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New methods for valuing, and for identifying spatial variations, in cultural services: A case study of the Great Barrier Reef

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ABSTRACT

Estimating values for ecosystem services (ES) can contribute to the decision making process, reducing the risk that ES benefits are overlooked. For ES with no (direct or indirect) links to markets, valuation is a non-trivial exercise. Traditional methods require the use of hypothetical markets; the life satisfaction (LS) approach does not. LS has previously been used to estimate the value of regulating ES, but to the best of our knowledge has never been used to estimate the value of cultural services (CS).

We examine the relationship between LS and a subset of CS provided by the Great Barrier Reef (GBR), (the non-use CS), using geographically weighted regression to investigate spatial variations in value. After controlling for other factors, we find income is more important to LS in the south than the north; the opposite is true for non-use CS.

The coefficients are used to estimate the amount of income required to keep overall LS constant, should the non-use CS of the GBR not be preserved, estimated at $8.7 bn annually. We acknowledge the imperfections of our work, noting the need for research on better CS measures, but feel that the general approach may add another useful tool to the valuation toolbox.

1. Introduction

Ecosystems provide mankind with an extensive range of goods and services that are critical to human welfare (Costanza et al., 1997; Daily et al., 2000). Valuation of ecosystem services (ES) is a useful tool available to decision makers tasked with managing resources (Daily et al., 2000). Monetising ES can provide a range of benefits that can help inform resource allocation decisions, including highlighting the appropriate weighting of vital services (Costanza et al., 1997), raising awareness about the importance of ES (de Groot et al., 2012), and making explicit the costs of ES degradation (Pascual et al., 2010).

Valuation has been criticised for not only failing to help conserve many of the world's ES, but by assisting the commodification process, facilitating their loss or degradation, (Gómez-Baggethun et al., 2010, 2011). However, 'valuing ES is not identical to commodifying them for trade in private markets' (Costanza, 2006, p. 749), and need not lead to commodification (Gómez-Baggethun and Ruiz-Pérez, 2011). Indeed, the diverse nature of ES suggests that whilst some services may be susceptible to commodification, the complex overlapping and entangled benefits provided by many ES make it difficult to either monetise a single particular ES (Stoeckl et al., 2014b) or to separate a single function into a discrete commodifiable unit (Gómez-Baggethun and Ruiz-Pérez, 2011).

Some ES are easier to value than others, with cultural services being particularly difficult. Cultural services (CS) are the "nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences" (Millennium Ecosystem Assessment, 2005, p. 40) and include "...existence and bequest constructs that may arise from people's beliefs or understandings" (Haines-Young and Potschin, 2013, p. 18). CS have been described as comprising aesthetic information, opportunities for recreation and tourism, inspiration for culture, art and design, spiritual experience, and information for cognitive development (de Groot et al., 2010), or more succinctly, as encompassing cultural heritage, recreation and tourism, and aesthetic values (Pascual et al., 2010). Recreation and tourism aside, many other CS provide the type of benefits that people would assign what economists term non-use values (Krutilla, 1967; Weisbrod, 1964). Thus, CS essentially provide a hybrid of use and non-use benefits, each of which contribute to the overall value (use and non-use) assigned to the CS (Braat and de Groot, 2012; Pascual et al., 2010). A core problem of this being

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that the values assigned to the non-use CS are not traceable through well-functioning markets, or indeed through any market at all (Costanza et al., 1997).

Omitting non-use values of CS from valuation estimates risks excluding that which people may care about most (Carson et al., 2001). Traditional non-market valuation approaches that have been explicitly developed to measure non-use values (such as contingent valuation, choice modelling) assume that utility is cardinally unobservable (Gowdy, 2005), requiring researchers to work with indirect utility functions derived from hypothetical markets. However, an emerging body of research has established that measures of life satisfaction (LS) or subjective well-being can serve as a proxy for utility (Kristoffersen, 2010) at both the microeconomic (Ferreira and Moro, 2010), and macroeconomic (Engelbrecht, 2009) level. Simplistically, LS researchers ask questions, such as "how satisfied are you with your life as a whole?", and responses are then regressed against a variety of other factors, the coefficients of the equations providing information about the marginal contribution which these factors make to overall LS (or utility). LS studies have examined a range of issues including pollution (Ferreira and Moro, 2010; Levinson, 2012; Luechinger, 2009; MacKerron and Mourato, 2009; van Praag and Baarsma, 2005), forest fires (Kountouris and Remoundou, 2011), floods (Luechinger and Raschky, 2009), climate and climate change (Ferreira and Moro, 2010; Maddison and Rehdanz, 2011). More recently, researchers have tested the approach with some of the harder to measure elements of ES, such as scenic amenities (Ambrey and Fleming, 2011), and ecosystem diversity (Ambrey and Fleming, 2014). But to the best of our knowledge, no-one has yet attempted to use the LS approach to assess the value of CS – the focus of this paper.

