Artificial reefs and marine protected areas: A study in willingness to pay to access Folkestone Marine Reserve, Barbados, West Indies

Anne E Smith, Philip M Wheeler, Magnus L Johnson

Artificial reefs and marine protected areas offer an interesting management solution to deal with visitor impacts to coral reefs, by providing additional habitat for marine biodiversity viewing. Marine park user fees can generate substantial revenue to help manage and maintain natural and artificial reefs. Using a stated preference survey, this study investigates the present consumer surplus associated with visitor use of the marine protected area in Barbados. Two hypothetical markets were presented to differentiate between respondents use values of either: (a) natural reefs within the marine reserve or (b) artificial reef habitat for amenity enhancement. Information was also collected on visitors' perceptions of artificial reefs, reef material preferences and reef conservation awareness. From a random sample of 250 snorkellers and divers, we estimate a mean willingness to pay of US$18.33 (median – US$15) for natural reef use and a mean value of US$17.58 (median – US$12.50) for artificial reef use. The number of marine species viewed, age of respondent, familiarity with Folkestone Marine Reserve and level of environmental concern were statistically significant in influencing willingness to pay. Regression analyses indicate visitors are willing to pay a significant amount to view marine life, especially turtles. Our results suggest that entrance fees could provide a considerable source of income to aid reef conservation in Barbados . In addition, the substantial use value reported for artificial reefs indicates a reef substitution policy may be supported by visitors to Folkestone Marine Reserve. We discuss our findings and highlight directions for future research that include the need to collect data to establish visitors' non-use values to fund reef management.

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Abstract

Artificial reefs and marine protected areas offer an interesting management solution to deal with visitor impacts to coral reefs, by providing additional habitat for marine biodiversity viewing. Marine park user fees can generate substantial revenue to help manage and maintain natural and artificial reefs. Using a stated preference survey, this study investigates the present consumer surplus associated with visitor use of the marine protected area in Barbados. Two hypothetical markets were presented to differentiate between respondents use values of either: (a) natural reefs within the marine reserve or (b) artificial reef habitat for amenity enhancement. Information was also collected on visitors' perceptions of artificial reefs, reef material preferences and reef conservation awareness. From a random sample of 250 snorkellers and divers, we estimate a mean willingness to pay of US$18.33 (median – US$15) for natural reef use and a mean value of US$17.58 (median – US$12.50) for artificial reef use. The number of marine species viewed, age of respondent, familiarity with Folkestone Marine Reserve and level of environmental concern were statistically significant in influencing willingness to pay. Regression analyses indicate visitors are willing to pay a significant amount to view marine life, especially turtles. Our results suggest that entrance fees could provide a considerable source of income to aid reef conservation in Barbados. In addition, the substantial use value reported for artificial reefs indicates a reef substitution policy may be supported by visitors to Folkestone Marine Reserve. We discuss our findings and highlight directions for future research that include the need to collect data to establish visitors' non-use values to fund reef management.

1. Introduction

Coral reefs are of significant economic value to the scuba diving and snorkelling industries (*Brander, van Beukering & Cesar, 2007*) and via these water-based activities, reef tourism contributes millions of dollars annually to coastal regions (*Dixon, Scura & van't Hof, 1993*; *Cesar & van Beukering, 2004*; *Sarkis et al., 2013*). A majority of reefs are located along the coastal strips of developing countries where people depend heavily on reef ecosystems for their livelihoods (*Cesar, 2000*; *Cesar, Burke & Pet-Soede, 2003*; *Burke et al., 2011*). In the Caribbean for example, *Burke &*

Maidens (*2004*) estimated the value of goods and services derived from coral reefs in 2000 were between US$3.1 and US$6 billion, from which an annual figure of US$2.1 billion was generated from diving tourism. In St. Lucia and Tobago alone, direct spending by coral reef associated tourists in 2006 contributed an estimated US$91.6 and US$43.5 million to each economy, respectively (*Burke et al., 2008*). More recently, *Sarkis et al.* (*2013*) calculated the average total economic value of Bermuda's coral reefs was US$722 million per year, from which US$406 million was related to coral reef tourism. Despite the value of coral reefs to coastal populations for marine recreation, shoreline protection and fisheries production, among others (*Moberg & Folke, 1999*), global reef decline continues as a result of various anthropogenic activities (*Halpern et al., 2008*).

Marine protected areas (MPAs) have largely become an effective means of conserving reef ecosystems from human impacts (*Halpern, 2003*; *Lester et al., 2009*) while still allowing for recreational use of resources including scuba diving and snorkelling (*Thurstan et al., 2012*). Considered by some to be the 'pinnacle' in marine conservation (*Thurstan et al., 2012*), an MPA is defined as "an area of sea especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources, and managed through legal or other effective means" (*Department of the Environment, 2013, p.4*). The last four decades have witnessed a proliferation of MPAs globally (*World Data Base on Protected Areas* (*WDPA*), *2013*). As of 2006, almost a thousand marine parks and equivalent protected areas were designated covering over 98,650 km^2 or 18.7% of the world's coral reef habitats (*Mora et al., 2006*). The many potential conservation benefits of MPAs are well documented (*e.g. Gell & Roberts, 2003*; *Selig & Bruno, 2010*), including an increase in the diversity and abundance of numerous fish species (*Mosqueira et al., 2000*; *Halpern & Warner, 2002*; *McClanahan et al., 2006*). As a consequence, biological enhancement typically increases the attractiveness of marine parks to divers and snorkellers (*Barker, 2003*), though this in itself may cause a dilemma between protection and use of coral reef resources (*Thurstan et al., 2012*).

In general, MPAs manage visitor use of reefs through a system of zoning (*Day, 2002*; *Roman, Dearden & Rollins, 2007*) and by implementing carrying capacity measures (*e.g. Hawkins & Roberts, 1997*; *Brylske & Flumerfelt, 2004*; *Ríos-Jara et al., 2013*).

Increasingly however, marine managers are investigating other ways of reducing the impacts of underwater recreational activities. Artificial reefs and MPAs have been envisaged as potentially interesting management solutions to deal with visitation levels to natural reefs (*Oh, Ditton & Stoll, 2008*), by providing additional habitat for marine biodiversity viewing (*e.g. Wilhelmsson et al., 1998*; *van Treeck & Schuhmacher, 1999*; *Polak & Shashar, 2012*). This practice helps alleviate visitor pressures from sensitive or heavily used natural reefs (*Leeworthy, Maher & Stone, 2006*; *Polak & Shashar, 2012*; *Kirkbride-Smith, Wheeler & Johnson, 2013*) and may contribute significant revenues to local host economies (*e.g. Brock, 1994*; *Wilhelmsson et al., 1998*; *Dowling & Nichol, 2001*; *Johns et al., 2001*; *Johns, 2004*; *Pendleton, 2005*; *Oh, Ditton & Stoll, 2008*). However, the use of artificial reefs for amenity enhancement has not been without past criticism (*Oh, Ditton & Stoll, 2008).* Such condemnation has largely been due to the ubiquitous use of 'materials of opportunity' for reef creation (*Stone et al., 1991*; *Tallman, 2006*), including car tyres (*Collins, Jensen & Albert, 1995*; *Collins et al., 2002*). Nevertheless, well conceived artificial reefs may facilitate various management strategies within protected waters including influencing the location of recreational use (*Leeworthy, Maher & Stone, 2006*; *Polak & Shashar, 2012*) and visitor behavior via scientifically-based interpretation materials (*Rangel et al., 2014*).

Despite the potential efficacies of MPAs (*Halpern & Warner 2002*; *Halpern, 2003*; *Lester et al., 2009*), many fail to meet management objectives (*Burke, Selig & Spalding, 2002*; *Burke & Maidens, 2004*; *Wells, 2006*; *Burke et al., 2011*; *De Santo, 2013*), are severely under funded (*e.g. Alder, 1996*; *Depondt & Green, 2006*) and exist as 'paper parks' only (*Brandon, Redford & Sanderson, 1998*; *Bruner et al., 2001*; *Bonham, Sacayon & Tzi, 2008*; *Mora & Sale, 2011*). Various funding mechanisms exist including personal donations, lottery revenues, international assistance and government taxes (*Spergel & Moye, 2004*). However, none of these mechanisms are wholly reliable. For instance, government taxes can be re-directed to responsibilities elsewhere (*Lindberg, 2001*), especially in times of economic difficulties (*Spergel & Moye, 2004*). Reef-based tourism is considered to be a lucrative means of financing protection of marine parks (*e.g. Dharmaratne, Sang & Walling, 2000*; *Depondt & Green, 2006*; *Peters & Hawkins, 2009*), through the recovery of user fees from visitors. Techniques, including the contingent valuation

method of 'willingness to pay', are used to determine the level visitors would contribute. Fees collected can increase the management capacity of parks through for example; education, scientific monitoring and enforcement (*Hime, 2008*; *Uyarra, Gill & Côté, 2010*) collectively helping sustain future conservation of reefs. However, many marine reserves remain free to use, or charge a nominal entrance fee (*Terk & Knowlton*, 2010; *Peters & Hawkins, 2009*), this is despite evidence that in some circumstances user fees could increase substantially with little impact on visitor numbers (*Thur, 2010*).

