Journal of Environmental Management 192 (2017) 281–291

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Research article

Estimates of the non-market value of sea turtles in Tobago using stated preference techniques

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ARTICLE INFO

Article history:
Received 26 July 2016
Received in revised form
26 December 2016
Accepted 28 January 2017
Available online 6 February 2017

Keywords:
Choice experiment
Contingent valuation
Willingness to pay
Sea turtles

ABSTRACT

Economic benefits are derived from sea turtle tourism all over the world. Sea turtles also add value to underwater recreation and convey non-use values. This study examines the non-market value of sea turtles in Tobago. We use a choice experiment to estimate the value of sea turtle encounters to recreational SCUBA divers and the contingent valuation method to estimate the value of sea turtles to international tourists. Results indicate that turtle encounters were the most important dive attribute among those examined. Divers are willing to pay over US$62 per two tank dive for the first turtle encounter. The mean WTP for turtle conservation among international visitors to Tobago was US$31.13 which reflects a significant non-use value associated with actions targeted at keeping sea turtles from going extinct. These results illustrate significant non-use and non-consumptive use value of sea turtles, and highlight the importance of sea turtle conservation efforts in Tobago and throughout the Caribbean region.

1. Introduction

Sea turtles play an important role in maintaining the health of marine and coastal ecosystems (Heithaus, 2013) and at past population abundances were key species in marine ecosystems (Bjorndal and Bolten, 2003). Through their unique diets (for example, green turtles: seagrass and algae; hawksbills: sponges) they maintain healthy seagrass beds and coral reefs and help balance marine food webs (e.g. Goatley et al., 2012; Hill, 1998; Wabnitz et al., 2010). Sea turtles also provide key habitat for other marine life (Wilson et al., 2010) and facilitate nutrient cycling from sea to land through their nesting behaviour (Bouchard and Bjorndal, 2000). Aside from the ecological services they provide, sea turtles have been exploited for thousands of years for their meat, shell and eggs. Their populations are now a fraction of what they once were as a result of overexploitation (Jackson, 1997), but economic benefits are beginning to be derived from sea turtle eco-tourism, particularly observation of nesting and hatching events (Cazabon-Mannette, 2014; Gutic, 1994; Troeng and Drews, 2004; Wilson and Tisdell, 2001).

Due to their extended geographic ranges and long life spans, turtles are important indicators of the health of the marine environment on small and large scales. These characteristics also expose turtles to a variety of threats. For example, the island of Tobago (sister island of Trinidad) in the Caribbean hosts large numbers of leatherback turtles (now Vulnerable, but classified as Critically Endangered at the time of this study) seasonally to nest, and significant numbers of green (Endangered) and hawksbill turtles (Critically Endangered) that forage at seagrass and coral reef habitats year-round (Cazabon-Mannette, 2016). Loggerhead and olive ridley turtles have also been documented in Tobago (Hailey and Cazabon-Mannette, 2011). Until 2011, green and hawksbill turtles were harvested for meat in a five month legal season in Tobago (Cazabon-Mannette, 2016; Walker et al., 2015). In 2011, all sea turtles in Trinidad and Tobago received complete legal protection from harvest, and in 2014 they received further legal protection when they were designated as Environmentally Sensitive Species (Cazabon-Mannette, 2016). Approximately 20 km of the most important leatherback nesting beaches in Trinidad have been legally protected since the 1990s (Hailey and Cazabon-Mannette, 2011). Analysis of the natal origins of hawksbill turtles reported in Cazabon-Mannette et al. (2016) suggests that hawksbill foraging aggregations in Tobago are predominantly composed of turtles

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http://dx.doi.org/10.1016/j.jenvman.2017.01.072
0301-4797/

originating from rookeries in Cuba, the leeward coast of Barbados and Puerto Rico. Further, a large proportion of the foraging aggregations in the Cayman Islands and Puerto Rico are derived from the Tobago rookery (Cazabon-Mannette et al., 2016).

Economic valuation of non-consumptive use is playing an increasingly important role in shaping policy decisions regarding the conservation and management of natural resources. Non-consumptive uses of turtles have been shown to generate greater revenue than consumptive uses, have greater potential for long-term growth than consumptive uses, and have the potential to create support for conservation and responsible management (Troeng and Drews, 2004). Sea turtle nesting tours are the primary non-consumptive use that generates significant revenue worldwide, including at Grande Riviere and Matura beaches in Trinidad. In 2014, 14,291 visitors were recorded at Matura beach, and tour fees totalled US$45,759 (Dennis Sammy, personal comment). Additionally, sea turtles encountered underwater by snorkelers and divers have been shown to greatly enhance the quality and enjoyment of underwater recreation (Bell et al., 2009; Godley et al., 2004; Kirkbride-Smith et al., 2016; Schuhmann et al., 2013), and a web-based contingent valuation study among US divers found that 76% of divers were willing to pay an additional fee for an increased likelihood of swimming with a sea turtle in the wild (White, 2008). Turtle encounters are thus one of many factors that add value to underwater recreational experiences which can be thought of as composite goods. The conservation of sea turtles has also been shown to convey economic value to society that is not necessarily associated with interaction or use. For example, estimates of the economic value derived from improving the status of endangered marine species in the US, including loggerhead and leatherback turtles (Wallmo and Lew, 2012) and hawksbill turtles (Wallmo and Lew, 2016) have been shown to be significant.

