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The role of interdisciplinary collaboration for stated preference methods to value marine environmental goods and ecosystem services

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ABSTRACT

With the increasing use of environmental valuation methods in coastal, marine and deep-sea settings, there is a growing need for the collaboration of natural scientists and environmental economists. Stated preference valuation methods in particular need to be based on sound natural science information and translate such information to be used in social surveys. This paper uses three applications to make explicit the flow of information between different disciplines in the preparation and implementation of stated preference studies. One approach for facilitating this flow is to increase knowledge and understanding of natural scientists on these methods. To address this, this paper highlights key opportunities and pitfalls and demonstrates those in the context of three case studies. It therefore provides guidance on stated preference valuation for natural scientists rather than for economists.

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1. Introduction

A rising demand for cost-benefit analyses of coastal and marine management measures, driven by national and international legislation, has recently been stimulating increasing efforts in environmental valuation in this field (Hanley et al., 2015; Börger et al., 2014a). Efficient use of public funds for marine environmental policy requires the assessment of costs and benefits of management measures (Oinonen et al., 2016; Scharin et al., 2016). Such management measures are a response to an increasing number of directly and indirectly human-induced stressors, such as climate change, fishing, maritime transport, land-based pollution and tourism. These stressors are leading to changes in the state of the marine environment and consequently impact human welfare (Halpern et al., 2015; Wolanski and Elliott, 2015). Beyond their direct and indirect influence on economic activity, such as the production of goods and services, there are a variety of impacts that are not directly accounted for in observable market transactions. Their value (for use in environmental cost-benefit analyses) cannot be assessed through the analysis of market data, necessitating the use of non-market valuation techniques. These can be divided into two main groups: revealed preference and stated preference (SP) methods. Other methods exist, such as cost-based approaches and value transfer (Johnston and Rosenberger, 2010), but as they do not employ survey methods, they are beyond the remit of this paper. Revealed preference methods, such as the travel cost method (e.g. Whitehead et al., 2008; Söderqvist et al., 2005; Bhat, 2003) or hedonic pricing (e.g. Gopalakrishnan et al., 2011; Samarasinghe and Sharp, 2010), use available data on market transactions or individual behaviour to infer the value of non-market goods. These methods are limited to the assessment of use values. Total economic value, potentially consisting of use and non-use value, can only be assessed by means of SP methods. The two most prominent of the latter are the contingent valuation method (CVM) (Carson and Hanemann, 2005; Mitchell and Carson, 1989) and discrete choice experiments (DCE) (Louviere et al., 2000).

In recent years, there has been an increase in the application of SP valuation studies in coastal locations (e.g. Hynes et al., 2013;

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Taylor and Longo, 2010; Hanley et al., 2003), the intertidal zone (e.g. Nunes et al., 2009; Bulte et al., 2005) and offshore resources (e.g. Brouwer et al., 2016; Aanesen et al., 2015; Börger et al., 2015; Jobstvogt et al., 2014a; Norton and Hynes, 2014; Wattage et al., 2011; Glenn et al., 2010; Liu and Wirtz, 2010; McVittie and Moran, 2010; Eggert and Olsson, 2009). Nevertheless, the number of high-quality primary valuation studies in the marine realm remains low compared to terrestrial environments as can be seen in the existing valuation databases such as that of the Marine Ecosystem Services Partnership (MSEP)[1] or the Environmental Valuation Reference Inventory (EVRI).[2]