Bryant et al. (*1998*) and *Burke et al.* (*2011*) emphasize the need for countries harbouring coral reefs to conduct applied valuation techniques to help underpin decision and policy-making. An integral part of willingness to pay studies is to discern what motivates people to donate funds. The non-economic motives behind willingness to pay for biodiversity conservation have been explored (*Martín-López, Montes & Benayas, 2007*) with results proposing familiarity and biophilia as having a marked effect on payment attitudes. Some authors (*e.g. Cooper, Poe & Bateman, 2004*; *Spash, 2006*) suggest that intrinsic value is the main motivator explaining visitor's choice to contribute, as is bequest value that benefits future generations (*Hargreaves-Allen, 2010*). Researchers have also sought to establish what factors influence how much visitors are willing to pay. Studies indicate that users of reefs (usually divers and snorkellers surveyed) are willing to allocate more money for an increase in the abundance or quality of a specific reef attribute or group of attributes (*e.g. Rudd & Tupper, 2002*; *Schuhmann, Casey & Oxenford, 2008*; *Polak & Shashar, 2013*). Additionally, the opportunity of viewing charismatic mega-fauna including marine turtles and whale sharks is greatly valued (*Hargreaves-Allen, 2010*; *Schuhmann et al., 2013*; *Farr, Stoeckl & Beg, 2014*). Conversely, studies have noted losses in consumer surplus relating to the demise of coral reefs. For example, *Doshi et al.* (*2012*) reported a reduction in divers' welfare identified by their decrease in willingness to pay for bleached coral reefs.

Numerous researchers (*e.g. Dixon, Scura & van't Hof, 2000*; *Arin & Kramer, 2002*; *Barker, 2003*; *Mathieu, Langford & Kenyon, 2003*) have undertaken contingent valuation surveys to measure visitors' willingness to pay for marine park entry (Table 1). In a meta-analysis detailing 18 studies, *Peters & Hawkins* (*2009*) found an

overwhelming approval of users to pay entrance fees, or an increase in fees, where charges currently existed. Additionally, there is evidence that user fees can generate sufficient funds to cover a significant share of marine park operating costs (*Spergel & Moye, 2004*). For example, in Australia's Great Barrier Reef Marine Park, tourist-based user fees of US$5 million contributed around 20% of the budget of the park authority in 2002/2003 (*Skeat & Skeat, 2003*). On Bonaire, user fee collections of around US$1 million represented 93% of the income required to operate the National Marine Park in 2008 (*STINAPA, 2009*; *Uyarra, Gill & Côté, 2010*).

To date, there has been a clear emphasis on measuring the consumer surplus of visitors' recreational use of natural reefs (*reviewed in Peters & Hawkins, 2009*). In contrast, only a handful of contingent valuation studies appear to have measured visitors' consumer surplus relating to recreation-orientated artificial reefs (*Bell, Bonn & Leeworthy, 1998*; *Ditton & Baker, 1999*; *Johns et al., 2001*; *Johns, 2004*; *Crabbe & McClanahan, 2006*; *Oh, Ditton & Stoll, 2008*; *Hannak et al., 2011*; *Chen et al., 2013*). However, none of these studies used marine park entrance fees as the payment vehicle to estimate consumer surplus, and just three papers (*Johns et al., 2001*; *Johns, 2004*; *Oh, Ditton & Stoll, 2008*) estimated recreational values of artificial and natural reefs in the same locality. To address this dearth of information, a valuation study was developed that encompassed both artificial and natural reef habitats within a MPA.

1.1 Research Aims

The main purpose of this analysis was to investigate the present consumer surplus associated with visitor use of the MPA in Barbados, using the contingent valuation method of willingness to pay. Willingness to pay is defined as, "the maximum amount a person is willing to pay for a good or service" (*Waite et al., 2014, p.77*). The payment vehicle used was a daily, per person entrance fee into the marine reserve. Two hypothetical markets were presented to differentiate between respondents use values of either: (a) natural reefs within the marine reserve or (b) artificial reef habitat for amenity enhancement. Further research objectives were to establish which characteristics influenced and thus explained differences in visitor willingness to pay. Finally, data were collected on respondent preferences towards artificial reef materials that were viewed appealing for use in future reef projects. We

discuss our findings with relevance to visitors funding reef conservation and highlight the potential that reserves and artificial reefs have for symbiotic partnerships in coral reef management.

Table 1. Selected papers and key findings of willingness to pay studies to access coral reefs in MPAs.

Author(s) (year)	Location	Users surveyed	Per	Value per user [a]		Suggested fee
				WTP mean	median	
Dixon, Scura & van't Hof (2000)	Bonaire	Divers only	Annum	$27.40	$20	$10
	_	_	_	_	_	_
Spash (2000)	Jamaica	Locals & tourists	Annum	$25.89	$2.87	N/R
Spash (2000)	Curaçao	Locals & tourists	Annum	$25.21	N/R	N/R
Arin & Kramer (2002)	Anilao, Philippines	Divers & snorkellers	Visit	$3.70	$3	$4
Arin & Kramer (2002)	Mactan, Philippines	Divers & snorkellers	Visit	$5.50	$5	$5.50
Arin & Kramer (2002)	Alona, Philippines	Divers & snorkellers	Visit	$3.40	$3	$4
Mathieu, Langford & Kenyon (2003)	Seychelles	Divers & snorkellers	Visit	$12.20	N/R	$12.20
	_	_	_	_	_	_
Seenprachawong (2003)	Phi Phi, Thailand	Divers & snorkellers	Visit	$7.18	N/R	$1

Notes: [a] reported in year of study in US dollars. N/R, not recorded in original paper.

2. Methods

2.1 Study Setting

All divers completed the survey themselves and gave their permission to use the results. Individuals were not identifiable from the data provided. The work described in this paper was reviewed and approved by the Centre for Environmental and Marine Science departmental ethics committee (certificate number H030). Verbal assurance was provided by a representative of the Barbadian Coastal Zone Management Unit that no permit is required to conduct questionnaire based research on the island.

This study was conducted on the west (leeward) coast of Barbados (13°10'N, 59°32'W) between the months of July to August 2013, over an 18 day period. Akin to many Caribbean islands, the tourism appeal of Barbados depends on its coastal environment. Coral reefs fringing the south-west coast (*Lewis, 1960*) provide a diversity of recreational opportunities including diving, snorkelling and sub-marine viewing. *Schuhmann, Casey & Oxenford* (*2008*) estimate that between 30,000 and 50,000 divers visit the island per year and the *Inter-American Biodiversity Information Network* (*2010*) report a further 176,600 visitors participating in snorkel trips. As a way of diversifying the marine tourism industry, several artificial reefs have been deployed along the south-west coast (*Agace, 2005*).

One small MPA (2.1 km^2) Folkestone Marine Reserve, is located in the parish of St. James on the western side of the island (*Cumberbatch, 2001*). The reserve extends for 2.2 km along the coastal fringe and stretches outwards between 660-950 m offshore (Fig. 1). Legislated in 1981 (*Cumberbatch, 2001*), the marine reserve protects 0.32 km^2 of accessible fringing, patch and bank reef (*Inter-American Biodiversity Information Network, 2010*) including nesting sites of the endangered hawksbill turtle *Eretmochelys imbricata* (*Horrocks & Scott, 1991*; *Beggs, Horrocks & Krueger, 2007*). A small artificial reef consisting of a disused barge (approximately 8 m long), that provides a site for instructor-led dives and for snorkellers, is situated within the reserve (Fig. 1). Encompassing just 11% of the coastline (*Cumberbatch, 2001*), the reserve attracts multiple stakeholders and represents the most heavily used recreational space in Barbados (*Blackman & Goodridge, 2009*), including

approximately 7,000 scuba divers using the Folkestone reefs per year (*Inter-American Biodiversity Information Network, 2010*). In anticipation of potential user conflict, the reserve has been divided into four distinct zones (*Cumberbatch, 2001*) (Fig. 1). The sites used for this study were located within Folkestone Marine Reserves 'southern water sports zone' (principally Sandy Lane patch reef and the disused barge – Site 1) and a site to the outside of the northern reserve boundary (Site 2), adjacent to the Lone Star reef (Fig. 1).