The LS approach lends itself to the valuation of CS in a number of different ways. The approach is neither rooted in the biophysical nor financial domains which are known to impact the values elicited, failing to fully reflect the social-cultural impact of ES (Martin-Lopez et al., 2014). It clearly focuses on the relationship between the environment and human well-being (as measured by the LS of individuals), which forms the root of the development of the ES concept (Martin-Lopez et al., 2014) and aims at the core objective of much welfare economics, namely to maximise (individual and/or social) welfare (utility). It also may be able to make a useful contribution to situations involving 'taboo trade-offs' where morally or culturally it is virtually impossible for an individual to contemplate a financial value for something considered sacred, such as a human life (Daw et al., 2015).[1]

The LS approach assumes that each explanatory factor enters the function in a separable and additive manner, but there is much potential overlap between factors (Stoeckl et al., 2014b; Windle and Rolfe, 2005); the implication is that this needs to be tested for before simply entering each factor as a separate contributor to LS. Location specific factors (e.g. scenic views, pollution, climate) also impact people's subjective satisfaction with those factors and/or the importance people assign to those factors as contributors to LS (Costanza et al., 2007). An implication of these location specific factors is that the relationship between CS and LS may vary across geographic regions. Estimating a single (regression) equation for all individuals across a wide geographic region implicitly assumes that all factors contribute similarly to the LS of all individuals in all locations; thus if regional variations are present global estimation techniques will not model relationships well and alternate techniques that address spatial relationships, such as geographically weighted regression (GWR), may be required to avoid biased or invalid estimation results (Bateman et al., 2002).

This paper takes a LS approach to demonstrate a way of assessing the value of CS, whilst also employing an estimation technique that can account for potential spatial variations in the relationship between LS and CS (not previously used in LS valuation studies). Here, we use the Great Barrier Reef World Heritage Area (GBR) as a case study to ask:

1. Do reported levels of satisfaction with the CS associated with the GBR contribute to the overall satisfaction with life reported by residents, and is there spatial variation within this relationship?
2. Can we use coefficients from the LS model to generate valid estimates of (some of) the CS values of the GBR?

Within Section 2 we briefly describe our case study area, the development of our model, the selection of our independent variables, and the design of our questionnaire. We also describe how the data were collected, our estimation techniques, and our method of estimating the value of CS. Results are provided and discussed in Section 3, whilst Section 4 draws conclusions from this research.

2. Materials and methods

2.1. Case study area

The GBR, situated in the Coral Sea off the coast of Queensland, Australia, is the world's largest reef system comprising 348,700 km^2 and was proclaimed a World Heritage Area in 1981 (UNESCO World Heritage Convention, 1981). There have been marked increases in the amount of nutrients, sediments and pesticides flowing into the GBR since European settlement (Furnas, 2003; Kroon et al., 2012; Lewis et al., 2009) and substantive declines in coral cover in areas where sediment loads have increased the most (De'ath et al., 2012). The GBR is close to being added to the World Heritage in Danger list (UNESCO World Heritage Centre, 2014), but many desire to further develop the ports and mines along the coast. It is therefore important to assess both the benefits and the costs of further economic growth, encompassing the harder to value environmental and social impacts in addition to the economic impact of development.

Numerous studies in recent decades have generated estimates of the monetary worth of various values associated with the GBR, although there have been many more studies of the services provided via markets (predominantly use values) where values are relatively easy to estimate (Stoeckl et al., 2011). Studies of non-use values are relatively sparse but include: a contingent valuation study of 'vicarious' users (tourists and Australian residents living outside the GBR catchment) (Hundloe et al., 1987); a choice modelling study of the non-use value of an estuary within the GBR catchment (Windle and Rolfe, 2005); and an attempt to estimate the collective value of numerous community defined benefits, grouped together to represent either provisioning services, regulation and maintenance services, cultural services, or a mix of cultural and regulation and maintenance service (Stoeckl et al., 2014b). Thus, the existing body of research does much to highlight use values (that may be enhanced by development) but may fail to sufficiently highlight some of the CS (particularly the non-use ones) provided by the GBR that may be lost if the Reef is not conserved. As discussed earlier, failing to fully reflect all aspects of ES in a valuation may result in misguided policy decisions; hence the importance of estimating a value of the (non-use) CS provided by the GBR.

[1] Making explicit the trade-offs between the well-being of different groups can ensure these issues are not overlooked in policy decisions; this does not assume that offering financial compensation is the solution to such taboo trade-offs.