Ocean & Coastal Management 137 (2017) 82–95

Contents lists available at ScienceDirect

Ocean & Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Who cares about dirty beaches? Evaluating environmental awareness and action on coastal litter in Chile

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ARTICLE INFO

Article history:
Received 12 May 2016
Received in revised form
20 October 2016
Accepted 29 November 2016

Keywords:
Marine litter
Willingness to engage
Socio-economic factors
Pro-environmental behaviour
Waste management

ABSTRACT

Coastal litter is a source of environmental, economic and health-related problems in many parts of the world, but local responses are not necessarily related to the severity of the impacts. In particular, it is unclear how environmental perception of community members and government bodies relate to active engagement on coastal pollution. The present study analyses the coastal litter situation and evaluates the willingness of citizens to engage at four sites (three regions of mainland Chile, and Easter Island; henceforth Rapa Nui) that feature differences in culture, economy sectors and landscape characteristics. Data on coastal litter were obtained from citizen science campaigns and assessments of large litter accumulations on beaches and rocky shores. The willingness to engage was evaluated qualitatively, considering municipal planning documents and the perception of residents on coastal litter and general waste management. We found very large quantities of litter in northern Chile, posing a hazard to marine wildlife and human health, and moderate quantities in the other regions. The region with the most severe case of coastal pollution does not feature the highest engagement, possibly a result of underlying factors such as an unsustainable economy and few possibilities for the population to connect with the natural environment. On mainland Chile, municipal engagement is low to moderate while on Rapa Nui there exist integrated waste-management strategies that address coastal pollution. Inhabitants of Rapa Nui seem to have a better conduct in the coastal environment (picking up litter, littering less), and show more engagement in waste-reduction strategies (recycling, volunteering for beach clean-ups). We suggest that the unique cultural history of the island, a landscape that allows meaningful interaction with nature and an economy based on sustainable tourism and high international visibility facilitates engagement on environmental issues. We advise managers to consider respective underlying variables, to create environments that allow contact with nature (e.g. public access to parks), and to encourage bottom-up initiatives, preferably by local actors (e.g. by promoting already engaged individuals or organisations).

1. Introduction

Litter in marine and coastal environments is ubiquitous (Galgani et al., 2015) and does not only present a hazard to a wide range of marine wildlife (Derraik, 2002; Kühn et al., 2015), but also affects human populations by causing health impacts, for example by accumulation and rotting of coastal litter, the presence of sharp objects, and the incorporation of microplastics in marine food webs (via ingestion by small organisms, e.g. Cole et al., 2013). Economic damage occurs in the form of costly clean-up operations, lost revenue from tourism due to the low attractiveness of a littered coastline (Ballance et al., 2000; Schuhmann, 2011), and damage to harbour infrastructure, boats and aquaculture facilities (reviewed in Newman et al., 2015).

This wide range of problems should ensure adequate local

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http://dx.doi.org/10.1016/j.ocecoaman.2016.11.029
0964-5691/

responses, resulting in the removal of coastal litter, the establishment of adequate waste management and, ultimately, the prevention of litter in the first place. However, this is not necessarily the case: a prerequisite for active and effective engagement is recognition of the coastal litter problem (or any environmental issue in question), which in turn is influenced by environmental perception and the awareness of the local community and relevant authorities.

Factors influencing environmental awareness and potentially pro-environmental behaviour and engagement of individuals have been the subject of numerous studies. Following Kollmuss and Agyeman (2002), factors may be divided into internal and external: among the former, personal experience and contact with natural areas (especially during childhood), a disposition of educators (parents and teachers), and witnessing environmental pollution seem to be among the key predictors of environmental awareness (Chawla, 1998; Palmer et al., 1998). Miller (2005) argues that a 'disconnection from nature' (caused for example by living in urban environments that do not allow for meaningful interaction with nature) is a cause for the lack of interest in biodiversity conservation. Several socio-economic factors such as age, income, education, gender, and the place of residence (urban or rural) are also predictors of environmental awareness. The role of those, however, is not conclusive and probably case-specific (reviewed in Van Liere and Dunlap, 1980). These socio-economic factors have been identified by the few studies on littering behaviour in coastal environments, finding that female visitors, those with higher education and more personal wealth, as well as older people usually litter less (see Santos et al., 2005; Dias Filho et al., 2011; Slavin et al., 2012; Eastman et al., 2013). However, Gusmerotti et al. (2016) emphasise the role of young adults to address the marine litter problem and they identify environmental knowledge and social norms as shaping factors for pro-environmental behaviour.