2.2 Valuation Method and Related Issues

The survey adopted a payment card contingent valuation method to elicit visitors' willingness to pay. Other common response formats used to measure demands for non-market goods, are single- and double-bounded dichotomous choice and open-ended questioning techniques. All four valuation approaches are subject to some degree of bias (*Bateman et al., 2002*; *Boyle, 2003*), though this can be reduced with the careful design and pre-testing of surveys (*e.g. Boyle et al., 1998*). Despite various biases, each of these stated preference techniques uses hypothetical market scenarios to discern a respondent's likely behaviour under various conditions of either willingness to pay, or willingness to accept, for an increase/decrease in a public good. In the case of the payment card approach, it uses an ordered set of threshold values that respondents are asked to peruse and indicate the highest value they are willing to pay. *Bateman et al.* (*2002*) and *Boyle* (*2003*) outline the various advantages of payment cards including the avoidance of anchoring and 'yea saying' to a sole bid presented (a problem in dichotomous choice) and the avoidance of starting point bias. In addition, *Mitchell & Carson* (*1989*) suggest payment cards assist in reducing non-response rates and eliminate the need for prompting by the interviewer. They have also been shown to yield willingness to pay estimates that are more conservative than those generated using other stated preference techniques (*Champ & Bishop, 2006*; *Thur, 2010*). Payment cards are however, subject to specific forms of bias relating to the design configuration in range of monetary values and size of intervals chosen (*Bateman et al., 2002*). Indeed, in payment card data, the true willingness to pay value is thought to lie between the bid amount chosen and the next highest value up on the payment card (*Cameron & Huppert, 1989*; *Bateman et al., 2002*; *Boyle, 2003*). Thus intervals rather than 'point' valuations are used in most statistical models.

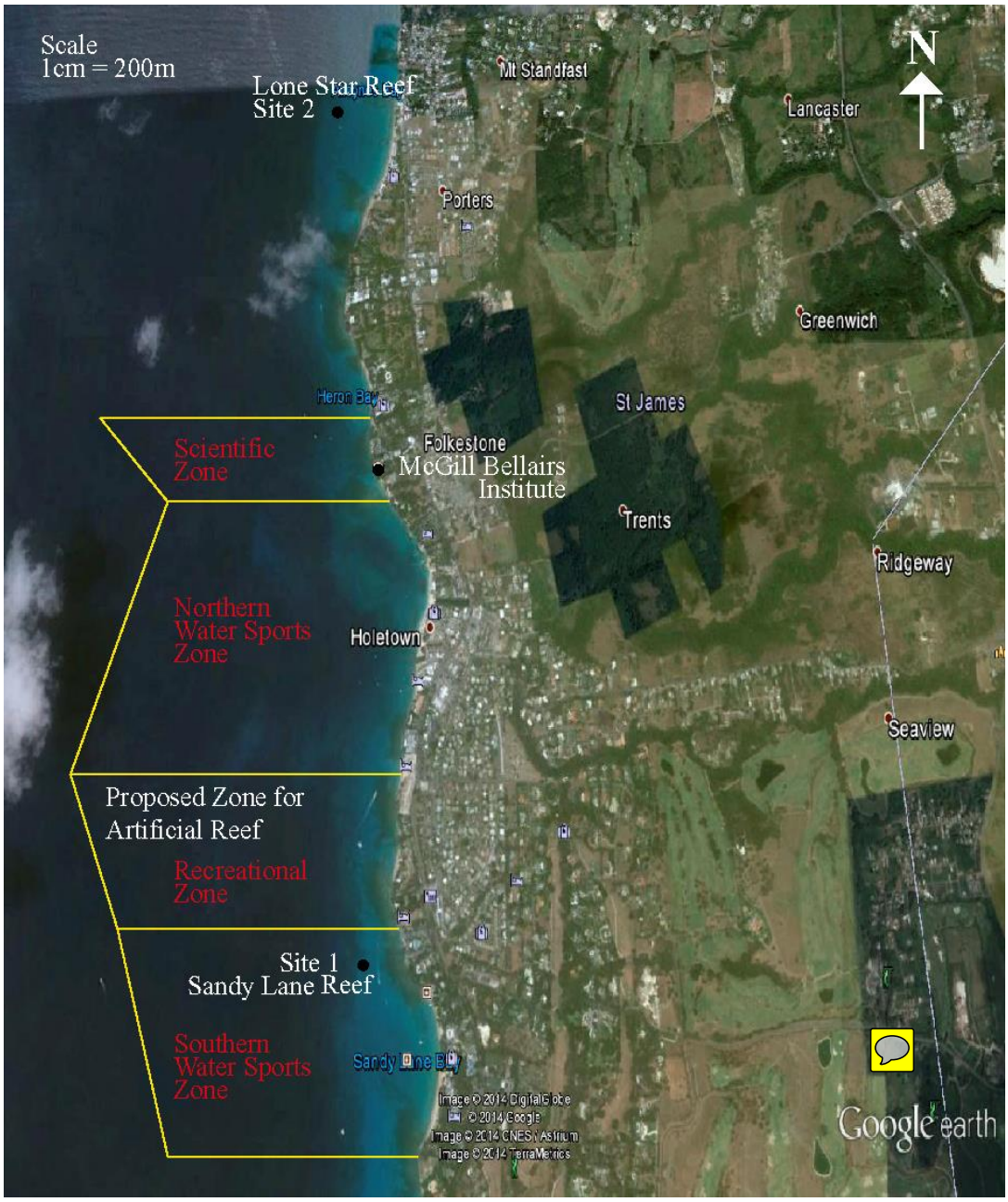

Figure 1. Folkestone Marine Reserve, Barbados. Map outlining boundary of marine protected waters and locations of study sites and proposed artificial reef (*Modified from: Google earth, 2014*).

2.3 Survey Design and Data Collection

An initial site visit to Folkestone Marine Reserve was conducted in 2012, to establish any entrance fee payment structure already in place (of which there were none) and to determine visitor trips/user patterns within the reserve. Additionally, an informal focus group consisting of divers and snorkellers was held to ascertain the range of bid values to be used in the data collection instrument. Two versions of the survey were produced; one aimed at valuing artificial reefs and the second aimed at valuing natural reefs. Both instruments were identical with the exception of sentence three and the wording 'artificial reef' in sentence four of the artificial reef valuation question (presented below) which were omitted from the natural reef script. The final survey consisted of 46 questions divided into five sections. A majority of the questions were closed-ended, as *Champ* (*2003*) suggests this format helps avoid respondent fatigue and simplifies statistical analysis in willingness to pay studies.

The first section explored respondents demographic characteristics that included number of years spent in education, country of residence and age. In this section also, participants were asked questions relating to their length of stay in Barbados and any previous visits to the island. In the second section, visitors were questioned about their marine recreation participation. A 5-point Likert rating scale (range: very experienced to very poor) was presented to establish their snorkelling proficiency. To gauge the experience of those who scuba dived, we asked for the number of dives they had logged in their diving history. A similar scale (range: very satisfied to very dissatisfied) was used to assess visitor satisfaction with snorkelling and diving on the island. The final question in section two assessed which marine related activities respondents had undertaken during their present stay. In the third part of the survey, the hypothetical valuation scenario was presented to establish each visitor's willingness to pay bid value. The valuation script contained background information pertinent to the reefs within the reserve and the challenges encountered in managing them. A laminated map of the reserve (Fig. 1) was shown to each visitor prior to the willingness to pay question being asked, as were photos of common species found within the reserve. Additionally, in the artificial reef survey, laminated cards of popular artificial reef materials were presented. The exact wording of the valuation question presented in the artificial reef survey was:

*Today, no entrance fee to visit the coral reefs and marine species within Folkestone Marine Reserve is paid by you as a visitor. All funding to conserve the reefs here is sourced elsewhere. There is a proposal to develop one or more artificial reefs within the reserve for both snorkelling and diving (show map and explain). An entrance fee into the reserve (held in a trust fund) would be used to help manage and maintain the artificial reefs within this protected area. With this in mind, I am going to show you a set of numbers in US dollars. Please consider your total trip costs for this visit and tell me; what is the maximum you would be willing to pay '**over and above your present trip costs**' as a daily entrance fee to recreate in Folkestone Marine Reserve?*

The survey presented 12 payment values in ascending order (*Champ, 2003*) from US$0 to US$60 (Table 3) from which respondents were asked to choose a value (or to specify another amount if above $60) as an indication of their willingness to pay to help manage and maintain the reefs within Folkestone. Section three of the survey also included follow-up questions exploring the rationale given for a bid value, or if a zero bid was given, the reason for that particular choice. We also asked respondents which type of organization they would prefer to manage the entrance fee revenues and enquired about any concerns relating to the management of funds raised. The fourth section of the survey was used to query respondents on their knowledge and use of artificial reefs, both in Barbados and elsewhere in the world. We included a specific question to identify respondents preferences, placed in rank order, relating to types of materials used for artificial reef creation. At this point of enquiry, three laminated cards with images of artificial reefs were shown to individuals. Three questions were also embedded in section four to help capture each visitor's environmental awareness and concern for reefs and the marine environment. The final part of the survey aimed to establish respondent's prior and current experience(s) of Folkestone Marine Reserve. We asked visitors to use a 5-point Likert rating scale (range: very good to very poor) to rate the quality of the seawater, coral and fish life encountered on their present trip. A question was also used to establish what marine life visitors had viewed whilst underwater. Finally, respondents were requested to score their overall experience of the reserve on a 4-point Likert rating scale (range: exceeded expectations to not satisfied expectations) after which visitors were asked to clarify if they had plans to return to the reserve in future.