The generation of income directly from turtle nesting in Trinidad has likely been a primary influence on local policy including the legal protection of the most important nesting beaches and the use of government funding to support patrols of nesting beaches. The objective of this study is to gain an improved understanding of the non-use and non-consumptive value of sea turtles in the Caribbean in order to highlight the importance of turtle conservation efforts, influence local policy and provide motivation for coordinated and collaborative regional management.

1.1. Stated preference valuation methods

The contingent valuation method (CVM) and choice experiments (CEs) are stated preference valuation techniques, which can be used to elicit non-market values, including non-use values. CVM relies on the creation of a hypothetical market where respondents express values for a good or service by responding to direct survey questions. Choice experiments recognize that many goods comprise a variety of characteristics which can take different levels. Respondents are asked to rank preferences for alternative goods, rate alternative goods or make choices across goods. Hanley et al. (1998a, 1998b, 2001) and Bateman et al. (2002) suggest that CVM is best suited to valuing an overall policy package, while the principle advantage of CEs is the ability to value individual characteristics of environmental goods and the marginal value of changes in characteristics. The use of CEs can therefore be considered more appropriate to examine diver willingness to pay (WTP) for turtle encounters due to its focus on an attribute-based theory of value (Hanley et al., 2001), the ability to measure the marginal WTP for turtle encounters and the relative importance of different dive attributes (Hanley et al., 1998a). Contingent valuation on the other hand, allows for estimation of a broader value of sea turtles, including non-use value for those who do not encounter sea turtles directly.

Applications of CEs for the valuation of marine quality by divers include Sorice et al. (2005) who examined Texas divers' preferences for supervision, crowding, reef education, the presence of marine life and the amount of an MPA open to diving, Schuhmann et al. (2013), who estimated WTP for fish diversity, turtle sightings, coral quality and crowding in Barbados, Gill et al. (2015) who estimated WTP for fish abundance, viewing large fish and the presence of fishing gear at three countries in the Caribbean, Rodrigues et al. (2015) who estimated WTP for underwater structure, the presence of jellyfish, crowding and the quality of gorgonian corals in Spain and Shideler and Pierce (2016) who estimate recreational divers' willingness to pay for goliath grouper encounters in Florida. Other applications include Wallmo and Lew (2012, 2016), who employed the CE methodology to estimate the value of improving the status of a variety of threatened and endangered marine species in the United States.

CVM has been used extensively to understand values associated with species conservation. Applications for conservation of marine species include Whitehead (1992) who estimated WTP for a loggerhead sea turtle protection program in North Carolina, Loomis and Larson (1994) who estimated the value of increasing gray whale populations in California, Indab (2016) who estimated WTP for whale shark conservation in the Philippines, Solomon et al. (2004) who estimated WTP for protection of manatees in Florida, Casey et al. (2010) who estimated tourists' WTP for coral conservation in Mexico, Stithou and Scarpa (2012) who estimated visitors willingness to pay for conservation of the loggerhead turtle and the monk seal in Greece, and Ressurreição et al. (2012) who used CVM to estimate WTP for conservation of marine mammals, sea birds, fish, invertebrates and algae in Poland, Portugal and the UK. Other examples of economic valuation applied to marine species include Lewis et al. (2012), who estimate the value of African penguins to tourism using the zonal travel cost method, and Cagua et al. (2014), who use market-based approaches to value whale shark tourism in Maldives.

Here we report on the results of a study using both CEs and CVM to assess the non-market economic value of endangered sea turtles to SCUBA divers and to international stay-over visitors to the island of Tobago in the eastern Caribbean, to assess whether non-market value can be as economically beneficial as traditional consumptive use.

2. Material and methods

2.1. Choice experiment design and implementation

The choice experiment methodology follows Schuhmann et al. (2013), who reported on the economic value of marine biodiversity to recreational SCUBA divers in Barbados. Attributes of importance to divers and to local environmental policy were selected for the CE, based in part on interviews with 52 SCUBA divers at 10 dive shops in Tobago in March 2007, and included coral cover, fish diversity, turtle sightings, the number of other divers at the site and price per two-tank dive. Four levels of condition were

Table 1
Dive trip attributes and levels used in the choice experiment.

Attributes	Level 1	Level 2	Level 3	Level 4
Price	US$50	US$100	US$150	US$200
Turtle Encounters	0	1	2	3 or more
Fish Diversity (number of species)	Up to 5	15	25	>25
Coral Cover	5%	15%	25%	35%
Crowding (number of other divers)	15	10	5	0