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A note on communicating environmental change for non-market valuation

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ABSTRACT

Communicating change in environmental condition is a critical component of non-market valuation studies. However, the underlying assumptions and implications associated with alternative ways of expressing change in environmental condition for surveys are rarely discussed in the literature. Our review found no cases where alternative formulations were both discussed and tested. In this note we report on our multi-disciplinary analysis of how best to express such change. We interrogate the meaning of, and inferences from, four formulations for quantitative expressions, or metrics, of environmental indicators that are used in the field of ecology and we then evaluate their usefulness in non-market valuation. The assumptions and limitations of each formulation are discussed using seven hypothetical cases of change in environmental condition. We show that formulations for expressing change can be grouped based on two inherent philosophies potentially held by people when they consider their preferences for environmental changes: 'more is better philosophy' and 'restoration philosophy'. We contend that, without careful consideration of which philosophy people may apply, it is possible to inadvertently bias respondent choices when a particular formulation is used in a valuation study. If this happens, resulting value estimates will be a poor reflection of what researchers seek. An alternative approach that does not presuppose a philosophy but instead helps reveal a respondent's philosophy, is proposed.

1. Introduction

Understanding change in environmental condition is pivotal to the development of policy and the management of environmental systems; poor understanding of change is often the cause of misguided or inappropriate policy or management actions (Golembiewski et al., 1976). Central to usefully representing change is the capacity to measure and communicate the type, magnitude and implications of change. The challenge is how best to represent change for monitoring and research purposes. Specifically, our particular interest is how to do so in order to elicit preferences in non-market valuation surveys aimed at ranking alternative levels of environmental condition on the basis of people's preferences.

When representing change, indicator metrics are widely used to succinctly represent the states of a system. Such metrics are particularly useful for providing information about complex systems especially where measuring all attributes is impractical or impossible (Heink and Kowarik, 2010). Indicators can be used to represent a change in state through repeated measures demonstrating trends (Butchart et al., 2010; Kubiszewski et al., 2013; Wolseley et al., 1994), or through formulations, to represent the state relative to some reference point (Bouleau and Pont, 2015; Norris et al., 2007). The latter approach is frequently used within environmental planning and management to establish goals or define limits on activities (Walker and Reuter, 1996). It is also widely used in environmental 'report cards' to communicate condition to the general public (Harwell et al., 1999). Typically, those designing these metrics are natural scientists and more specifically ecologists.

Approaches to estimating economic values held by people for environmental resources are often based on surveys administered by economists to representative samples of the underlying popu-

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lation (Laurila-Pant et al., 2015). Responses are used to estimate the willingness-to-pay (WTP) for environmental resources and changes in their condition. There is an extensive literature and many textbooks on how to estimate WTP (e.g. Haab and McConnell, 2002). Much advice exists on the various sources of bias afflicting the various non-market valuation methods (Venkatachalam, 2004). Lack of prior knowledge about the environmental goods and services is commonly a problem in environmental valuation and a potential cause of information bias. It is dealt with typically by using information sheets provided to respondents (Ajzen et al., 1996). However, vagueness in descriptions of the object of valuation may produce meaningless results (Hanemann, 1994) and insensitivity to scope has often been highlighted as a potentially serious issue that can compromise validity of a survey (Carson, 1997). In a classic example, Kahneman (1986) found little difference in respondents' WTP for cleaning up lakes of different sizes. Similarly, Desvousges et al. (1992) found very small difference between respondents' WTP estimates to save 2000, 20,000 or 200,000 birds. Hence, it has been argued that respondents' stated WTP derived from non-market valuation surveys reflects more of a general support for the environmental causes underlying the survey than a preference for particular degrees of improvement. Carson (1997), however, argues that in many cases what is seen as insensitivity to scope is actually the result of poorly conveyed description of environmental goods, highlighting the need for careful formulation.

Some researchers have resorted to using photographs to convey a difference between scenarios (Ruto et al., 2008; Scarpa et al., 2007; Willis and Garrod, 1993). However, such approaches rely on respondents being able to contextualise those images sufficiently to articulate preferences. Insufficient understanding or knowledge on behalf of the respondents may yield results that lack robustness. Examining this issue while studying respondents' preference of wilding conifers (an invasive species) in New Zealand, Greenaway et al. (2015) asked survey respondents to pick a preferred scene from two pictures (Fig. 1). The photos were of the same location taken 30 years apart – before and after the spread of invasive wilding conifers. For the next question, the respondents were then shown a close-up of the trees in the photos and asked if they could identify them. As expected, those who correctly identified the trees chose option 'A' – an equivalent of 'natural condition' discussed later; whereas the majority that did not correctly identify the trees, and did not understand that the trees were an invasive species, preferred option 'B'. This illustrates that without a scenario specification that most respondents can interpret in an identical manner, photos can result in biased estimates.

