

ATTACHMENT C: Review of Literature on Coral Reef Attributes for Recreation-tourism

Beharry-Borg, Nesha and R. Scarpa, “*Valuing quality changes in Caribbean coastal waters for heterogeneous beach visitors.*” Ecological Economics 69 (2010): 1124-1139.

This study examines the impact of the quality of coastal waters upon the tourism sector in Tobago. The purpose of this study is to fill a gap in the literature on valuation estimates specific to Tobago. The study utilizes two choice experiments designed to estimate willingness to pay (WTP) for an improvement in coastal water quality for snorkellers and nonsnorkellers. Study results indicate WTP estimates vary significantly between these two groups. It also demonstrates the value of using estimation methods designed to account for individual-specific difference in WTP estimates. Of all the studies found in the literature review this one included the most comprehensive suite of indicators as noted below.

Coral cover levels were noted as up to 15% coral cover and up to 45% coral cover. Fish abundance levels were 0-10 and 0-60. Water clarity levels were noted as visibility up to 5 m and visibility up to 10 m. Number of other users included recreational and fishing boats near coastline (up to 2, up to 7) and number of snorkelers allowed per group (up to 5, up to 15). Presence of marine protected area included two permutations: MPA where you can tour, swim, snorkel, dive and fish and MPA where you can do all such activities except fish. Coastline development was indicated by levels of up to 75% development allowed and up to 25% development allowed. Levels for risk of contracting an ear infection from swimming in polluted water were noted as increased chance or reduced chance. Plastic debris, as measured by the number of plastics per 30 m of coastline, was indicated by levels of less than 5 pieces or up to 15 pieces. Finally, a contribution fee to beach authority notes pricing levels of \$10, \$20 and \$25. In all cases, with the exception of the fee category, a third possibility for an attribute level was the total absence of a relevant policy.

Ditton, Robert B. and D. Clark, “*Characteristics, Attitudes, Catch and Release Behavior, and Expenditures of Billfish Tournament Anglers in Puerto Rico.*” Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX. July 1, 1994.

This research paper was initiated by The Billfish Foundation. It was designed for three reasons: 1) educate people regarding the social and economic significance of billfish angling, 2) support billfish conservation and management efforts and 3) provide information useful to the billfish conservation community to positively influence policy decisions made by ICCAT. A mailed survey questionnaire was used to collect information from resident and non-resident anglers who participated in tournaments held in Puerto Rico between August, 1991 and October, 1992.

No discrete levels of indicators were noted in this study.

Hargreaves-Allen, Venetia, S. Mourato and E. Milner-Gulland, “*A Global Evaluation of Coral Reef Management Performance: Are MPAs Producing Conservation and Socio-Economic Improvements?*” Environmental Management 47 (2011) 684-700.

This paper provides an analysis using several metrics to answer the question as to whether marine protected areas provide conservation and socio-economic improvements. Performance measures utilized to test the hypothesis include (but were not limited to) fulfillment of design and management criteria, achievement of aims, cessation of banned or destructive activities and

changes in threats. Analytical results were mixed with most MPAs failing to produce improvement in coral cover and conflict reduction. Yet a majority did produce a slowing of coral loss, reduction in destructive uses and an increase in tourism and local employment.

The only indicators listed associated with coral reef condition are 'coral mining/destructive fishing never occurs', 'better coral cover than national average' and 'maintained or improved coral cover'. No discrete levels for these indicators are provided.

Edwards, Peter, "*Sustainable financing for ocean and coastal management in Jamaica: The potential for revenues from tourist user fees.*" Prepared for the Latin American and Caribbean Environmental Economics Program. Project No. WP04. June, 2008.

This study explores the feasibility of implementing a sustainable funding mechanism for ocean and coastal management in Jamaica. The study models contingent behavior for tourists who receive two slightly different scenarios and provides hypotheses about how consumer demand may differ across individuals. Study results indicate that an environmental surcharge of US\$2 per person could generate \$3.4M per year for management with 0.2% rate of decline in tourist visitation.

No levels relevant to coral reef condition were noted in this study.

Parsons, George R. and Steven Thur, "*Valuing Changes in the Quality of Coral Reef Ecosystems: A Stated Preference Study of SCUBA Diving in the Bonaire National Marine Park.*" *Environmental Resource Economics* 40 (2008): 593-608.

This study estimates the economic value of changes in the quality of a coral reef ecosystem to SCUBA divers in the Caribbean who purchased a tag to obtain diving access to Bonaire National Marine Park in 2001. A stated preference mail survey was used to infer the value of three different levels of quality defined by the metrics of visibility, species diversity and percent coral cover.

Coral cover levels are noted at 5%, 20%, 30% and 35%. Coral and fish diversity combination levels are 50 fish/10 corals, 125 fish/25 corals, 225 fish/40 corals and 300 fish/45 corals. Water visibility levels are noted at 20 feet, 50 feet, 75 feet and 100 feet.

