, outcomes of the "The Beaches of Cascais: past and present" exhibition emphasize that science outreach efforts can be highly valuable in fostering public engagement and in developing a knowledge-based society.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ocecoaman.2017.04.008.

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