Economic valuation of coastal water quality improvements in Tobago

Nesha Beharry-Borg* Riccardo Scarpa†

January 2010

Abstract

The quality of the coastal waters is now a major environmental issue in Tobago due to its role in supporting the economically important tourism sector and for safeguarding public health. In this paper we report the results of two choice experiments designed to estimate willingness to pay (WTP) for an improvement in coastal water quality for two groups of beach recreationists: snorkellers and nonsnorkellers. Responses from 284 respondents were analyzed and included both locals and tourists to the island who participated in beach recreation. Latent class and mixed multinomial logit models were used in the analysis of the responses to explain the presence of any unobserved taste heterogeneity. The results indicate that individual specific means of WTP estimates vary significantly between snorkellers and nonsnorkellers. The results from the analysis using the latent class model identified two subgroups with distinct preferences with the snorkeller group. Unobserved taste heterogeneity was better represented for the nonsnorkellers with a mixed multinomial logit model. This study not only addresses the lack of valuation estimates on this island but also demonstrates the importance of using estimation methods that account for individual specific differences in WTP estimates. By understanding how preferences vary between and within the sub populations, policy makers are better able to manage this natural resource in a sustainable way and to strategically position the recreational product to accommodate these differences. By linking the management recommendations to WTP values, they can also gain an understanding of how different recommendations will be valued by different segments of users. This gives managers a measure of how well potential policies will be accepted if they are implemented.

1 Introduction

The coastal waters around small-island states in the Caribbean are an important but vulnerable natural resource. It contains some of the regions most productive biodiversity reserves and is also used to economically support the majority of its human population (UNEP 2003). These uses span across several sectors and include the generation of income from tourism, provision of food and energy resources and coastal protection. In most of the small island states, tourism contributes an

*Sustainability Research Institute, University of Leeds, LS29JT, Leeds, United Kingdom, Email: n.c.beharry-borg@leeds.ac.uk, Fax (+44 113 343 6716)

†Department of Economics, Waikato Management School, The University of Waikato, New Zealand, Email: rscarpa@waikato.ac.nz

average of 35% of GDP and accounts for 20 to 86 per cent of earnings as a proportion of total exports (Secretariat 2000).

The purpose of this study is to determine the recreational value associated with a hypothetical improvement in coastal water quality in Tobago. Beach recreation is an important contributor to welfare in Tobago for both local and tourist populations. There are now over thirty thousand visits to the beaches of Tobago every year (CSO 2001)[1]. This increase in visitation, in combination with pollutants from land based activities, exacerbates the existing coastal water pollution and degradation problems. Within the past ten to fifteen years, coastal water pollution has become an important concern in Tobago and in the wider Caribbean region (Siung-Chang 1997). Deterioration in coastal water quality has not only made many beaches unsuitable for swimming, but it has also damaged ecological systems such as coral reefs, mangroves and seagrass communities (IMA 2006). The source of deterioration has been identified as nutrient pollution leading to a series of environmental issues such as eutrophication, harmful algal blooms, loss of seagrass and coral reefs and marine diseases (Lapointe et al. 2004). Nutrient pollution of Tobago's coastal waters is likely to have a direct impact on the tourism industry. While the environmental impacts of degraded costal water quality have been described and documented, no study has yet been undertaken to estimate the recreational benefits of improving coastal water quality on the island.

Environmental valuation studies provide information which policy makers and managers require to manage the coastal environment. As in other developing areas of the world, there is a paucity of environmental valuation studies in the Caribbean region, primarily because of the limited use of these tools in decision and policy making. However, in the small number of economic valuation studies which have been undertaken on marine recreational activities, the emphasis has been on valuing the benefits accrued to recreational users who engage in scuba diving and snorkelling (Williams & Polunin 2000, Barker 2003, Parsons & Thur 2008). This could be because although marine protected areas (MPA) have recently been highly advocated as a form of marine conservation and management, they are quite costly to implement. Hence, valuation studies have tended to focus on recreational activities which could be used to fund the management of these parks. While snorkelling and scuba diving are commonly undertaken by visitors to the Caribbean, most of the local population do not regularly engage in these activities (Beharry 2008). The systematic categorisation of the two recreational groups, snorkellers and nonsnorkellers or general beach users, was instrumental

[1]The average number of beach visits per year is based on the authors' calculation using data from The Central Statistical Office of Trinidad and Tobago.

in allowing a specific investigation into the preferences of visitors and local beach users. This is important to resource managers as it provides them with information on the preferences of both local and visitor populations.

Even within systematic groups there can be diverse preferences, particularly when investigating a quality aspect of a natural resource. Therefore, in addition to identifying systematic heterogeneity, it is important that studies also account for any unobserved taste heterogeneity within groups in the measurement of preferences. Homogeneity is commonly assumed in theoretical enquiries into the general properties of environmental problems (Milon & Scrogin 2002). However, to make a better informed case for protection, and thereby to improve policy making, it is important that environmental policy decisions allow for any taste heterogeneity.

The paper is organized as follows. Section 2 discusses the literature on the economic benefits of improved coastal waters for marine recreation and the specific role of our contribution. Sections 3 and 4 provide a description of the coastal water quality issues in Tobago and the design of the surveys, respectively. Section 5 and 6 present theory and results of the analysis. Finally, section 8 presents a summary and conclusion.