The challenge of how best to formulate environmental change has motivated us in our interdisciplinary research. However, in the literature we found little discussion and even less testing of what constitutes the best way to communicate environmental change. What we found in the literature is that non-market valuation surveys broadly express environmental conditions using a variety of different indicators that represent change in quantity or extent of the environmental conditions (Freeman et al., 2014). Indicators that represent condition relative to a reference point have been developed to help understand the significance of changes. For example, Bennett et al. (2008) estimated values for a certain percentage improvement in fish population or river length with healthy vegetation; Hatton MacDonald and Morrison (2010) investigated values for change in habitat area; Loomis et al. (2000) measured change through increase in ecosystem services. The reference point for each of these is implicitly the current condition. On the other hand, in ecology or conservation literature, the selection of reference points to assess change is often based on a 'natural' condition – the condition that we consider to be healthy or acceptable in an ecosystem. This gave rise to the reference condition approach in bioassessment (Bailey et al., 2004). Note that in the ecological literature, the term 'reference condition' generally refers to natural or best available condition, whereas we use the term 'reference condition' to mean any condition that is selected as a point of comparison. Our concern is that there are different ways to represent or express change and yet these are rarely discussed in the existing literature; nor is there guidance on 'best practice'.

In this paper we explore how to formulate environmental indicators for use in valuation studies where people are asked to value policy or management actions that change the ecology of a system. We contend that the selection and formulation of indicator metrics has significant bearing on how people understand and interpret the often unfamiliar changes in the environment. To ensure that valuations are 'meaningful', we examine a range of metric formulation options using a hypothetical case study. The intention is to raise awareness of the underlying implications of alternative formulations and promote debate about the way we communicate environmental change in the context of non-market valuation to ensure we generate meaningful valuation results.

2. Hypothetical case study

Let us assume one wants to elicit people's preferences for changes in environmental flow outcomes obtained from policy options regulating the flow regimes in a large wetland ecosystem. The environmental outcomes are predicted from a model that quantifies the number of suitable flooding events (events that meet pre-defined water requirements of species) in a given time period from various flow scenarios (Fu et al., 2015). These *suitable* flooding events are defined on the basis of existing knowledge about what a species requires to persist within an environment, rather than more complex concepts of the provision of an ecosystem service by the species. For example, a suitable event for waterbird breeding or survival of riparian vegetation in a landscape is an event of a certain magnitude and duration at a particular time of year. There will be a physical limit to the number of suitable events achievable in a given time period, depending on the species of interest. The number of suitable flooding events is then used to construct indicators for a survey designed to elicit people's preferences for the environmental outcomes. The challenge is to find an unambiguous formulation for an indicator of change that people find useful and is not too complex so as to ease cognitive processing.

We surmise that there are two reference points that people would find helpful in their interpretation of the number of suitable flooding events under each scenario. The first reference point is a 'Current' value, which indicates the number of suitable flooding events under the current policy (e.g. for our research this is the currently legislated *Water Sharing Plan* in New South Wales, Australia). The second reference point is a 'Natural' value, which indicates the number of events under natural conditions (e.g. prior to river regulation upstream of the wetland). Changes in environmental condition can then be measured relative to a reference point for a range of possible scenarios of interventions.

We have defined seven different sets of possible combinations of scenario, current and natural conditions that could occur in this hypothetical wetland. These are called 'cases' in Fig. 2. The number of suitable flood events under 'Current', 'Natural' and 'Scenario' conditions is given for each case. Cases A, B and C are common, showing reduced or increased number of suitable flood events under a specific scenarios (e.g. due to less or more environmental watering for the right time, duration and dry period). Cases D, F and G are less common, showing situations where more suitable flood events under the scenario condition than what would have naturally occurred (e.g. due to policy intervention where more water is diverted to and/or retained in a focused area for the right time, duration and dry period). Cases E and F are characterised by