The stimulation for further marine valuation already exists due to increasing activity within marine policy and management domains (for example, the EU Marine Strategy Framework Directive (2008/56/EC), the development of marine plans and growing interest in the promotion of the blue economy (Spalding, 2016)). To ensure that environmental valuation is robust, of high quality, and useable in the decision-making process, what needs to be fostered is increased collaboration between natural scientists and environmental economists. This requires contributions from different disciplines at different stages of the valuation process. On a practical level, the valuation of environmental goods and ecosystem services entails four steps (Freeman, 2002): (1) determining (and quantifying) the size of the environmental change to be valued and its effect on ecosystem structure and function; (2) determining (and quantifying) the impact of these effects on the provision of ecosystem services to humans; (3) assessing changes in human welfare in monetary terms, i.e. valuation; and (4) aggregating individual valuations over the affected population. While steps (3) and (4) have received considerable attention from environmental economists and relevant manuals are available (e.g. Johnston et al., forthcoming, Kanninen, 2006; Champ et al., 2003; Bateman et al., 2002; Haab and McConnell, 2002), there is no standardised way to translate natural science information into a valuation scenario in steps (1) and (2). It is evident that these steps depend heavily on the specific survey topic. Interdisciplinary teams are indispensable to ensure that the links between environmental changes and ecosystem services affected are presented to survey respondents in a correct, succinct and understandable, yet neutral and non-leading way. This involves a trade-off between the provision of more detail to increase ecological accuracy and realism of the environmental changes to be valued and the risk of overburdening respondents on a cognitive level. Against this backdrop, this paper explores how natural science knowledge and data can be best translated for the use in SP studies by making the information flow in this interdisciplinary type of research explicit. One approach for facilitating this information flow is to increase the understanding of natural scientists of practical SP environmental valuation. In addition, while biases and procedural problems still challenge valuation practitioners (Hoyos, 2010; Venkatachalam, 2004; Mitchell and Carson, 1989), the application of CVM and DCE in the marine environment has its own recognised set of difficulties (Hanley et al., 2015). Therefore, key opportunities and pitfalls in the use of SP valuation in the marine environment are highlighted by means of three recently conducted valuation surveys in Poland, the Netherlands and the UK in the framework of the EU FP7 project VECTORS (www.marine-vectors.eu). Consequently this paper is intentionally aimed predominantly at a natural science readership rather than environmental economists. This focus will enable the former to better assess the quality of existing valuation studies and generally to improve the translation of environmental information for valuation purposes. Using the three applications of the DCE approach as examples, this paper examines the approach and its application to value ecological changes in the coastal and marine environment and thereby intends to raise awareness amongst natural scientists for the particular requirements of interdisciplinary research around environmental valuation.

2. Using stated preferences to value non-market environmental goods

2.1. Introduction to the concept of value in economics and stated preference methods

In economics, value can be expressed through exchange, and as such is instrumental and anthropocentric (Freeman, 2002; Turner, 1999). Instrumental (as opposed to intrinsic) values relate to individual preferences and needs. Something has value to the extent that it satisfies existing human preferences. Value can be thought of as the value of the good as a whole, which underpins the conceptualisation in the CVM, or made up of the value of the different characteristics of the good, which is the foundation of the DCE approach. Values are relative in the sense that the value of good A relates and is comparable to the value of good B (Turner, 1999). Consequently, in economics value is usually assessed by employing the concept of willingness to pay (WTP), which implies a comparison between the value of a good and money. This concept attempts to assess welfare changes by quantifying how much of an individual's current income or wealth he is willing to trade for the provision of a good or service (or to prevent the cessation or reduction of this provision). An alternative to this is the concept of willingness to accept (WTA) compensation to go without an improvement or to endure deterioration of environmental quality. The majority of practical applications, however, employ the WTP concept. In other words, what is the amount of money forgone that leaves an individual exactly as well off, in terms of welfare, as before a positive change in environmental quality occurred? This establishes a substitution relationship between the provision of environmental quality and money. WTP can therefore be interpreted as an indicator of the change in welfare that this individual expects from the change in provision or quality expressed in monetary terms.

When goods or services are traded in markets, market data can usually be used to infer WTP and hence the value of the goods in question.[3] For the case of non-market goods this is not possible, but SP valuation methods can be used to assess how much people *would* be willing to pay if there was a market for these goods. While the beginnings of the CVM go back to the middle of the 20th century (Randall et al., 1974; Davis, 1963; Ciriacy-Wantrup, 1947), DCE originate in the 1980s in marketing and transport research (Louviere, 1988; Louviere and Woodworth, 1983) with first applications in the environmental field appearing in the 1990s (Hanley et al., 1998; Boxall et al., 1996; Adamowicz et al., 1994). Both methods are survey-based and present respondents with hypothetical environmental management measures, the 'valuation scenario'. These scenarios detail a proposed, hypothetical environmental management project, which will lead to changes in specific aspects of a non-market good or service. It is further

[1] www.marineecosystemservices.org.
[2] www.evri.ca.

[3] Note that there is a difference between WTP and market prices in that the amount a person is willing to pay for a good might be more than she actually needs to pay in the market, i.e. the market price. Valuation is therefore concerned with WTP, which is associated with the concept of consumer surplus (Bateman et al., 2002; Morse-Jones et al., 2011). However, in well-functioning markets (and only there), market prices are usually a good approximation of WTP.

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