Rudd, Murray A., "*Live long and prosper: collective action, social capital and social vision.*" *Ecological Economics* 34 (234): 131-144.

"This paper demonstrates the utility of social capital theory by articulating linkages between human decision making at individual and collective levels and social vision, an important research focus within the emerging ecological economics research tradition."

No levels relevant to coral reef condition were noted in this study.

Schuhmann, Peter W., Juan Seijo and James Casey, “*Economics Considerations for Marine EBM in the Caribbean*” taken from “Towards Marine Ecosystems based Management in the Wider Caribbean.” Center for Maritime Research. MARE Publication Series No. 6. Amsterdam University Press. 2011.

This paper contributes to the ongoing dialogue regarding how an ecosystem approach to fisheries (EAF) may inform ecosystem-based management (EBM) practices and ultimately contribute to successful implementation of EAF in the Caribbean Region. EAF is seen as desirable as it promotes a more holistic approach to resource allocation and management as opposed to the single-species approach to fisheries management.

No levels relevant to coral reef condition were noted in this study.

Spash, Clive L., “*Multiple Value Expression in Contingent Valuation: Economics and Ethics.*” *Environmental Science and Technology* 34 (2000): 1433-1438.

This paper explores the influence of ethics and economics in human value formation. It specifically presents evidence “confirming the influence of ethical beliefs about rights for endangered species in determining willingness to pay (WTP) responses to a CVM survey.”

No levels relevant to coral reef condition were noted in this study.

Spash, Clive L., “*Ecosystems, contingent valuation and ethics: the case of wetland recreation.*” *Ecological Economics* 34 (2000): 195-215.

“This paper addresses a current issue in environmental valuation, namely, the extent to which environmental preferences depart from the usual economics paradigm to incorporate some lexicographic elements. After a theoretical discussion the paper reviews attempts to explore this question empirically by supplementing contingent valuation analyses with an exploration of the motives behind willingness-to-pay responses, including zero bids and refusals to answer.”

No levels relevant to coral reef condition were noted in this study.

Uyarra, Maria C., Isabelle Cote, Jennifer Gill, Rob Tinch, David Viner and Andrew Watkinson, “*Island-specific preferences of tourists for environmental features: implications of climate change for tourism-dependent states.*” *Environmental Conservation* 32 (1): 11-19.

This paper examines the impact that climate change induced alteration in key environmental components of tourism destinations may have on the tourism economies of Bonaire and Barbados. Temperature, water clarity and health risk were determined to be environmental features most influential upon holiday destination selection. A strong correlation was found between the quality of environmental attributes and a willingness of tourists to return. For example, “more than 80% of tourists in Bonaire and Barbados were noted to be unwilling to return for the same holiday price in the event, respectively, or coral bleaching as a result of elevated sea surface temperatures and reduced beach area as a result of sea level rise.”

This study provided a number of environmental attributes to assess what may influence tourism behavior. Environmental attributes included coral diversity, coral cover, coral health, fish diversity, fish abundance,

presence of sea turtles, bird diversity, landscape attractiveness, water clarity, air temperature, few tropical diseases, no malaria, no vaccination requirements, beach size, sand quality and number of tourists. No discrete values for these attributes were provided. Importance of attributes was computed using a Likert scoring system.

Van Beukering, Pieter J.H., Samia Sarkis, Emily McKenzie, Sebastiaan Hess, Luke Brander, Mark Roelfsema, Loes Looijerstijn-van der Putten and Tadzio Bervoets, “Total Economic Value of Bermuda’s Coral Reefs, Valuation of Ecosystem Services”
Institute for Environmental Studies, Vrije Universiteit, Amsterdam, The Netherlands.

“This environmental economic study seeks to address the lack of environmental consideration in current policy and decision-making for the marine environment, by providing a means of recognizing the value of the range of ecosystem services provided by Bermuda’s coral reefs. Bermuda is one of the most densely populated countries in the world, with an economy supported by international business and tourism; increasing coastal development places intense pressure on the island’s natural resources, namely on the marine environment and more specifically on the northernmost coral reef system in the world. The policy issues affecting Bermuda’s coral reefs involve the lack of formal procedure when “planning” or “developing” in the marine environment, and the absence of a mechanism for integrating environmental values into those decisions.”

No levels relevant to coral reef condition were noted in this study.

Waterman, Troy, “Assessing Public Attitudes and Behavior Toward Tourism Development in Barbados: Socio-Economic and Environmental Implications.” Systems Consulting Ltd. Presented at Annual Review Seminar, Central Bank of Barbados. July 27-30, 2009.

“This research discusses the negative social, environmental and economic impacts of tourism development in Barbados; describes the perceptions of residents and tourists to such; and measures their preferences for environmental management changes using the island’s lone marine reserve, the Folkestone Marine Reserve, as a case study. The research outcomes demonstrated that environmental management within the context of tourism development in Barbados requires the balancing of public needs with the environmental and economic consequences of development.”