A preliminary test of the survey (n = 20) was conducted in Barbados on the target population and changes made accordingly, prior the main data collection period. *Dharmaratne & Brathwaite* (*1998*) emphasize the importance of choosing respondents familiar with the good being valued, thus the sample frame population consisted of snorkellers and/or divers with prior experience of either activity. In addition, English speaking overseas tourists of any nationality, between the ages of 18 to 70 years of age, visiting the reserve, were a requirement. As very few Barbadian residents scuba dive or snorkel (*Inter-American Biodiversity Information Network, 2010*), they were not included in the surveying process.

Visitors to Folkestone Marine Reserve were approached on board Tiami catamaran cruise trips (www.tiamicruises.com). These 5 hr snorkelling trips visit the reserve daily, providing visitors with two 30 minute snorkel stops (Fig. 1) and a beach visit. A randomized sampling technique was chosen to sample the population by approaching every other seated tourist, moving systematically from the front to the rear of the catamaran. In view of the fact that interview context has been reported as a significant determinant of willingness to pay (*Arrow et al., 1993*; *Hime, 2008*; *Hargreaves-Allen, 2010*) all interviews were conducted personally using the same location (i.e. on-board a Tiami catamaran) and after experiencing the reserves underwater environment. Each interview took approximately 20 minutes to complete. For consistency, the same two interviewers administered both surveys on a rotational (daily) basis, initially giving each respondent a short introduction to explain the reasons for the survey. Only one survey type was administered to each respondent. Prior to the bid valuation question being presented, it was emphasized that no entrance fee is currently imposed on visitors to the reserve. All visitors who participated in the survey gave their permission to use the results on an anonymous basis.

2.4 Data Analysis and Willingness to Pay Estimation

Responses were analyzed using SPSS (Version 19) or R (*R Development Core Team, 2008*). To investigate differences between the responses given in survey 1 (artificial reef scenario) and survey 2 (natural reef scenario), we applied Chi-square tests with Yate's Continuity Corrections for categorical data and Mann-Whitney U tests (two-

tailed) for continuous data. Variations in willingness to pay were investigated for several variables (e.g. between divers and snorkellers and for Likert scale questions) using Mann-Whitney U tests (two-tailed) and Kruskal-Wallis tests, where applicable. Consistent with the method adopted in *Fitzsimmons* (*2009*), a distinction was made between the experience level of divers, denoted by two categories; novice divers (< 100 logged dives) and experienced divers (≥ 100 logged dives).

Data were screened for zero bids (US$0) and each individually assesses, via follow up questions, as to why the respondent was not willing to pay. Mean and median willingness to pay, prior to and after zero bid removal, were compared. Following *Bateman et al.* (*2002*), zero bids were excluded from the data prior to calculating mean and median willingness to pay for all models. We ensured that specific characteristics of the sample (e.g. age and gender) had not been systematically biased, by testing for significant differences between the two study populations. Standard errors and 95% confidence intervals of estimates of willingness to pay were calculated using bootstrapping (*Kling & Sexton, 1990*) based on 1,000 replications.

2.5 Econometric Analysis

Willingness to pay (WTP) is hypothesized to be influenced by a number of independent variables (*Arin & Kramer, 2002*) represented by the vector $\boldsymbol{x}$.

$$\boldsymbol{WTP_i = \beta' x_i + \varepsilon_i}$$

where $\boldsymbol{\beta}$ is a vector of slope parameters and $\boldsymbol{x_i}$ is a vector of observations on the explanatory variables for individual $\boldsymbol{i}$. The error term $\boldsymbol{\varepsilon_i}$ is assumed to be normally distributed.

Payment card data were analyzed using interval regression (*Bateman et al., 2002*), as it is thought that the true payment value given lies between the value chosen and the value bounding the upper interval of that category (*Cameron & Huppert, 1989*). Thus for the payment card sample, a maximum likelihood estimation (MLE) procedure was used (*Cameron & Huppert, 1989*) that accommodates the intervals, that is the

probability that WTP falls in the range defined by the lower limit t_{li} and the upper limit t_{ui}, represented by the adjacent payment card value given by;

$$Pr(\log w_i \subseteq (\log t_{li}, \log t_{ui}))$$

$$= Pr\,(\log t_{li} - X'_i\beta)/\sigma < z_i < Pr(\log t_{ui} - X'_i\beta)/\sigma),$$

where z_i is the standard normal random variable. *Arin & Kramer* (*2002*) note that because the probability given by the latter equation can be written as the difference between two standard cumulative densities a likelihood function can be defined over the parameters β and σ. Interval regression analysis was performed to estimate the interval boundary parameters (*Therneau, 2014*).

For comparison, an ordinary least squares regression model was also applied. In the latter model, the precise mid-point of each interval category is used as the dependent variable of willingness to pay. Normality is assumed for the regression models (*Cameron & Huppert, 1989*), with a *lognormal* conditional distribution proposed as a first approximation. Many researchers have adopted *Cameron & Hupperts* (*1989*) methodology in willingness to pay studies using payment cards (*e.g. Arin & Kramer*, 2002; *Blaine et al., 2005*; *Mahieu, Riera & Giergiczny, 2012*; *Yang, Hu & Liu, 2012*), as one of the advantages is that value estimates can be interpreted in a straightforward manner (as apposed to log transformed data). Also, by using both interval regression and an ordinary least square model, it helps validate the payment card range presented and serves as an ad hoc check of the normality assumption. The stepwise backward elimination method was employed for both regression models to investigate the effects of 12 independent predictor variables (Table 2) on visitors' total willingness to pay. Variables that did not yield covariates significant at ≤ 10% level were excluded from the final model.

Table 2. Descriptions of the explanatory variables.

Variable	Description
Age	Continuous: the age of the respondent
Gender	Discrete: 1 = male, 0 = female
Education	Continuous: number of years the respondent has spent in education
Barbados_visits	Continuous: number of visits to Barbados
Env_concern	Continuous: level of environmental concern: 1 being the least concerned, 10 being the most concerned
Catamaran_cruise	Continuous: how many catamaran cruises undertaken in Folkestone Marine Reserve?
Dived_FMR	Discrete: if the respondent had dived in Folkestone Marine Reserve, 1 = yes, 0 = no
Species_view	Continuous: number of species mentioned in response to open ended question to the no. of species encountered
Satisfaction_trip	Discrete: did the snorkel trip satisfy expectations? 1 = yes, 0 = no
Fish_life	Discrete: if the respondent rated the fish life viewed as good, 1 = yes, 0 = no
Coral_life	Discrete: if the respondent rated the coral life viewed as good, 1 = yes, 0 = no
Seawater_quality	Discrete: if the respondent rated the seawater quality as good, 1 = yes, 0 = no

3. Results

3.1 Visitor and Holiday Characteristics

Surveys (n = 250) were completed during the study period divided equally between the two reef scenarios (n = 125 for each survey). An almost equal sex ratio (51% female) was recorded from both surveys. The majority of visitors resided in the United Kingdom (72%), followed by the United States (12%), with 5 additional countries (Canada, Brazil, Norway, Italy and the Caribbean Island States) making up the sample. The mean and median age of respondents was 38 (± 13.6 s.d.) and 40 years respectively, with an age range of 18 - 69 years recorded. The total number of years visitors had spent in education ranged from 11 - 27 years with the average length being 16 (± 3.3 s.d.) years. Over a third (38%) of those surveyed, were repeat visitors to Barbados with a mean of 3 (± 3.9 s.d.) visits (including the present one). The number of nights being spent on the island ranged from 2 – 30 nights, with the majority (50%) of respondents having an average duration of 12 (± 3.9 s.d.) stop-overs. Group differences investigated between survey 1 and survey 2 identified one variable; *Age* being statistically different between the two surveys (U = 6173, z = -2.206, $p \leq 0.027$, r = 0.14). Artificial reef survey participants were slightly older than natural reefs survey participants; means: 39 (± 14.25 s.d.) and 36 (± 12.7 s.d.) years, medians: 43 and 36 years, respectively. Data from the *Caribbean Tourism Organization* (*2014*) for visitors to Barbados in 2013 were used to assess for sample representativeness. From the limited data available, tourist stop-over arrivals for that year suggest that our sample was over-represented by UK respondents. Additionally, no cruise ship tourists were available for interview.

3.2 Marine Recreation Participation

Prior to the survey being administered, visitors had carried out 3.75 (± 0.9 s.d.) activities whilst on vacation. The majority had relaxed on the beach (85%), swam (81%), snorkelled from the shore (39%), kayaked (21%) and scuba dived (12%). The majority of snorkellers described themselves as being average (50%) to very good (31%) at the sport, while 17% suggested they were poor and a further 2% very poor at snorkelling. Respondents that scuba dived (n = 76) had an average of 32 (± 86.81 s.d.)

previously logged dives and a median of 10 dives [interquartile range: 2-25]. Seventy-four percent of the sample had been given a snorkelling and/or diving briefing at some point in their life. When visitors were asked to rate their satisfaction with snorkelling on the island in general, 83% was either satisfied (41%) or very satisfied (42%) with the experience, with the remainder being ambivalent. Respondents who had dived (n = 39) whilst visiting Barbados, were all either satisfied (66%) or very satisfied (34%) with their prior experiences.

