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The non-consumptive (tourism) 'value' of marine species in the Northern section of the Great Barrier Reef

Marina Farr*, Natalie Stoeckl, Rabiul Alam Beg

School of Business, James Cook University, Townsville 4811, Queensland, Australia

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ABSTRACT

This paper uses the Kristrom (logit) spike model to analyse contingent valuation (payment card) data from a study of 2180 domestic and international visitors taking reef trips to the Northern section of the Great Barrier Reef. It investigates: (a) their willingness to pay for a "100% guaranteed sighting" of several different marine species; and (b) the sensitivity of final estimates to various methodological issues. It finds that final estimates are particularly sensitive to questionnaire design, but that the ranking of species (from most to least 'valued') is robust across a range of methodological specifications. The most valued groups of species were (in order): whales and dolphins; sharks and rays; 'variety'; marine turtles; and finally large fish. Evidently, whale watching is not the only potentially lucrative source of tourism revenue; other marine species may be similarly appealing. These potential revenues need to be considered when making decisions about whether or not to conserve marine species.

1. Introduction

The Great Barrier Reef Marine Park (GBRMP) is one of the world's largest and most diverse ecosystems and is home to thousands of marine animals including populations of dugongs, snubfin and hump-backed dolphins, humpback whales and dwarf Minke whales, sea snakes, six of the world's seven species of marine turtles and a variety of sharks [1].

Since European settlement, development along the coast adjacent to the GBRMP has been associated with extensive agricultural and some urban development which has led to the removal of the buffering and filtering function of the landscape. Suspended sediment loads have been estimated at up to five times pre-European loads in some rivers [2], some nitrate loads are up six times higher than 150 years ago and considerable quantities of pesticides are now discharged from rivers which would have been completely absent prior to the 1950s [3].

These increased sediment, nutrient and pesticides loads to the Great Barrier Reef (GBR) lagoon have been linked to coastal ecosystem degradation in the GBR [4,3], and perhaps at least partially because of that and partially also because of more direct threats such as fishing (for some species only) and other impacts related to climate change—there are now 27 ecologically important marine species in the GBR that have declined significantly and are, therefore, listed as 'critically endangered' under Australian and Queensland Government legislation [5]. This list includes six marine mammals, some shark species (e.g. whale shark, great white shark, grey nurse shark)[1], all marine turtles[2] and eight birds [5].

Not only is this of concern because the species are important by, and of, themselves and for biodiversity in general, but these species are of value for a variety of economic reasons [6,7]. Traditionally, the Total Economic Value Framework groups these values into use and non-use values[3] although if interested in addressing conservation-type questions it is also useful to further distinguish between consumptive and non-consumptive values, giving the following broad categories:

(a) Use values
  (i) Consumptive use values—those which 'relate to the … goods produced by the ecosystem that can be consumed and used by people' [11]. A relevant example here, is when sharks are used for food.

[1] There are 182 species of sharks and 125 ray species occurring in Australian waters and 134 species of sharks and rays are recorded in the GBR. Sharks and rays have been under significant threat in the GBR area because of some commercial and recreational fishing activities (e.g. targeted fishing, bycatch or illegal fishing) or from shark control activities (to provide swimmer protection at popular beaches) [5].

[2] All marine turtles in the GBR are 'recognised internationally as species of conservation concern' [8]. The main threats are pollution, habitat loss, interaction with fisheries, over-harvesting of eggs and meat for body oil and beautiful shells, illegal hunting and predation of eggs by feral pigs, foxes, dogs and goannas [9,10].

[3] Although use-values are often subdivided into 'direct' and 'indirect' use values, and there is some disagreement as to whether option values should be categorised as use of non-use values.

* Corresponding author. Tel.: +61 7 4781 6623; fax: +61 7 4781 4019.
E-mail addresses: marina.farr@my.jcu.edu.au, marishka.farr@gmail.com (M. Farr), natalie.stoeckl@jcu.edu.au (N. Stoeckl), rabiul.beg@jcu.edu.au (R. Alam Beg).

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(ii) Non-consumptive use values—those which generate use-benefits for humans but which do not require one to consume the good or service [12,13]. Corals and marine species such as sea turtles, sharks, and whales 'have non-consumptive use values to divers based on their active enjoyment of diving with these species' (p. 7; [9,10]).

