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The value of coastal lagoons: Case study of recreation at the Ria de Aveiro, Portugal in comparison to the Coorong, Australia

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ABSTRACT

Coastal lagoons are some of the most inhabited and yet threatened ecosystems in the world. Cultural services in coastal lagoons are important for supporting human wellbeing and therefore their valuation is gaining recognition among decision makers responsible for managing development that affects these areas. This study is focused on the recreational aspect of cultural services employing two econometric methods revealed and stated preference – to estimate the non-market value of recreation at two coastal lagoons. This is part of an international and interdisciplinary study conducted by ecologists and economists. The same survey questionnaire, with minor adaptations, employing the same valuation methods, i.e. Travel Cost Method (TCM) and Contingent Valuation Method (CVM), were used at both the Coorong (Australia) and the Ria de Aveiro (Portugal). Results of the two surveys at the two sites revealed largely similar visitor profiles. The estimated values of Consumer Surplus obtained were 132€ and 160€ (per adult and per day) according to the TCM for the Australian and the Portuguese lagoons respectively, and 103€ and 110€, respectively with the CVM. These quantitative monetary estimates of non-market recreational visitor values represent part of the total value of these coastal lagoons and can be used directly as input for evaluations of alternative management options using Cost-Benefit Analysis. As such, the estimates fill part of what has previously been an information gap that has prevented a full accounting of the net benefit of alternative options. Now, with a more complete set of values, managers can better assess the extent to which financial resources should be allocated towards nature conservation *vis à vis* development.

1. Introduction

1.1. Ecosystem services of coastal lagoons

Coastal lagoons and their wetlands represent one of the Earth's most productive ecosystems, providing a wide range of ecosystem goods and services essential to life on the planet, for example, food, timber and habitat provision (Camacho-Valdez, Ruiz-Luna, Ghermandi, & Nunes, 2013). Coastal lagoons have been identified as ecosystems of strategic importance because they play a crucial role in almost all biogeochemical processes (such as carbon sequestration and fuel production) that sustain the biosphere (Sousa, Lillebø, Gooch, Soares, & Alves, 2013), supporting a large biological diversity. Furthermore, these areas support nearly 40% of the human population living within 100 km of coasts (Willaert, 2014), thus these coastal systems are also some of the most threatened in the world (MA (Millennium Ecosystem Assessment), 2005). There is no question that the services they provide are becoming increasingly vulnerable because of development pressures (Agardy, 2010).

One of the reasons for their vulnerability is that the full set of the values of conservation is not included in development decisions. In particular, there is increasing recognition that ecosystem services (ES) should be valued and included in the assessment of costs and benefits of alternative development options for many locations, including

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wetlands. ES are defined as "*the functions and products of ecosystems that benefit humans, or yield welfare to society*" (MA (Millennium Ecosystem Assessment), 2005). Services provided by marine and coastal ecosystems include provisioning ES (e.g. food, fibre, fuel, medicines), regulating ES (e.g. freshwater storage, hydrological balance and flood protection), supporting ES (e.g. biochemical and nutrient cycling) and cultural ES (e.g. recreation, cultural and aesthetics) (Lopes & Videira, 2013).

ES are beneficial to various aspects of human health and the general feeling of well-being (Fisher, Turner, & Morling, 2009; Haines-Young & Potschin, 2013; Sandifer, Sutton-Grier, & Ward, 2015). However, 60% of the ES evaluated to date are being degraded or used unsustainably (MA (Millennium Ecosystem Assessment), 2005). The identification and quantification of the extent and quality of coastal ecosystems and the services they offer is increasingly recognized as essential information that enhances the ability of decision-makers to evaluate trade-offs between ecosystems protection and management of alternative uses (Camacho-Valdez et al., 2013; IUCN, 2007). Hence, ecologists and environmental economists are increasingly committed to developing methods to attribute monetary value to ES (Chan, Satterfield, & Goldstein, 2012; Jones-Walters & Mulder, 2009). Within this context, an interesting aspect are the benefits associated with recreational experiences that are not directly paid for in markets through charges and fees. As these benefits are not explicitly expressed through markets, they are often not included in management decisions that focus on monetary costs and benefits. Therefore, conservation and remediation measures may be considered as too expensive because only their costs are fully included and not the full extent of their benefits (Daniel et al., 2012). Economic values of ES are needed for more comprehensive assessments, such as in an extended cost-benefit analysis.

In practice, ES are typically assessed from the supply side, for example the avoided costs of building water treatment plants where wetlands are available to naturally clean the water. Alternatively, environmental valuation approaches assess monetary values of ES from the demand side. These approaches provide ways to estimate demand curves that would exist if there were markets for these non-market ES. Hence, the environmental valuation approaches are used to gain estimates of the monetary value of the Willingness to Pay (WTP) for aspects of ecosystems that are not provided through existing markets.

