



## Recreational SCUBA divers' willingness to pay for marine biodiversity in Barbados

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### ABSTRACT

The use of natural resources and the services they provide often do not have an explicit price and are therefore undervalued in decision-making, leading to environmental degradation. To 'monetize' the benefits from these services requires the use of non-market valuation techniques. Using a stated preference survey of recreational divers in Barbados conducted between 2007 and 2009, the economic value of marine biodiversity to recreational SCUBA divers in Barbados was estimated. In addition to a variety of demographic variables, divers were asked about their level of experience, expenditures related to travel and diving, and encounters with fish and sea turtles. Divers then completed a choice experiment, selecting between alternative dives with varying characteristics including price, crowding, fish diversity, encounters with sea turtles, and coral cover. Results indicate that divers in Barbados have a clear appreciation of reef quality variables. Willingness to pay for good coral cover, fish diversity and presence of sea turtles is significantly higher than prices paid for dives. In general, divers valued reef attributes similarly, although their appreciation of low density of divers at a site and high coral cover varied with prior diving experience. The results of this study demonstrate the economic value generated in Barbados by the recreational SCUBA diving industry and highlight the potential for substantial additional economic contributions with improvements to the quality of a variety of reef attributes. These results could inform management decisions regarding reef use and sea turtle conservation, and could aid in the development of informed 'win-win' policies aimed at maximizing returns from diving while reducing negative impacts often associated with tourism activities.

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### 1. Introduction

Increasing demand for limited resources in today's world means that conservation often entails trade-offs (Hirsch et al., 2011). Unfortunately, many of the trade-off choices lead to biodiversity loss and habitat destruction (Shogren et al., 1999; Holland et al., 2009), and these negative changes to the environment are simply viewed as an inevitable "cost of doing business". Conservation efforts are frequently seen as costly because they may preclude certain activities that have large immediate financial rewards, whilst the longer term costs associated with species loss and habitat destruction are overlooked in the pursuit of short-term economic gains.

Economic valuation can be used to better understand the costs of these trade-off decisions and can demonstrate the often very large economic consequences of natural resource mismanagement. For example, the level of degradation being experienced by Caribbean

coral reefs from anthropogenic activities has been projected to result in losses of up to US\$300 million per year in net revenues from dive tourism and up to US\$140 million per year in reef-associated fisheries by 2015 (Burke and Maidens, 2004). The losses associated with diminished production of beach sand and coastal protection in the Caribbean as a result of this reef degradation will be even greater at a projected US\$140–420 million annually over the next 50 years (Burke et al., 2011).

Numerous studies have shown that natural resources are more valuable when conserved (Loomis et al., 2000; Naidoo and Adamowicz, 2005; Burke et al., 2008). Indeed, the traditional market economy is entirely dependent upon the "free" services provided by natural systems (Daily et al., 1997). Investing in natural capital yields considerable net gains, while underinvestment in conservation efforts exposes ecologically valuable resources to degradation (Wells, 1997), leaving society worse off and often exacerbating rural poverty (TEEB, 2009). One of the challenges is that many of the benefits of conservation only occur in the future, so that there is a short-term imbalance between costs of conservation

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and the immediate gains from activities that deplete and/or degrade the environment (Daily et al., 1997). A potential solution is to increase contemporaneous net gains from conservation through promoting uses that enhance human well-being in the near term and are compatible with long term conservation objectives, for example via conservation or ecotourism subsidies or direct payment for ecosystem services (Wunder, 2007; see Abson and Termansen, 2011 for a review). Again, in order to do this, policy-makers need information about the benefits associated with compatible uses and the value of conserving biodiversity. Another challenge is that the uses of natural resources and the services they provide do not have an explicit price, such as the enjoyment derived from diving on a coral reef rich in biodiversity, or the coastal protection that is provided by a healthy reef. To 'monetize' these uses and services requires the use of non-market valuation (NMV) techniques. Despite the depth and breadth of the associated literature on NMV, it has not been applied to the majority of natural assets and the literature often provides inadequate support for policy formation (Pendleton et al., 2007).

Against this background, an adequate understanding of the economic value of environmental goods and services can play an essential role in the policy process. The protection of biological resources maintains essential ecosystem services that, while not explicitly represented in GDP (de Groot et al., 2002), serve to attract foreign exchange to developing nations via tourism (e.g. Troëng and Drews, 2004), and significantly contribute to human health and quality of life (McField and Kramer, 2007). This is extremely pertinent to the insular Caribbean region where tourism is the mainstay of most Caribbean island economies and is itself dependent upon a healthy marine environment (Burke and Maidens, 2004; Agard et al., 2007).

