



The social costs of marine litter along European coasts



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ABSTRACT

This is the first study to assess the social costs of marine debris washed ashore and litter left behind by beach visitors along different European coasts. Three identical surveys, including a discrete choice experiment, are implemented at six beaches along different European coastlines: the Mediterranean Sea in Greece, the Black Sea in Bulgaria and the North Sea in the Netherlands. Beach visitors are asked for their experiences with beach litter and their willingness to volunteer in beach clean-up programs and their willingness to pay an entrance fee or increase in local tax to clean up marine litter. Significant differences are found between countries. This has important implications for the size and transferability of the estimated social costs of marine litter across Europe.

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1. Introduction

The economic values from coastal recreation are considerable worldwide (Ghermandi and Nunes, 2013). Clean seas and beaches are key to attract local and international tourists and are an integral part of the European Marine Strategy Framework Directive (MSFD), in which marine litter is one of the key indicators to assess good environmental status and the effectiveness of policy measures (Galgani et al., 2013). Marine debris and beach litter have been argued to pose a significant cost on society, in particular in the way they affect coastal tourism and recreation (UNEP, 2009). Marine litter stranded on beaches poses a serious visual and aesthetic stroke for tourists and local beachgoers, limiting overall beach enjoyment and causing a decline in coastal tourism and corresponding revenues (Munari et al., 2016). Since coastal tourism contributes significantly to coastal economies, changes in these revenues will directly affect coastal communities (KIMO, 2010). However, remarkably few studies exist that have investigated the impacts of marine litter on coastal tourism and the social costs of beach litter (Mouat et al., 2010). An exception is the widely cited study by Ofiara and Brown (1999), who reported a reduction in

beach visitation along the Jersey shores of between 8 and 33 percent due to large amounts of landfill debris washed ashore in the state of New York during two consecutive summers in 1987 and 1988. The economic loss as a result of reduced local business was estimated at 15–40 percent, equivalent to USD 0.25–1.23 billion.

Although based on an extreme incident, these numbers highlight the extent of the potential social costs involved. Several studies show that litter plays a role in beach selection and the presence of litter may be a reason for tourists not to visit a beach (for a comprehensive overview of these studies, see Tinch et al., 2012). At the same time, a strong correlation exists between beach visitor density and marine litter generation (Santos et al., 2005), and beach recreation and tourism have been found to be among the main responsible for the litter found on beaches (OSPAR, 2009). Those responsible for littering may not necessarily incur the full cost of their actions and may have limited incentives to change their behavior and thus minimize their impact on the coastal environment (Oosterhuis et al., 2014), hence requiring coastal policy and management interventions. In order to inform sustainable coastal management policy, insight is needed in the economic value of the impacts of marine litter.

The non-commercial (non-market) impacts of beach litter on social welfare can be assessed using surveys and asking beach visitors about their perception of marine litter and preferences for clean beaches. As for the assessment of the commercial (market)

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impacts of beach litter, the number of studies applying surveys to assess the social welfare impacts of beach litter based on public perception and valuation is very limited. A number of studies exist, which focus more generally on public willingness to pay (WTP) for beach and water quality improvements. Examples include [Blakemore and Williams \(2008\)](#), [Beharry-Borg and Scarpa \(2010\)](#) and [Östberg et al. \(2010\)](#). These studies refer to beach litter, but in hardly any of these cases is it possible to assess the non-market value for beach litter separately. Beach litter is only one of the aspects influencing beach quality. [Smith et al. \(1997\)](#) were the first to apply contingent valuation (CV) to estimate the non-market values of beach litter management in New Jersey and North Carolina using different baseline scenarios for the valuation. Clean up programs of different baseline situations, depicted on photographs showing varying degrees of beach littering, were valued, as expected, differently. Median WTP values elicited through a mail survey varied between US\$ 21 and 72 per person per year in annual income tax (in 1992 price levels). The only other study we are aware of by [Loomis and Santiago \(2013\)](#) compared the results from a CV and discrete choice experiment (DCE) in split samples, interviewing 427 visitors to 5 beaches in Puerto Rico and asking for their WTP to eliminate trash along with improving water clarity. The two methods yielded similar mean WTP values for eliminating trash between US\$ 98 and 103 per visitor day (in 2011 price levels).

