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How a coastal community looks at coastal hazards and risks in a vulnerable barrier island system (Faro Beach, southern Portugal)

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ABSTRACT

Faro Beach is a vulnerable and heavily urbanized settlement in the Ria Formosa barrier island system, exposed to beach erosion, overwash and other hazards that have resulted in house and road destruction. Residents have accepted the risks in exchange for the benefits of living at the beach. Previous qualitative studies have suggested that residents' risk perception is low and incongruent with the real risk to which they are exposed to. In this study we aimed to evaluate residents' awareness and risk perception, as well as determinants and outcomes of risk perception, using a quantitative approach based on the psychometric paradigm.

Results show that Faro Beach residents possess significant knowledge on coastal hazards and awareness of risks that derive mainly from life experience. Other sources of information (environmental education campaigns, public discussions and formal education) are mostly irrelevant for residents. Their risk perception is relatively high, but they believe hazards are not that dangerous and are distant in time; consequently, their preparedness towards risks is low. Residents' risk perception is related to their length of residence at the beach (mostly > 10 years), their "positive" past experience with hazards, that never resulted in fatalities, and their psychological distance in relation to threats, all of which may hamper residents' preparedness in case of disaster. Other behavioural barriers, such as mistrust in authorities, externalisation of responsibility, optimism bias, or low self-efficacy, may also hinder their preparation efforts. Authorities' efforts to give more information and education to coastal populations in order to increase risk perceptions or decrease psychological distance may have the opposite effect, given that individuals use a variety of strategies to psychologically cope with threats and thus maintain their psychological well-being. A thorough knowledge of the psychological determinants and responses to coastal risks is thus highly relevant in the context of coastal management.

1. Introduction

Coastal ecosystems are among the most productive systems in the world, but also among the most threatened by growing human population, exploitation pressure (e.g., Agardy et al., 2005) and marine hazards. Marine hazards have significant impacts in coastal areas, particularly low elevation coastal zones, defined as the contiguous area along the coast that is less than 10 m above sea level, where an estimated 10% of the world's population lives (McGranahan et al., 2007). These regions are extremely vulnerable to damage from wave forcing and flooding, aggravated by climate-related sea level rise and other human-induced changes (Nicholls and Cazenave, 2010).

Barrier island systems, which constitute 6.5% of the world's open ocean shoreline (Stutz and Pilkey, 2001), are narrow, long low lying sedimentary deposits separated from the hinterland by a shallow bay or lagoon. Barrier islands are characterized by their sandy/gravel composition, low elevation and exposure to storms and inlet processes; thus, they are extremely vulnerable to erosion, overwash, flooding and breaching (Vila-Concejo et al., 2006). Barrier islands have been occupied by humans for thousands of years, with a degree of human utilisation ranging from negligible to extreme (Stutz and Pilkey, 2005). Due to the vulnerability of barrier islands, coastal human settlements can thus be severely impacted by several coastal hazards such as inundation and overwash, storm-induced erosion, long-term shoreline retreat, or even larger disasters such as tsunamis (Nicholls and Cazenave, 2010). Therefore, living at the coast is a high-risk choice (Kron, 2013; Neumann et al., 2015). Nevertheless, many coastal populations feel safe living in risky coastal areas, despite being relatively aware of the risks they face by living there (Costas et al., 2015; Luís et al., 2016; Martins et al., 2009).

Faro Beach, located at the Ria Formosa barrier island system (southern Portugal; Fig. 1), is one such example of a human settlement

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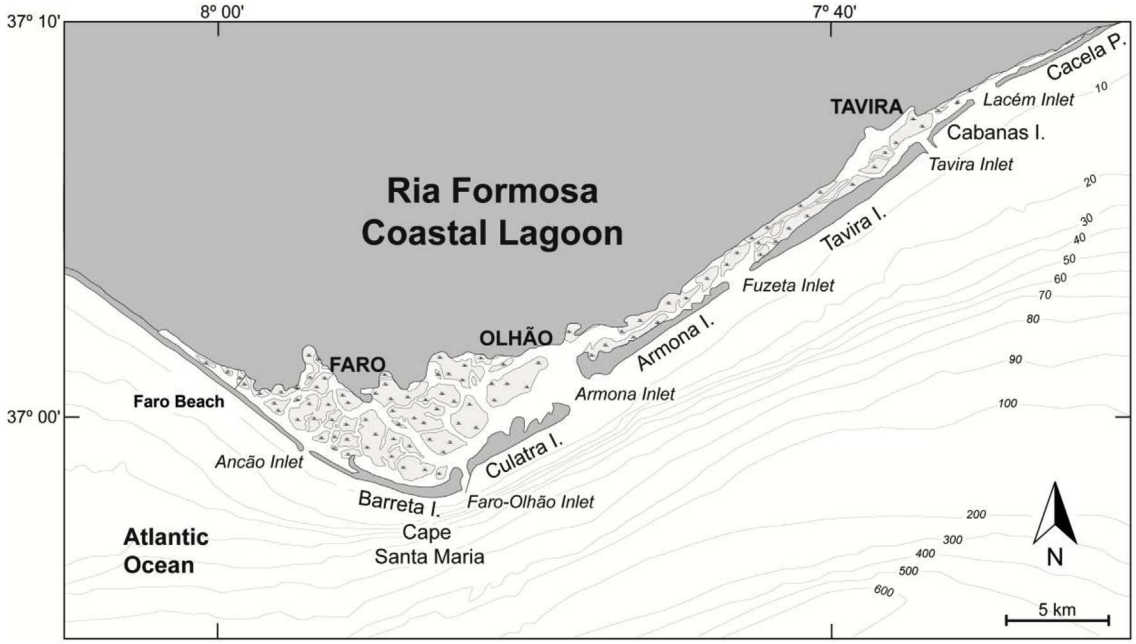