(b) Non-use values—those which do not require one to 'use' an environment or ecosystem—such as existence and bequest values. Existence values arise from knowledge of presence while bequest values arise from wanting to preserve something for future generations [6,13].

There is a long history of using marine species for consumptive purposes, but the demand for non-consumptive uses of wildlife—particularly for recreational activities has been also growing rapidly, worldwide [10,14]. The story is not different in Australia where visitors/tourists regularly expect to interact with different types of wildlife such as

- whales and dolphins in and around the coast [15,16];
- dingoes on Fraser Island [17,18];
- whale sharks in Ningaloo Marine Park, Western Australia [19,20];
- penguins at Kangaroo Island [16] and Phillip Island [21];
- saltwater crocodiles in the Northern Territory [22];
- turtles at the Mon Repos Conservation Park in Queensland [10].

Numerous recreational studies have reported the importance of seeing wildlife, signs of wildlife, and 'the psychological benefits of expecting to see wildlife during the activity' [20,21]. Some researchers have found that various species are 'highly sought after and preferred by visitors, and that visitors are usually willing to pay greater amounts of money to see these' [23] than other species. Yet despite the fact that many researchers around the world [24–35] have estimated the use and/or non-use 'value' of different species, most studies have been undertaken in different parts of the United States. A selection of some of those studies (differentiated according to whether the researcher was estimating non-consumptive use values or non-use values) is presented in Table 1.

This is not to say that little research has been done on the GBR: indeed, there have been more than a dozen published studies that have investigated economic and financial 'values' associated with the tourism and recreational activities in the GBR [47] (see Table 2).

But, only one study has attempted to estimate the value of an individual species on the GBR: Stoeckl et al. [63]; all other studies have, instead, valued activities (which may or may not be associated with individual species). That said, Stoeckl et al.'s [63] study was, like others, primarily focused on valuing an activity (specifically dive tourism) and included only a preliminary, descriptive analysis of data that focused in on particular species encountered whilst diving. As such, relatively little is known about the value of particular marine species (as opposed to the value of an activity that is associated with a variety of species).

This could be an important omission. A well-managed fisher will not put at risk the species it seeks to earn money from. But consumptive uses (e.g. fishing) will generally reduce stocks below that which would prevail in the absence of fishing, and there is

Table 1
Selected studies on non-consumptive use and non-use values of rare or endangered species.

Source	Region	Species	Non-consumptive use value US$	Non-use value US$ or €
Hageman [36]	California, USA	Sea otter	$7.20	$13.62
		Blue or grey whales		$25
		Bottlenose dolphins		$18
		Northern elephant seals		$18
Samples and Hollyer [37]	Hawaii, USA	Humpback whale		$172.92
Olsen et al. [38]	Columbia River Basin, USA and Canada	Salmon and steelhead fish	$47.64	$26.52
Duffield and Patterson [39]	USA	Cutthroat Trout		$13.02
Whitehead [40,41]	North Carolina, USA	Sea turtle		$12.99
Cummings et al. [42]	New Mexico, USA	Squawfish		$8.42
Loomis and Larson [43]	California, USA	Grey whale		$17.15–31.51
Lupton [44]	Tofo beach, Mozambique	Manta ray	$57 (divers)	$14 (divers)
		Whale shark	$50 (divers)	$58 (snorkelers)
			$69 (snorkelers)	
White [9]	USA	Sharks	$35.36	
		Sea turtle	$29.63	
		Corals	$55.35	
Hageman [45]	California, USA	Blue and grey whales		$2.34–17.15
		Bottlenose dolphins		$2.21–12.20
		California sea otters		$2.49–13.62
		Northern elephant seals		$1.16–13.50
Ressurreiçãoa et al. [46]	Pico and Faial Islands, Portugal			Visitors
		Algae		66–77€
		Fish		86–100€
		Mammals		85–99€
		All marine species		581–665€
				Residents
		Algae		45–51€
		Fish		58–66€
		Mammals		58–66€
		All marine species		405–463€
Stithou [88]	Zakynthos Island, Greece			Visitors
		Sea turtle		13–19€
		Monk seal		13–18€
				Residents
		Sea turtle		29.60–32€
		Monk seal		30–40€