3.3 Folkestone Marine Reserve Willingness to Pay

A total of 7 zero bids (Table 3) for willingness to pay were identified. Follow-up questions were asked to establish the reason why a zero bid was given. Four individuals were uncertain the money would be spent on reef conservation *per se* while the remaining respondents were unsure their contribution would make any difference to the condition of the reefs in Folkestone Marine Reserve.

Table 3. Interval selection frequencies of willingness to pay bids (daily, per person).

	Raw frequency (%)					
Interval (US$)	**All data (n =250)**		**AR data (n = 125)**		**NR data (n = 125)**	
0	7	(2.8)	4	(3.2)	3	(2.4)
2 – 5	4	(1.6)	3	(2.4)	1	(0.8)
5 – 8	22	(8.8)	12	(9.6)	10	(8.0)
8 – 10	26	(10.4)	11	(8.8)	15	(12.0)
10 – 15	70	(28.0)	35	(28.0)	35	(28.0)
15 – 20	43	(17.2)	16	(12.8)	27	(21.6)
20 – 25	42	(16.8)	26	(20.8)	16	(12.8)
25 – 30	12	(4.8)	7	(5.6)	5	(4.0)
30 – 40	11	(4.4)	8	(6.4)	3	(2.4)
40 – 50	6	(2.4)	1	(0.8)	5	(4.0)
50 – 60	4	(1.6)	1	(0.8)	3	(2.4)
> 60	3	(1.2)	1	(0.8)	2	(1.6)

Notes: AR = Artificial reef, NR = Natural reef. Figures in parenthesis are percentages.

Zero bids were removed and mean and median values calculated for pooled data and for each individual survey (Table 4). Mean values were higher than median values for

all estimates calculated. This was due to positive right skews in the willingness to pay distributions. The removal of the few zero bids had a meager US$0.51 impact on mean willingness to pay (Table 4), which did not bias the results. For pooled data, mean willingness to pay (person/day) was estimated at US$17.96 with a lower bound of US$16.62 and an upper bound of US$19.27 at a 95% confidence interval. Visitors who were asked the natural reef survey question, had a higher mean willingness to pay of US$18.33 in comparison to mean values estimated for visitors presented with the artificial reef survey; US$17.58. The median value was also higher for the natural reef scenario (US$15) than for the artificial reef scenario (US$12.50). Differences in willingness to pay between the two surveys were not significant ($U = 7291$, $z = -.167$, $p \geq 0.867$, $r = .01$).

Table 4. Respondents' willingness to pay (WTP) to access Folkestone Marine Reserve (daily, per person) in US$.

WTP Scenario	*N*	Lower [a] bound CI	Mean ± 1*SD*	Upper bound CI	Median
All data (zero bids in)	250	15.92	17.45 ± 11.30	18.96	12.50
All data (zero bids out)	243	16.62	17.96 ± 11.05	19.27	12.50
Artificial reef data	121	15.81	17.58 ± 9.96	19.52	12.50
Natural reef data	122	16.25	18.33 ± 12.06	20.73	15.00

Note: [a] Based on 1,000 replications.

Females had a significantly higher ($U = 5921$, $z = -2.709$, $p \leq 0.007$, $r = 0.17$) mean willingness to pay of US$19.54 (± 11.89 s.d.) compared with a mean value of US$16.31 (± 9.89 s.d.) estimated for males. Visitors who had viewed a turtle while snorkelling (n = 196) had a mean of US$19.59 (± 11.50 s.d.) compared with a value of US$11.56 (± 5.52 s.d.) for those who had not viewed a turtle (n = 47). This latter difference of US$7.93 was highly significant ($U = 2232$, $z = -5.588$, $p \leq 0.001$, $r = 0.37$). Divers who had experienced the underwater environment within the reserve prior to being interviewed (n = 24) had a lower mean of US$12.50 (± 5.95 s.d.) compared with divers (n = 52) visiting the reserve for the first time; US$18.55 (±

11.32 s.d.). Again, this difference was highly significant (U = 1654, z = -3.036, $p \leq$ 0.002, r = 0.35). Finally, repeat catamaran visitors to the reserve (n = 49) had a significantly (U = 3610, z = -2.946, $p \leq 0.003$, r = 0.19) lower mean bid value of US$13.37 ($\pm$ 8.12 s.d.) compared with individuals who were first time visitors (n = 194) to the reserve of US$18.45 ($\pm$ 11.74 s.d.). From a point of interest, snorkellers and divers had a very similar mean value of US$17.89 ($\pm$ 11.24 s.d.) and US$16.45 ($\pm$ 11.43 s.d.), respectively. It also appeared that a higher level of experience attained in either sport did not significantly affect willingness to pay of snorkellers (U = 5993, z = -0.617, $p \geq 0.537$, r = 0.04) or divers (U = 112.500, z = -1.351, $p \geq 0.190$, r = 0.15).

Most visitors (75%) reported they would donate to help conserve the reefs for future generations, followed by 10% indicating it gave them genuine pleasure to contribute towards reef conservation. A motivator of being a 'moral duty' to contribute was also important among 8% of visitors. Of those who were willing to pay, 70% reported concerns over the legitimate use of monies collected for reef conservation while the remaining 30% of visitors reported no concerns. Content analyses of the follow-up question to understand these concerns revealed that most individuals were anxious that the funds raised would be spent elsewhere; typically on other government projects in Barbados. Respondents were also asked which type of organization they would prefer to manage the entrance fee revenues. An environmental non-governmental organization was clearly the most popular choice yielding 75% support, followed by the government of Barbados (13%) and public sector (3%), while 9% chose a mix of all three authorities. The question that queried respondents in relation to where they would prefer to see entrance fee revenues spent, yielded a high level of support for marine education/children's outreach programmes (47%) and for recreational artificial reefs (27%). Scientific monitoring also appeared important with 18% of respondents choosing this item. In contrast, land-based tourist facilities (1%) and marine reserve patrols (2%) seemed unimportant investments.

3.4 Perceptions and Use of Artificial Reefs and Environmental Concern

Artificial reef awareness was good amongst the population sampled with 69% having heard of the term artificial reef, and 82 respondents (34%) having either snorkelled or dived on an artificial reef previously. When asked to rate their experience of this type

of reef, 79% of snorkellers and 88% of divers rated their prior experiences as good to very good. Additionally, 35 respondents had used local artificial reefs, the majority (*n* = 29) situated in Carlisle Bay and the remaining 6 individuals using the *SS Stavronikita*, the largest wreck to dive on in the Caribbean (*Agace, 2005*).

Three reef material types were presented using visual aids. The most preferred material choice was a shipwreck (73%), followed by Reef Balls™ (as a snorkel trail) (17%), with underwater art, chosen by only 10% (Fig. 2). Asked whether the creation of an artificial reef in Folkestone Marine Reserve would encourage a repeat visit, 77% answered yes, 12% no and 11% were unsure.

When asking respondents if they were a member of an environmental group, only 10% responded positively. In contrast, 83% of visitors read or watched on television topics about marine life and marine conservation. Respondents rated their level of concern relating to coral reefs and the marine environment (on a scale of 1 – 10, with 1 being the least concerned) with a mean and median value of 7 ($\pm$ 1.77 s.d.).

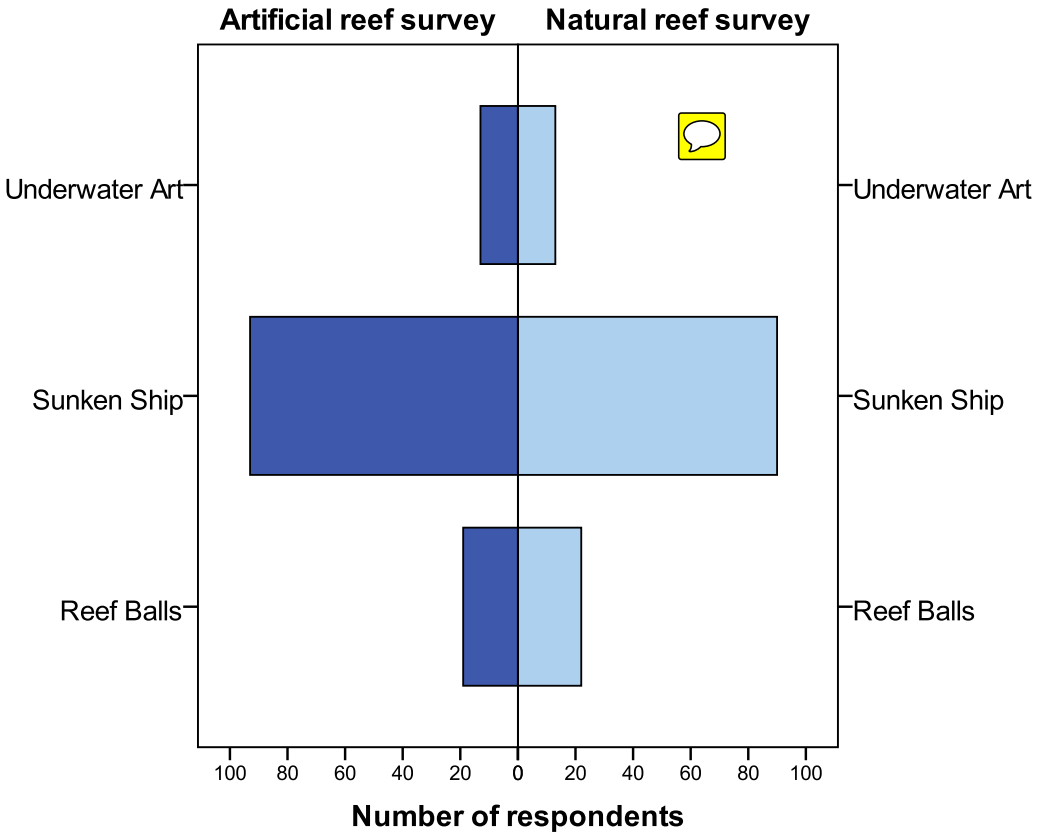

Figure 2. Respondents' preferences for type of artificial reef material for future use in Folkestone Marine Reserve. Sample size: n = 243.