Fig. 1. Ria Formosa island barrier system and location of Faro Beach at Ancão Peninsula, westernmost part of the system (kindly provided by Dr. Ana Matias, CIMA-UAlg).

exposed to several coastal hazards, whose residents seem to be aware of the risks but feel safe there and show no intentions of moving to more protected areas (Costas et al., 2015; Domingues et al., 2017). The beach has a history of human occupation that extends over five decades, with a significant increase in the number of buildings and population observed since the 1980's. It currently includes a traditional fishermen community and some non-fishermen residents, in a total of 245 permanent residents; it also includes many second residences occupied mainly during summer by residents of the nearby city of Faro and tourists. Two distinct areas with contrasting characteristics can be found at Faro Beach. In the central area there is a 2 km strip of sandy barrier that has been removed from the maritime public domain in the 1950's and is managed only by Faro municipality. This strip includes 378 buildings, of which 57 are used as first residence and 16 are illegal (NEMUS, 2013). Houses in this area are generally larger and better built than the fishermen's houses, and some are 4 storeys high; most of these houses are second residences or tourists accommodations (Costas et al., 2015). Bordering the 2 km central strip, there are two fishermen settlements, located in the maritime public domain. This area is managed by governmental institutions and subjected to coastal management plans, namely POOC (Coastal Zone Spatial Plan) and POLIS Litoral (programme on integrated operations towards the renewal and enhancement of the coastal zone). According to these plans, several re-naturalization and re-qualification measures should be implemented in this area, such as beach nourishment, dune recovery and the demolition of all buildings, either first or second residences. Before 2015, approximately 232 “illegal” houses, of which 102 were first residences, existed in the maritime public domain area (RioPlano/A.T93, 2011); these houses were smaller and poorer in quality in relation to buildings in the central 2 km strip (Costas et al., 2015). Currently, all second residences and some first residences have already been demolished by authorities, and the plan is to demolish all houses, after appropriate housing elsewhere is given to residents. The main rationale behind these measures, particularly demolitions, is to prevent ecological and socio-economical risks associated with coastal erosion and wave-driven flooding.

Since its inception, the Faro Beach community (and other settlements in the Ria Formosa system) has always been threaten by coastal hazards, particularly storms, that have already resulted in inlet opening, destruction of sandy barriers and damages to houses and roads. Historical records demonstrate the occurrence of four severe storms in the first half of the XIX century that sank fishing boats, ripped roofs and uprooted trees, destroyed fishermen's huts and caused the collapse of stone walls (Garnier et al., 2018). A relatively calm period followed, free of high intensity storm events, until a violent cyclone hit the Iberian Peninsula in February 1941, causing significant damages in the whole Ria Formosa system and in nearby villages and towns. For instance, eucalyptus and pine trees were uprooted and thrown to the ground, zinc plate roofs were lifted, some houses, street lamps, telegraph and electric poles in the city of Faro were destroyed, many fishing boats and fishing equipment were lost, and fishermen's houses and huts disappeared; geomorphological changes were significant, with the water level covering a large part of the islands, causing the destruction of an entire village and the opening of a new inlet (Garnier et al., 2018). The last major storm that hit the Ria Formosa and resulted in house destruction in Faro Beach was in the winter 2010, associated with the passage of the extratropical cyclone Xynthia, but every winter strong winds and overwash result in erosion and some material damages. In addition, Faro Beach is located in an area of high seismicity, thus highly vulnerable to tsunami entrance, even for tsunami heights of just 3 m (Nunes et al., 2009). In fact, the entire barrier system was most probably overwashed and disrupted by the so-called Lisbon tsunami of 1755 (Andrade, 1992).

Despite the material damages that Faro Beach has suffered throughout the years, no casualties were ever observed due to coastal hazards. In fact, most people living at Faro Beach have voluntarily accepted to live in a highly risky area in exchange for benefits that they perceive as largely exceeding potential personal damages (Costas et al., 2015). Previous studies have approached residents' risk awareness and risk perception, but these terms have often been used interchangeably, although they represent distinct psychological variables. Awareness refers to having information and knowing about hazards and associated risks (Gifford, 2014; Luís et al., 2016), but being aware of a hazard does not necessarily lead to concern or behavioural changes (Schuetz et al., 2011). Risk perception is an emotion-based variable, often driven by individual's feelings, such as fear and anxiety (Gifford, 2014). Risk perception is not rational, objective or analytical, but instead an intuitive and subjective judgment that individuals make regarding the characteristics and severity of a risk (Slovic, 1987). It is a mental construct (Sjöberg, 2000), mostly based on individual processes and