The Caribbean island of Barbados is no exception, with tourism being the major foreign exchange earner, directly responsible for around 15% of GDP in recent years, and generating considerably more via the construction and service sectors (UN ECLAC, 2010). With 97 km of coastline and 92 km<sup>2</sup> of accessible shallow reef associated habitat, Barbados relies heavily on healthy reefs. They provide habitat for numerous species including endangered green and hawksbill sea turtles (Horrocks, 2000). They support nearshore fisheries (Oxenford et al., 2008a; Schuhmann et al., 2011; Maraj et al., 2011) and watersports tourism such as reef viewing and turtle watching via SCUBA diving, snorkeling, glass-bottom boat and recreational submarine (Uyara et al., 2005). Healthy reefs produce and protect the white sand beaches on which Barbados' tourism depends for aesthetics and recreation (Oxenford et al., 2008b, 2010) and on which the local population of endangered hawksbill sea turtles depends for nesting (Beggs et al., 2007). They also protect the coastlines on which the high density tourism infrastructure is built (National Commission on Sustainable Development, 2004). Despite the critical importance of reefs to Barbados, there has been no attempt to determine their economic value through NMV techniques, leaving coastal managers and policy makers with a knowledge gap and lack of empirical justification to support reef conservation efforts. Likewise, there is only informal recognition of the value of sea turtles, as reflected in the numerous ways in which they are used in advertising and promoting Barbados as a holiday destination. Acute threats to reef habitats (e.g. over fishing, poor water quality, sea surfacing warming) and turtle nesting beaches (e.g. coastal construction, beach erosion, beach lighting) around Barbados are growing and in some cases being exacerbated by remediation measures taken to address other problems, such as beach armoring to counteract eroding beaches and protect coastal properties, and alteration of natural drainage to relieve coastal flooding.

We use the NMV technique of choice modeling to explore SCUBA divers' willingness to pay for different attributes of dive

quality including live coral cover, fish species diversity and encounters with sea turtles, and thereby begin to address the knowledge gap in the real economic value of reefs and their associated biodiversity. We explore preference heterogeneity by estimating conditional logit (CL), mixed logit (ML) and latent class (LC) specifications for diver utility. Our analysis may be useful to other researchers exploring the empirical determination of preference heterogeneity in choice modeling applications. Moreover, the value estimates derived here can support decision-making by organizations involved in the use and management of natural systems in Barbados. Given the lack of value estimates associated with reef quality and biodiversity for most Caribbean nations, the results of this work may also serve as a valuable foundation for benefits transfer applications at other sites.

## 2. Methods

### 2.1. Survey instrument

Data were collected using a survey of 165 recreational SCUBA divers in Barbados between July 2007 and April 2009. Divers were intercepted at dive shops on the west and south coasts of the island and asked to participate in the study.<sup>1</sup> Approximately 95 percent of divers were interviewed after returning from a dive trip.<sup>2</sup> The survey instrument was pre-tested on a sub-sample of divers and edited accordingly before being used in the main data collection exercise. Respondents completed a 5-page survey instrument that solicited a range of information regarding demographics, expenditures, dive experience and perceptions of coastal and marine quality encountered during their dive. The survey also incorporated a choice experiment.

### 2.2. Choice experiment (CE)

We used a choice model design with five attributes (one of which was price), each with four levels of condition, to ensure that the choices were cognitively manageable, whilst still permitting the estimation of non-linear main effects for each of the attributes (Kuhfeld, 2006).

Attributes that SCUBA divers consider to be important were ascertained *a priori* through a short interview survey of approximately 50 divers at two dive shops in Barbados, in which they were presented with a list of 30 dive trip attributes and asked to rate (on a scale of 1–5) the importance of each in influencing dive trip choice. The divers were also asked to indicate which single attribute was the most important in influencing their trip decisions. Variables of particular relevance to divers and to local environmental policy took precedence in our choice of attributes. Hence, coral cover, fish diversity, turtle sightings, the number of other divers at the site and price were selected as attributes to be included in the choice experiment. Water clarity, while also obviously important to divers, was not included because on the bank reefs, where much of the diving is concentrated, water

<sup>1</sup> To obtain a representative sample, the distribution of surveys was aligned with the distribution of divers across days of the week, weeks of the year, and across dive shops, as ascertained from key informant dive shop operators and field observation prior to the survey. To enhance the likelihood of preference variation across respondents, interviews were conducted with only one individual per traveling party.

<sup>2</sup> Of the 9 divers who were interviewed prior to a dive, six reported having completed their most recent dive trip in Barbados. We find no statistically significant differences between the two subsamples for ratings of dive quality with the exception of rating of supervision. Those that completed the survey immediately upon returning from a dive had a significantly higher ratings of supervision ( $p$ -value = 0.048).

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