3.5 Experience of Folkestone Marine Reserve

A fifth (n = 49) of respondents had previously visited the reserve on catamaran snorkelling cruises, with 1.84 (± 2.63 s.d.) former trips recorded. All respondents said they had snorkelled during these trips. Additionally, 24 respondents that had previously dived, had conducted 4.88 (± 4.31 s.d.) dives in the reserve.

Respondents were asked to recall the number of 'species' viewed. The marine life noted in the study was; fish, coral, turtles, eels, manta rays and sea urchins. A majority of visitors recalled 3 species (3.4 (± 1.11 s.d), median and mode = 3) with a maximum of 6 species seen, with no person noted as viewing no marine life. The most common species recalled were fish, spotted by 95% of people, followed by a turtle noted by 80% of visitors.

Thirty-two percent of respondents had their expectations of the visit to the reefs exceeded and a further 55% were noted as being satisfied. Only 19 individuals said the trip had made no difference to them, while 8 visitors had not had their expectations satisfied. A significant relationship occurred between visitors' willingness to pay and their level of satisfaction with the marine park (Kruskal-Wallis test; x^2 (3) = 12.32, $p \leq 0.006$). Further post hoc analysis revealed the two groups most dissatisfied/ambivalent with the trip (when combined), had a significantly lower willingness to pay than the two 'satisfied' groups combined (U = 961.500, z = -1.960, $p \leq 0.050$, r = 0.16). When visitors were asked if they would return to Folkestone Marine Reserve in the future, the majority (80%) said they would, while the remainder said no.

The final survey question asked respondents to rate the quality of seawater, fish and coral life they had experienced during their present visit. The overall mean ranks were calculated for each item on a scale of 1 – 5, five being the highest quality rating. Seawater (in terms of clarity) was rated highly by visitors, with a mean value of 4.48 ($\pm$ 0.43 s.d.) recorded. Fish life was rated above average with a mean of 3.80 ($\pm$ 0.88 s.d.). Coral life however, received the lowest mean rating of 3.26 ($\pm$ 0.99 s.d.). It was found that snorkellers and divers differed in their ranking of coral life, with snorkellers rating this attribute significantly higher than divers (U = 5510, z = -2.196, $p \leq 0.028$, r = 0.14).

3.6 Econometric Analysis

The results of the ordinary least squares and interval regression models are presented in Table 5. Our results showed consistency in the coefficient estimations obtained between the two regression models, suggesting the payment card design used for the surveys was well ordered (*Cameron & Huppert, 1989*) and/or the normality assumption was well maintained by the data (*Yang, Hu & Liu, 2012*).

Table 5. Coefficient estimates of visitors' willingness to pay using ordinary least squares (OLS) and interval (MLE) regression models.

Variable	**All data**	**All data**	**Artificial reef data**	**Artificial reef data**	**Natural reef data**	**Natural reef data**
Model	OLS	Interval (MLE)	OLS	Interval (MLE)	OLS	Interval (MLE)
Intercept	-6.542**	-5.958**	-7.719**	-7.30**	-9.401**	-8.958**
Age	-0.106***	-0.103***	-	-	-0.175***	-0.169***
	(0.040)	(0.038)	-	-	(0.059)	(0.056)
Env_concern	1.264***	1.190***	1.051**	1.00**	1.456***	1.423***
	(0.331)	(0.313)	(0.428)	(0.405)	(0.472)	(0.445)
Dived_FMR	-3.238*	-3.149*	-	-	-	-
	(1.771)	(1.677)	-	-	-	-
Coral_life	-	-	-	-	4.368***	4.286***
	-	-	-	-	(1.460)	(1.378)
Species_view	5.806***	5.685***	5.052***	4.99***	6.573***	6.422***
	(0.516)	(0.490)	(0.709)	(0.672)	(0.714)	(0.677)
Model	n = 243	n = 243	n = 121	n = 121	n = 122	n = 122
parameters	F stat: 71.43	Chi^2: 167.99	F stat: 37.56	Chi^2: 61.6	F stat: 43.04	Chi^2: 112.21
	p = 000	p = 000	p = 000	p = 000	p = 000	p = 000
	R^2: 47%		R^2: 39%		R^2: 59%	

Notes: standard errors in parentheses. Only significant variables shown. ***, **, * Significance at the $p \leq 0.01$, $p \leq 0.05$, $p \leq 0.10$ levels, respectively.

The explanatory powers of the ordinary least squares models were good, yielding r^2 values of 39%, or above (Table 5). Overall, five of the twelve estimated coefficients expected to influence willingness to pay, were statistically significant. Based on previous research (*Arin & Kramer, 2002*; *Lindsey & Holmes, 2002*; *Seenprachawong, 2003*; *Togridou, Hovardas, Pantis, 2006*; *Hargreaves-Allen, 2010*), variables expected to show significant explanatory power, but in the event did not, included number of years in education, previous catamaran trips and number of prior visits. Of the variables found to be significant, three (*Age, Env_concern* and *Species_view*) were significant at the 1% level (*Env_concern* 5% significance level for the artificial reef survey), whilst *Dive_FMR* was marginally significant at the 10% level. Two variables (*Age* and *Dived_FMR*) had negative signs on the coefficients, implying that younger respondents and those who had not previously dived in the reserve were willing to pay more as a daily entrance fee into Folkestone Marine Reserve. The coefficients for the remaining three variables (*Env_concern, Coral_life* and *Species_view*) were positive. This indicates that respondents who rated the coral life as good, reported higher levels of concern for the reefs and marine environment and viewed more marine life, had higher willingness to pay. It should be noted, the variable *Coral_life* was only significant in the natural reef entrance fee model.

The regression results indicated the variable '*Species_view*' made the largest unique contribution to the variance in willingness to pay, with a mean value of 22% noted across all data sets. A one unit increase elevates willingness to pay on average US$5.69 – US$5.81 for each additional species viewed (Table 5).

A Kruskal-Wallis Test indicated a high level of association between the dependent variable and *Species_view* (x^2 (5) = 133.39, $p \leq 0.001$) (Fig. 3). Further post hoc analysis confirmed significant differences in willingness to pay occurring between 'two and three' species viewed, 'three and four' species viewed and 'four and five' species viewed (U = 1119, z = -3.391, $p \leq 0.001$, r = 0.30; U = 1154, z = -7.380, $p \leq 0.001$, r = 0.58; U = 314, z = -4.703, $p \leq 0.001$, r = 0.47), respectively.