Attributes listed in this study are *not specific* to coral reef quality. Selected attributes and levels include sewage treatment, facilities and information, watersports zoning, and a payment vehicle for both residents and visitors. Sewage treatment levels include no change in policy, most sewage treated to moderate quality and most sewage treated to high quality. Facility levels include no policy change and signposts showing zones and user information with or without additional public showers/toilets. Zoning possibilities included no policy change, an expansion of watersports zone and complete exclusion of watercrafts from recreational zone. Resident payment levels included \$9, \$15, \$20, \$37, \$48 and \$70. Non-resident (visitor) payment levels were \$15, \$25, \$43, \$60, \$74 and \$100.

Wielgus, Jeffrey, Nanette Chadwick-Furman, Naomi Zeitouni and Mordechai Shechter,
“Effects of Coral Reef Attribute Damage on Recreational Welfare.” Marine Resource Economics
 18 (2003): 225-237.

“This paper presents the results of an economic valuation of coral reef degradation at Eilat, Israeli Red Sea. The marginal prices of coral and fish diversity and water visibility are estimated to be US\$2.60 and US\$1.20 per dive, respectively. From the standpoint of recreational diving welfare, the annual social costs of activities contributing to coral reef degradation are approximately US\$2.86 million.”

Coral cover and fish abundance attribute levels are indicated by a combined index which is based on the number of different taxonomic categories for coral and fish plus abundance per square meter. A low level is 7 taxonomic categories plus 1.75 abundance per square meter. Medium is 20 taxonomic categories plus 5.75 abundance per square meter. High is 21 taxonomic categories plus 11.25 abundance per square meter.

Coral Reef Ecosystem Attributes for Recreation-tourism Ecosystem Service

Attributes/Levels	Reference
1. Coral Cover	
low, medium, high (videos of sites with different levels) See index below under coral and fish diversity.	Wielgus (2003)
Can view up to 15% coral cover while snorkeling, can view up to 45% coral cover while snorkeling	Beharry-Borg/Scarpa (2010)
5%, 20%, 30%, 35%	Parsons & Thur (2008)
2. Coral and fish diversity	
low, medium and high (videos of sites with different levels) Calculated Index as number of different taxonomic categories for coral and fish plus abundance per square meter (m ²).	Wielgus (2003)
Low = 7 taxonomic categories plus 1.75 abundance/m ² or 8.85	
Medium = 20 taxonomic categories plus 5.75 abundance/m ² or 25.75	
High = 21 taxonomic categories plus 11.25 abundance/m ² or 32.25	
50 fish 10 corals, 125 fish 25 corals, 225 fish 40 corals, 300 fish, 45 corals	Parsons & Thur (2008)
3. Fish Abundance	
low, medium, high (see combined index above)	Wielgus (2003)
0-10, 0-60	Beharry-Borg/Scarpa (2010)
4. Water Clarity/Visibility	
Meters of maximum visibility 3, 10 and 30 (videos of reference SCUBA diver at different distances)	Wielgus (2003)
Visibility up to 5 m, visibility up to 10m	Beharry-Borg/Scarpa (2010)
20 feet, 50 feet, 75 feet, 100 feet	Parsons & Thur (2008)
5. Opportunity to View Major Predators/Large Fauna	
Presence/absense	

6. Number of Other Users

Number of recreational and fishing boats near coastline - up to 2, up to 7

Beharry-Borg/Scarpa (2010)

Number of snorkelers allowed per group - up to 5, up to 15

Beharry-Borg/Scarpa (2010)

7. Marine protected area - (presence of a marine protected area)

MPA where you can tour, swim, snorkel, dive AND fish, MPA where you can all

Beharry-Borg/Scarpa (2010)

EXCEPT fish

8. Coastline development - percentage of coastal development on the coastline

Up to 75% development allowed, up to 25% development allowed

Beharry-Borg/Scarpa (2010)

9. Average bathing water quality - Risk of contracting an ear infection from swimming in polluted water

Increased chance, reduced chance

Beharry-Borg/Scarpa (2010)

10. Plastic debris - number of plastics per 30m of coastline

Less than 5 pieces, up to 15 pieces

Beharry-Borg/Scarpa (2010)

11. Sewage Treatment

Most sewage treated to moderate quality, most sewage treated to high quality

Waterman (2009)

12. Facilities/Information

Signposts showing zones and user info, signposts showing zones and user info + more public showers/toilet

Waterman (2009)

13. Watersports zoning

Expansion of watersports zone, total exclusion of watercraft from recreational zone

Waterman (2009)

14. Fee - Contribution fee to beach authority

\$10, \$20, \$25

Beharry-Borg/Scarpa (2010)

Called a 'conservation levy': For residents: \$9, \$15, \$20, \$37, \$48, \$70

Waterman (2009)

For visitors: \$15, \$25, \$43, \$60, \$74, \$100