External factors, such as the political system, the social and cultural background and the economic situation (Kollmuss and Agyeman, 2002) affect not only single individuals but at least a group of people or residents of a specific region. Social pressure, often exercised by connected communities rather than large anonymous residential areas, can also influence pro-environmental behaviour, as has been shown by Heinen (1995) in the context of waste management. Scenic characteristics of the environment (i.e. the type of surrounding landscape) may also shape the relation to nature: most participants who were shown visual clues of different landscapes preferred savanna-type locations and open woodlands over urban and desert environments, especially when asked whether they would like to live there (Balling and Falk, 1982; Hartmann and Apaolaza-Ibáñez, 2010).

Yet another factor to consider is the economic development of a given region. If wealth, usually measured in (per capita) gross domestic product (GDP), derives from large industrial operations with great environmental impact such as the mining industry (Dudka and Adriano, 1997; Mani and Wheeler, 1998), a transition to a more sustainable economic development, incorporating alternative measures of wealth like social justice and biological productivity (Barbier, 1987), is likely to be more cumbersome than for economies ultimately dependent on integrated and healthy ecosystems. Growing wealth is usually also associated with a higher per capita waste production (Hoornweg and Bhada-Tata, 2012), although this does not necessarily translate into higher coastal litter quantities because of more efficient and alternative disposal strategies (recycling, composting). Still, mismanaged plastic waste, constituting a large proportion of coastal litter, contributes significantly to ocean pollution in developing and developed countries (Jambeck et al., 2015).

In summary, factors shaping environmental awareness are manifold and while internal factors apply mostly to individuals, external factors are often uniform for a given region. In order to address the coastal litter problem properly, a variety of these factors should be assessed and considered for management strategies. In particular, it is unclear how environmental awareness translates into engagement on coastal litter and how the latter is related to the severity of the problem. In this paper we present an integrated approach that assesses the severity of the problem (coastal litter quantities) and the environmental awareness and perception of inhabitants (employing surveys on beach litter and recycling habits) and municipalities (assessing municipal planning documents) of four regions in Chile. We expect that a region with (i) a sustainable main economy sector, (ii) an 'attractive' landscape that will enable individuals to have meaningful interactions with nature, (iii) a cultural history, anchoring residents to their birthplace, and (iv) outside pressure (for example in the shape of international tourism) will feature the highest environmental awareness and willingness to engage in managing coastal litter pollution.

2. Material and methods

2.1. Study sites

Chile is a country with a coastline of more than 4000 km and, apart from the capital Santiago (with 40% of the population, INE, 2012), most cities are located close to the coast. Three of the four selected regions that serve as case studies (Antofagasta, Coquimbo, and Los Lagos) are located on the Chilean mainland (Fig. 1). Easter Island (henceforth Rapa Nui, the name preferred by its inhabitants) is located in the central South Pacific, about 3700 km from the mainland and constitutes a municipality within the mainland region of Valparaíso. Rapa Nui is surrounded by oligotrophic waters (recognised as a distinct marine ecoregion, Spalding et al., 2007), and has only a fraction of inhabitants of the mainland regions, each of which is home to over half a million people (Table 1).

Chile covers a wide range of climate zones ranging from dry deserts in the north, to Mediterranean and temperate climates in the central regions and alpine tundra in the south (Peel et al., 2007). The Antofagasta region is located in the Atacama Desert and therefore characterised by virtually no rainfall. Plant growth is restricted to very few areas where moisture accumulates. The Coquimbo region is considered an arid zone at the southern edge of the Atacama Desert with limited rainfall, which provides sufficient water for irrigation agriculture in the transverse valleys. The Los Lagos region has a temperate climate with regular rainfall and features extensive forests and large freshwater lakes. Rapa Nui has a subtropical, oceanic climate and a mostly rocky coastline though a few sandy beaches exist. The area of the island is 164 km^2 and therefore much smaller than the mainland regions (126,000 km^2 for Antofagasta, 41,000 km^2 for Coquimbo and 49,000 km^2 for Los Lagos).

Traditionally, one of the most important and well-paying economic sectors in Chile has been the mining industry. In Antofagasta, mining is especially important (generating most of the GDP of the region), followed by the construction industry. People in Antofagasta enjoy one of the highest average wages (15,000 US$ annually compared to the Chilean average of 11,000 US$), and the region is the richest of Chile (according to per capita GDP). Few people live in