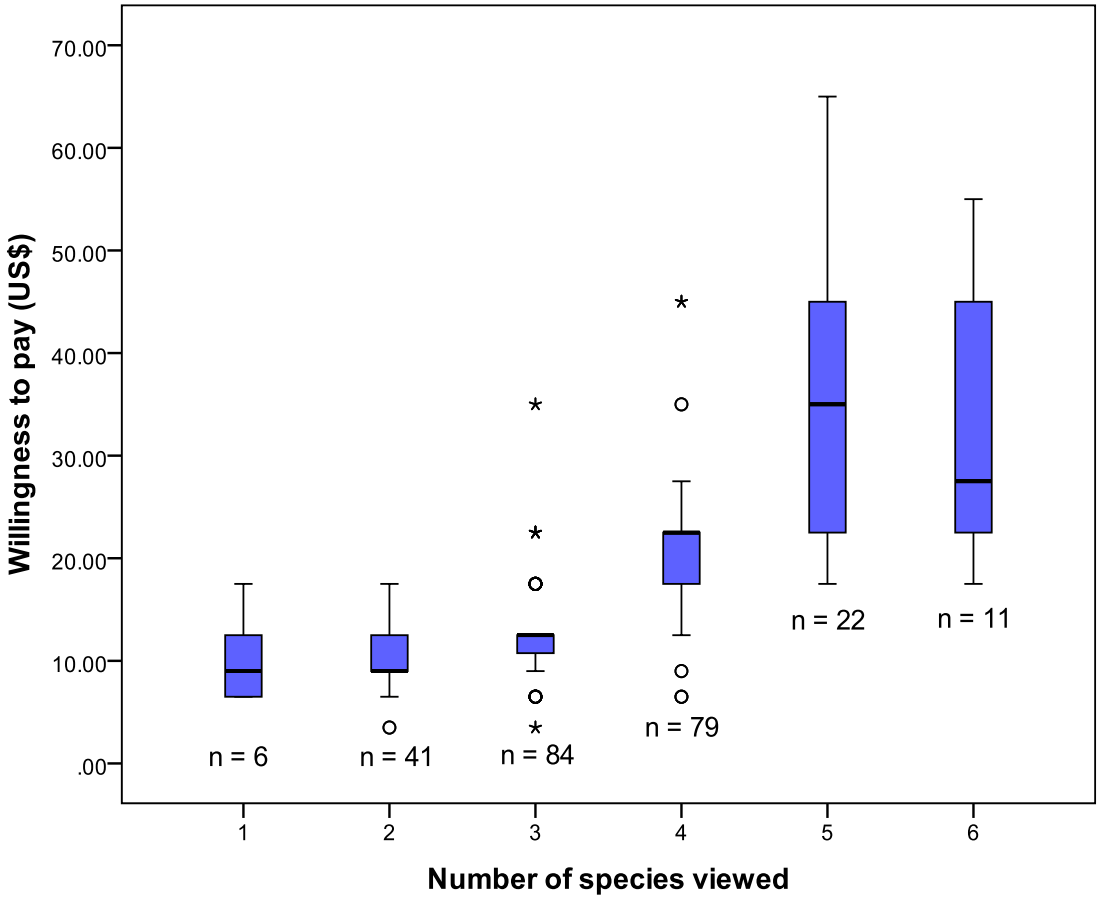

Figure 3. The relationship between the number of marine species viewed and respondents willingness to pay for reef protection in Folkestone Marine Reserve (the line is the median, boxes the 25-75% quartiles and the whiskers the 95% CI).

4. Discussion

The principal focus of this study was to estimate visitors consumer surplus for the MPA in Barbados and to differentiate between visitors use value of natural and artificial reefs. As far as we are aware, it constitutes the first work to compare use values of two types of reef habitat within a reserve environment.

It is apparent that willingness to pay for natural reefs yielded a higher mean value (US$18.33) than estimates for artificial reef use (US$17.58). Three studies (*Johns et al., 2001*; *Johns, 2004*; *Oh, Ditton & Stoll, 2008*) have reported use values relating to consumer's surplus of both reef habitats, and all three investigations yielded higher estimates for natural reef usage. *Oh, Ditton & Stoll* (*2008*) estimated an average consumer surplus for diving per trip in Texas waters at US$171 for natural reef divers

and US$101 for artificial reef divers; a net increase of 70% per trip for scuba diving at natural reefs. Both *Johns et al.* (*2001*) and *Johns* (*2004*) estimated consumer's surplus for managing and maintaining the natural and artificial reefs in southeast Florida and Martin County, Florida, respectively. *Johns et al.* (*2001*) reported an average use value for residents and visitors at natural reefs of US$12.74/person-day and US8.63/person-day for artificial reefs at the same location. In a later study, *Johns* (*2004*) estimated non-local tourists use value for diving, fishing and snorkelling combined at US$46.00/person-day at natural reefs, compared to US$23.84/person-day at artificial reefs.

Unlike the latter three studies, our results show mean willingness to pay estimates being just marginally higher for natural reef than for artificial reef habitat. Hypothetical bias linked to the 'warm glow' effect (*Andreoni, 1990*; *Christie, 2007*) may partially account for similar bid values been elicited for both reef types. Other environmental studies have identified this phenomenon of impure altruism (*Nunes & Schokkaert, 2003*; *Polak & Shashar, 2013*), which may be more prevalent among tourists on vacation (*Polak & Shashar, 2013*). *Kahneman & Knetsch* (*1992*) propose that contingent valuation responses reflect willingness to pay for the moral satisfaction of contributing to public goods – not the economic value of the goods in question, though most (75%) visitors in this present survey exhibited the motivation of bequest value as the main driver of willingness to pay. *Diamond & Hausman* (*1994*) believe that willingness to pay would be more conservative if one were asked to pay for it during the surveying process. In spite of this, given at the time the Tiami cruise cost US$85 per person, it may be plausible that some respondents may have rounded their willingness to pay up to US$100 regardless of the reef habitat being valued. Indeed, 45% of bid values fell within the US$10-20 intervals (Table 3).

Several variables were significant in influencing willingness to pay. We found that as respondent's age decreased bid value increased, which is not unusual in this type of study. *Arin & Kramer* (*2002*) also noted that younger people were more willing to donate towards reef conservation and *Uyarra, Gill & Côté* (*2010*) found younger divers had a more positive attitude towards paying higher marine park entrance fees in Bonaire. Moreover, *Asafu-Adjaye & Tapsuwan* (*2008*) reported that Thai respondents accepted the bid in a contingent valuation study more readily as the age

of the diver decreased. With regard to older generations, it may be plausible that they are more skeptical about contributing towards conservation efforts in general or perhaps are more familiar and experienced with the goods being valued, thus reflecting reduced utility and diminishing marginal returns. In fact, we found repeat visitors to the reserve, had a significantly lower bid value than first-time visitors there. Our results lend support to *Dharmaratne, Sang & Walling* (*2000*) who noted repeat visitors to a terrestrial park and marine reserve in Barbados and Jamaica respectively, had a lower willingness to pay than first-time visitors. The present study also confirmed that environmental awareness and concern for reefs generally, has a positive effect on willingness to pay bids (*Tapsuwan, 2005*; *Togridou, Hovardas & Pantis, 2006*; *Casey, Bro & Schuhmann 2010*; *Hargreaves-Allen, 2010*) but not consistent with *Barker's* (*2003*) results.

Overall, the number of species viewed had the strongest effect on mean bid value for the marine park entrance fee. The model indicated that each additional species viewed elevated willingness to pay by approximately US$5.50 (Table 5). This suggests visitors are willing to pay a significant amount to view wildlife within Folkestone. Indeed, marine life is regarded as one of the greatest sources of revenue for the dive and snorkel tourism industries (*Barker, 2003*) and viewing it has a positive impact on customer satisfaction (*e.g. Musa, 2002*; *Musa, Kadir & Lee, 2006*; *Coghlan, 2012*). Willingness to pay studies have shown that divers will pay significantly for conservation efforts that favour high biodiversity on artificial coral reefs (*Polak & Shashar, 2013*) and for greater fish abundance/size on natural reefs (*Rudd & Tupper, 2002*; *Barker, 2003*; *Wielgus et al., 2010*). Individuals also hold considerable consumer surplus value for viewing large species such as dolphins, rays, whale sharks and turtles (*Davis & Tisdell, 1999*; *Schuhmann, Casey & Oxenford, 2008*; *Hargreaves-Allen, 2010*; *Schuhmann et al., 2013*; *Farr, Stoeckl & Beg, 2014*). In Barbados, turtles provide an additional means to attract tourists to the island (*Troëng & Drews, 2004*; *Uyarra et al., 2005*) being widely promoted in various advertising campaigns. Willingness to pay to view turtles is substantial in this area of the Caribbean. Divers in Barbados are willing to pay over US$57 for the first encounter with a marine turtle, and approximately US$20 per 2-tank dive for each additional encounter (*Schuhmann et al., 2013*). We also established that turtles are a valuable resource, as they were associated with an US$8 increase in mean bid value per

person, compared to divers and snorkellers who had not viewed a turtle during their trip.

An important aspect of this present research was to solicit visitors' opinions on reef material preferences for future purpose-built reef. Overwhelmingly, underwater art as sculptures was viewed as the most unappealing material choice. This is despite its reported success in marine parks in Cancun, Mexico and Grenada in the Caribbean (www.underwatersculpture.com). Salient points noted as to visitors general dislike of this type of reef appeared to firmly centre on the lack of available habitat for species refuge, such as holes and crevices for fishes, and also on the 'out of context' appearance of human statues underwater as well as the small ecological footprint created. On the other hand, Reef Balls™ (www.reefball.org) presented as a snorkel trail, were viewed more favourably, especially among non-divers. Interestingly, *Ramos et al.* (*2006*) concluded that concrete modules were the least important choice of reef material among scuba divers in Portugal. Nevertheless, snorkel trails have been used with notable success in parts of the Caribbean. For example, in Antigua a 5-row Reef Ball™ breakwater structure also acts as a successful nature trail for divers and snorkellers (*Kaufman, 2006*) and in the U.S. Virgin Islands nearly 90% of the 50,000 annual visitors use a managed snorkel trail (*Thorsell & Wells, 1990*). Of significance, *Hannak et al.* (*2011*) established that most visitors to a snorkel trail in Dahab, Egypt were willing to pay US$14-27 for a guided trip. Notwithstanding, purposefully sunken ships were found to be the most popular material choice among 73% of respondents. Divers have communicated an immense preference for shipwrecks and deliberately sunken vessels for artificial reef creation (*Ditton et al., 2002*; *Stolk, Markwell & Jenkins, 2005*; *Shani, Polak & Shashar, 2011*; *Kirkbride-Smith, Wheeler & Johnson, 2013*). Content analysis of our current data suggests the appeal of sunken ships is related to their perceived capacity to provide adequate substrate and shelter for marine species, their 'in keeping' generic form and visual appeal when viewed underwater and to their historical fascination.