The main objective of this study is to add to the empirical evidence base and estimate the social costs of marine litter across different European beaches and coastal zones using the same survey design. Six hundred and fifty beach visitors are interviewed in-person at six different beach locations in Greece, Bulgaria and the Netherlands. More specifically, the objectives are to assess (1) public perception of marine litter at these beaches, (2) public willingness to volunteer in beach clean-up actions, and (3) public WTP local entry fees and municipality taxes to reduce marine litter in a DCE. WTP values are derived from the DCE where beach visitors are asked for their preferences for alternative beach clean-up scenarios. The WTP value is directly related to the welfare loss experienced by beach visitors as a result of the presence of marine litter and therefore used as an indicator of their social cost. The novelty of the DCE is that a distinction is made between point and diffuse pollution sources, i.e. litter left by visitors and marine debris washed ashore, given the fact that a large share of the beach litter originates from beach visitors self ([OSPAR, 2009](#)). Using the same survey instrument furthermore allows for the fourth and final objective of international comparison and testing of the equality of findings across the different study sites. The application of such identical international DCEs to test the transferability of the non-market costs or benefits of environmental change is very limited (e.g. [Brouwer et al., 2015a](#)), but essential to improve our understanding of the context specificity and spatial variation and distribution of the environmental costs and benefits of European policy implementation such as the MSFD across member states ([Lopes da Silva et al., 2015](#)).

The remainder of this paper is organized as follows. Section 2 presents the general survey design and the DCE. This is followed in Section 3 by a description of the econometric models estimated in this study, in particular the discrete choice model. Section 4 presents the case study locations and the data collection procedure, while the survey results are presented in Section 5. Finally, Section 6 concludes.

2. Survey design

A common survey was developed and pretested over a period of 5 months in the project CleanSea, a large European research project aiming to provide instruments and tools to keep European seas

clean. In doing so, it focused on improving the knowledge base of marine litter composition, distribution and impact in order to identify cost-effective policy strategies. As part of the project, a separate working group looked at the socio-economic costs of marine litter.

The questionnaire was first developed and pretested in the Netherlands and subsequently translated and pretested in Greece and Bulgaria. The questionnaire consists of five main parts.

The first part includes relatively easy warm-up questions related to the number of times people visit the beach where they are interviewed, whether they are on holidays, where they live and what recreational activities they generally undertake when visiting the beach. The second part focuses on the specific characteristics of the beach, and visitors' evaluation of these characteristics, including water quality and beach littering. This is followed by a series of questions related to the amount and types of litter found on the beach (or not) over the year and the impact of the presence of beach litter on visitor's beach experience and appreciation.

The third part asks visitors for their willingness to volunteer in beach clean-up schemes for the particular beach where they are interviewed. They are first asked if they are willing to participate in such a voluntary clean-up action, and secondly how many hours per year they would be willing to volunteer. If they are not willing to participate, visitors are asked for the reasons why not.

The fourth part introduces the DCE. Here respondents are asked for their preferences for cleaning up and removing litter from the beach using choice cards depicting alternative littering situations on the beach. Beach visitors as direct beneficiaries of a clean beach and in some cases also as beach polluters are asked to help pay for the clean-up costs of the beach. Against payment of an extra tax or entrance fee, more can be done to clean the beach. The amount of money visitors are being asked to pay will be used exclusively for the removal of beach litter. Beach visitors are told that if no action is taken, the amount of beach litter is expected to increase in the near future. They are explained that currently on average between 10 and 30 litter items are found on 100 square meters beach, ranging from small items such as the cap of a bottle or a cigarette butt to bigger items such as a bottle or plastic bag. Visitors are first shown an example card which is used to explain and clarify the choices respondents are asked to make and this is then followed by 6 new choice cards displaying each time a completely new situation. Respondents are asked to indicate on each card which situation they prefer most. The design of the DCE is presented in [Table 1](#). The litter types are based on global findings reported for example in [Ten Brink et al. \(2009\)](#) and [Ocean Conservancy \(2014\)](#).

Alternative situations are created by combining the attributes presented in [Table 1](#) based on their possible levels. This yields 192 possible combinations. Because visitors cannot be shown all possible choice situations, the number of combinations was reduced to 60 choice tasks, which were blocked in 10 versions of 6 choice tasks each based on a D-efficient fractional factorial design (the design is available from the authors). Each beach visitor was randomly shown one of these 10 versions with 6 choice cards. Interviewers were trained to memorize a standard text introducing the choice experiment to beach visitors. The attributes and their

Table 1
Design of the discrete choice experiment.

Attribute	Levels
Type of beach litter	Plastic - Nets - Cigarette butts - Glass
Amount of litter	Average - Below average - None
Origin of the litter	Washed ashore - From visitors
Beach crowdedness	Many visitors - Few visitors
Entrance fee/local tax	€0.5 - €1.0 - €2.5 - €5.0

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