For our purposes, we are interested in the WTP and derived demand curve for one aspect of total WTP – recreational demand for visits to a coastal lagoon. Total WTP would depend on the total set of values assigned to a lagoon (Haab & Mcconnell, 2002). Total Economic Value would include all the components of WTP including existence values, bequest values and option values, etc., that would be held by the population in general beyond visitors to the sites. In the case of coastal lagoons, WTP for recreational visits is dependent on the characteristics of the visitors and their preferences including their preferences for the site characteristics and their ability to pay for a visit. Site characteristics provide the link from the condition of the ecosystem of the lagoon to the WTP assigned by visitors. The assumption is that WTP is a positive function of site condition, which in turn is related to the degree of conservation.

The WTP estimates enable us to calculate the Consumer Surplus (CS), which is the total value people receive that is in excess of what they pay (Fig. 1). As such, even if the market price is equal to zero, the CS is positive if there are non-market values enjoyed by visitors that are associated with the benefits they receive from their visits. The economic techniques are aimed at estimating the visitors' monetary value of the CS for these non-marketed goods and services. In this sense, the CS can be thought of in our context as the non-market value associated with recreational use (Haab & Mcconnell, 2002). CS for recreational use is only one part of the total economic value of a lagoon.

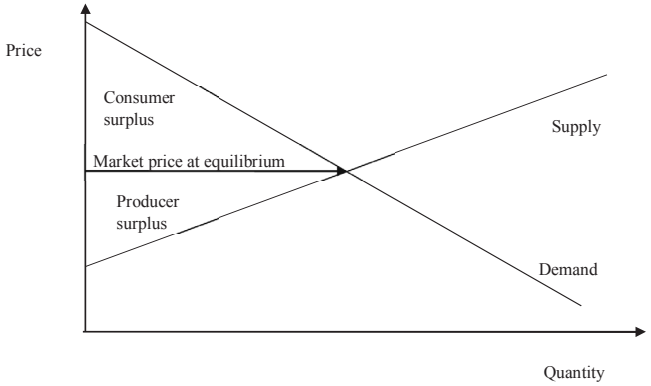

Fig. 1. Consumer Surplus and Producer Surplus.

1.2. Aims and objectives of the study

This study aims to help bridge the cultural ES knowledge gap by providing monetary estimates of the non-market recreational use value at the Ria de Aveiro, Portugal. Estimating monetary values is a first step in understanding how these values might be affected by changing local environmental conditions over time. This is part of a larger international research programme that aims to estimate and evaluate the comparability of the values of recreation use across globally distant coastal lagoons. This interdisciplinary research is being conducted collaboratively by ecologists and environmental economists using a common, standardized, replicable visitor survey instrument and valuation techniques.

The three main questions underlying this study are of worldwide concern:

1) Can non-market value estimates in monetary terms that go beyond a dollar-for-dollar accounting of ES using market values increase our understanding of people's preferences about values of coastal lagoons?

2) Is it possible to make a comparison of valuation results across geographically diverse coastal lagoon sites?

3) How can such values be used in planning and other development decisions on a local level and for global decisions as well?

In this study we focus on estimating the values assigned by recreational visitors to the coastal lagoon at the Ria de Aveiro, Portugal, and compare results to those obtained using the same techniques at the Coorong Lagoon in Australia (Dyack, Rolfe, Harvey, O'Connell, & Abel, 2007; Dyack, 2010, 2011). By using two different valuation techniques and two different sites, we are able to test for convergent validity between sites.

2. Methods

2.1. Study areas

The Ria de Aveiro (Fig. 2) is a shallow coastal lagoon located on the Northwest Atlantic coast of Portugal (40°38′N, 8°45′W), with an average depth of 1–1.5 m (Brito, Newton, Fernandes, & Tett, 2011; Dias, Lopes, & Dekeyser, 2000). It is a bar-built estuary, protected from the ocean by a barrier island (Dias & Lopes, 2006) and has an irregular geometry, characterized by some elongated and branched channels (as an arborescent network system; Martins et al., 2011). The lagoon is 45 km long and 10 km wide and covers an area from 64.9 km^2 to 89.2 km^2 at neap and spring tides, respectively (Lopes, Vaz, Vaz, Ferreira, & Dias, 2015). It has only one connection with the Atlantic Ocean through an artificially opened channel (Dias et al., 2000).

The coastal lagoon of Ria de Aveiro is a transition zone between aquatic and terrestrial systems as well as freshwater and marine systems, integrating urban, natural and semi-natural areas (Sousa, Sousa,

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