Our results demonstrate that most (97%) visitors would be willing to pay an entrance fee to access Folkestone Marine Reserve to improve reef management locally. By combining data of the artificial and natural reef models, these results indicate overseas tourists would be willing to pay almost US$18 as an entrance fee per visit to

protect the reefs. This amount is broadly consistent with results of similar willingness to pay studies (*Barker 2003*; *Mathieu, Langford & Kenyon, 2003*; *Tapsuwan, 2005; Hargreaves-Allen, 2010*).

However, US$18 would seem high to charge as a single daily fee, and indeed, to help ensure wider acceptance of marine park fees, they are typically kept low (*e.g. Dixon, Scura & van't Hof, 2000*; *Arin & Kramer, 2002*; *Seenprachawong, 2003; Table 1*) with discriminatory pricing sometimes imposed on divers and snorkellers (*Barker, 2003*; *Inter-American Biodiversity Information Network, 2010*; *Uyarra, Gill & Côté, 2010*). In view of this, a US$10 daily entrance fee for overseas divers and a US$5 daily entrance fee for overseas snorkellers seem fair to suggest. By using upper bound figures quoted by the *Inter-American Biodiversity Information Network* (*2010*) that indicate 7,000 scuba divers visiting Folkestone's reefs annually and a further 176,600 visitors participating in snorkel trips, an estimated consumer surplus of US$953,000 could be generated per annum. This figure is in line with the hypothetical fee structure proposed by the *Inter-American Biodiversity Information Network* (*2010*) for the islands MPA. At present, it is unclear what the current operating costs are for Folkestone Marine Reserve. However as a guide, recent running costs for the Bonaire National Marine Park in the Caribbean, are in the region of US$1.1 million per year (*STINAPA, 2009*; *Uyarra, Gill & Côté, 2010*) of which user fees contributed ~US$1 million in 2008.

Implementing a successful entrance fee system needs cooperation among visitors, tour operators and managers (*Terk & Knowlton, 2010*). To help achieve adoption of fees among visitors, they require clarity on how their money is used and managed (*Peters & Hawkins, 2009*). Studies suggest that fee acceptance improves if visitors have knowledge their funds are managed appropriately (*Casey, Brown & Schuhmann, 2010*) and specifically; that money is spent on reef protection (*Casey, Brown & Schuhmann, 2010*) and on improving park management (*Yeo, 2005*). In this current study, we found respondents concerned over how funds would be used and managed, and established that three quarters of visitors wanted a non-governmental organization to manage their payments. To create confidence and support in a fee system, supplying park booklets to visitors detailing the purpose and nature of fees may assist. Indeed, many participants that were interviewed requested information

about the reserve and wildlife encountered, as did divers and snorkellers studied by *Barker* (*2003*) in St. Lucia. Moreover, by providing meaningful information for tourists, it helps develop place attachment and stewardship (*Ham, 1992*). Dive and tour operators also need encouragement to adopt fees. As an incentive to collect them, *Terk & Knowlton* (*2010*) suggest a system for compensating operators administration time, by giving them a small percentage of the fees gathered. This system was originally employed in Mexico (*United Nations Environment Programme, 2003*) and appears a simple but fair approach.

Visitors also need to see 'what they are getting for their money', and good reserve infrastructure helps justify fee payment (*Sedley Associates Inc., AXYS Environmental Consulting (Barbados) Inc. & Scantlebury and Associates Ltd., 2000).* This is especially relevant to repeat customers who were noted as having a lower willingness to pay. Developing eco-tourism opportunities via artificial reefs can create unique selling points in a resort (*Dowling & Nichol, 2001*; *Leeworthy, Maher & Stone, 2006*; *Shani, Polak & Shashar, 2011*; *Edney, 2012*) and have the potential of drawing visitors to reserves. In previous research (*Kirkbride-Smith, Wheeler & Johnson, 2013*) we established that artificial reefs were a prime motivator for some dive tourists to holiday on Barbados. Also, as fish abundance is often greater within protected waters (*e.g. Chapman & Kramer, 1999*; *Varkey, Ainsworthy & Pitcher, 2012*) it appears a fitting environment to deploy artificial reef for amenity enhancement. Creating a new reef within Folkestone's waters appeared to be very popular among respondents, as over three quarters of those interviewed said this type of resource would encourage repeat visitation. We also discovered that many visitors had heard of artificial reefs and over a third had either snorkelled or dived on one previously, including many deployed in Barbados. Increasingly, artificial reefs are becoming more popular, especially among scuba divers (*e.g. Blout, 1981*, *Scuba Travel, 2006*; *Edney, 2012*; *Kirkbride-Smith, Wheeler & Johnson, 2013*), and given the substantial use value we report for them, it suggests visitors would be willing to support a reef substitution policy in Folkestone and potentially in other reserves offering this type of amenity.

Among the recreationally used natural reefs within Folkestone, it is the fringing reefs that are the most impacted (*Bell & Tomascik, 1993*; *Lewis, 2002*; *Inter-American Biodiversity Information Network, 2010*) and this would appear the most appropriate

zone to site underwater attractions. Several benefits could be yielded from developing artificial reefs in reserves. For example, managers may use them to influence and contain visitor use. Creating 'honey pot' sites within marine parks has been endorsed by some managers (*Clark et al., 2005*) as a strategy to conserve other coral reefs by redirecting reef use. Such a policy would be especially useful for managing in-training and novice divers who are documented as causing substantial damage to natural reef (*Roberts & Harriott, 1994*; *Walters & Samways, 2001*; *Warachananant et al., 2008*; *Chung, Au & Qui, 2013*). Moreover, these installations could be of value to dive shops to help sustain existing local resources. However, concentrating tourist use is open to debate as *Barker* (*2003*) found that visitors disliked the idea of being 'contained', suggesting it would lead to overcrowding and reduced naturalness of an area. In contrast, *Hannak et al.* (*2011*) established that a marine viewing trail would be the principal reason that their study group would choose a dive or snorkel site.

Notwithstanding, artificial reefs have been shown to offer opportunities to view interesting marine life (*Wilhelmsson et al., 1998*; *Perkol-Finkel & Benayahu, 2004*; *Arena, Jordan & Spieler, 2007*; *Kirkbride-Smith, Wheeler & Johnson, 2013*). Indeed, studies have confirmed artificial reef can support a comparable diversity and density of marine species than found on natural reef outcrops (*Clark & Edwards, 1999*; *Perkol-Finkel & Benayahu, 2004*), and this is especially true for fish abundance, where in some instances it has exceeded that present on natural reefs (*Fast & Pagan, 1974*; *Wilhelmsson et al., 1998*; *Arena, Jordan & Spieler, 2007*; *Santos, Oliveira & Cúrdia, 2013*; *Granneman & Steele, 2014*). Clearly, creating the right type of artificial reef that encourages a diverse species community is crucial for reef tourism, as this study showed the principal driver of willingness to pay was marine life. In addition, artificial reef development allows for increased accessibility of reefs (*Milton, 1989*; *Stolk, Markwell & Jenkins, 2005*) and arguably, encourages the employment of more robust/resistant environments within reserves (*Marion & Rogers, 1994*; *Claudet & Pelletier, 2004*). To this end; MPAs provide the greatest opportunity to manage tourism use of natural reefs (*Thurstan et al., 2012*) and environmental enhancement using 'well planned' artificial reef could potentially facilitate this (*Oh, Ditton & Stoll, 2008*).

5. Conclusions and Further Research

This study used the MPA in Barbados to differentiate between respondents use value of natural and artificial reefs. Our findings show that most visitors are willing to pay to support reef conservation in Folkestone and this represents an unexploited revenue stream that could be used for the day to day management of the reserve. A mean willingness to pay of US$18.33 and US$17.58 was estimated for natural and artificial reef use, respectively. This latter result thus indicates that significant use value could be gained from the provision of recreation-orientated artificial reefs within a reserve environment. Reef tourism is a valuable business in Barbados, and overall, creating substitute dive and snorkel sites have the capacity to maximize revenue without threatening natural resources.

This research serves as a valuable foundation for future work that should aim to uncover divers' willingness to pay for 'diving trips' within the reserve. Also, cruise trip passengers were not represented in this current study, and ideally, this omission needs addressing in future willingness to pay studies for Folkestone. Finally, research into the recovery of non-use values (not current users of the resource) to fund reef management in Folkestone, is also an area worthy of future exploration.

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