2 Literature Review

Several studies have estimated the recreational benefits of quality improvements in marine coastal waters. Such interest can broadly be justified by two factors. The first is the wide range of public policy issues associated with the protection of this natural resource, such as balancing extractive and non-extractive uses, disposal of biodegradable wastes and multiple uses of marginal lands. The second is the large number of marine recreational activities the public can engage in, which cumulatively produce large public benefits. The basic premise of all these studies is that quality improvements in marine coastal waters should enhance the experience of marine outdoor recreation, which in turn should lead to measurable economic benefits.

In 1995, Freeman produced a review of the empirical literature on the economic value of marine recreational activities (Freeman 1995). The review indicated that the recreational activities which have received the most attention are fishing, swimming (along with related beach activities) and boating. His analysis also revealed that in comparison to marine recreational activities such as boating or fishing, the number of studies undertaken on swimming and beach-related activity remains small. Today, just over a decade later, the number of beach applications still remains small in comparison to marine recreational activities such as boating or fishing (Massey 2002), this despite the fact that in many areas of the world, beach-based activities are by far the most popular.

The literature on outdoor recreation demand analysis for beach services can be categorised into two main streams of research. The first describes studies which have estimated the recreational value of beach access due to a change in a site characteristic linked to water quality. The second describes studies which address characteristics which are not directly linked to water quality. This second category can be further subdivided into two parts. The first gives the recreational value of beach access due to a change in site quality characteristics which are unrelated to water quality. Studies in this area include those on congestion (McConnell 1977) and beach nourishment (Silberman & Klock 1988, Huang & Poor 2004, Landry et al. 2003). The second calculates an economic value for beach access and does not link directly to any site quality attributes (Bell & Leeworthy 1990, Leeworthy & Wiley 1991, Parsons et al. 2000, Bin et al. 2004).

The study described in this paper falls into the first of the aforementioned categories. Therefore, this review will focus on the methods and studies used for (1) estimating the economic value of beach access for swimming and beach-related activities and (2) investigating how these are affected by variations in attributes linked to water quality. The majority of these studies were undertaken using systems of demand equations, travel cost models, random utility models and the contingent valuation method. More recently, a small number of studies which use choice experiments to produce value estimates have been carried out.

The first applications to show the benefits of improving coastal water quality were carried out by Freeman (1979), Feenberg & Mills (1980), Vaughn et al. (1985), Bockstael et al. (1987). In order to accommodate the valuation of site characteristics, Vaughn et al. (1985) used a varying parameter model. This was the first study which attempted to determine how participation in swimming at marine beaches was influenced by pollution. The same dataset used for by Vaughn et al. (1985) was used in the study by Feenberg & Mills (1980) and Bockstael et al. (1987). However, Feenberg & Mills (1980) used the random utility methodology (RUM) while Bockstael et al. (1987) compared and contrasted the RUM model with the hedonic travel cost model. The travel cost and the RUM site choice methods were the two most prominent methods used at this time.

The popularity of contingent valuation (CV) grew from the 1990s onwards because it freed analysts from their reliance on observations of behaviour in order to make inferences of value. The earliest study using the CV method was that on Chesapeake Bay carried out by Bockstael et al. (1989). Other more recent applications include (Zylick et al. 1995, Barton 1998, Machado & Mourato 1999, Goffe 1995).

Although discrete choice experiments have become increasingly prevalent in environmental economics to study the value of multi-attribute resources, few have focused on coastal water quality in the context of beach recreation. To date, only two studies exist in the latter category, that of EFTEC (2002) and that of Eggert & Olsson (2005). In the study by EFTEC (2002), 6 attributes (water quality, advisory note system, litter or dog mess, safety and additional water charges per year) were examined and related to the implementation of a revised European Commission Bathing Water Quality Directive. In the study by Eggert & Olsson (2005), water quality was described using 4 attributes: fish stock level, bathing water quality, biodiversity level and cost. Both studies linked the levels of their attributes to changes in coastal water quality.

A number of studies have carried out previous economic evaluations using choice based methods method to study diver preferences for reef-related attributes such as fish abundance, coral cover and access to an marine protected areas in developing countries (Wielgus et al. 2003, Parsons & Thur 2008, Sweden 2000, Lindsey & Holmes 2002, Tongson & Dygico 2004)[2] With respect to Tobago, there has been two study that have carried out economic evaluations. The first has used contingent valuation as part of trade-off analysis that was applied to investigate the management options of the Buccoo Reef Marine Park (**?**). The second has estimated the economic benefit of coral reef associated tourism and recreation and fisheries (L. Burke & Cooper 2008).

As far as we know, this research represents the third application of this method to examine the effect of varying levels of beach visit attributes on beach users' stated WTP for beach access. It therefore contributes to the literature in two ways:

1. This study provides valuation estimates for two attributes (plastics and number of boats) linked to coastal water quality and beach recreation which have not previously been undertaken in a

[2] There is a vast literature on economic evaluation of reef related attributes using valuation methods such as contingent valuation, travel cost and lost revenues to fisheries and tourism. Please refer toL. M. Brander & J.Cesar (2007) 2000 for a compilation of some of these studies.

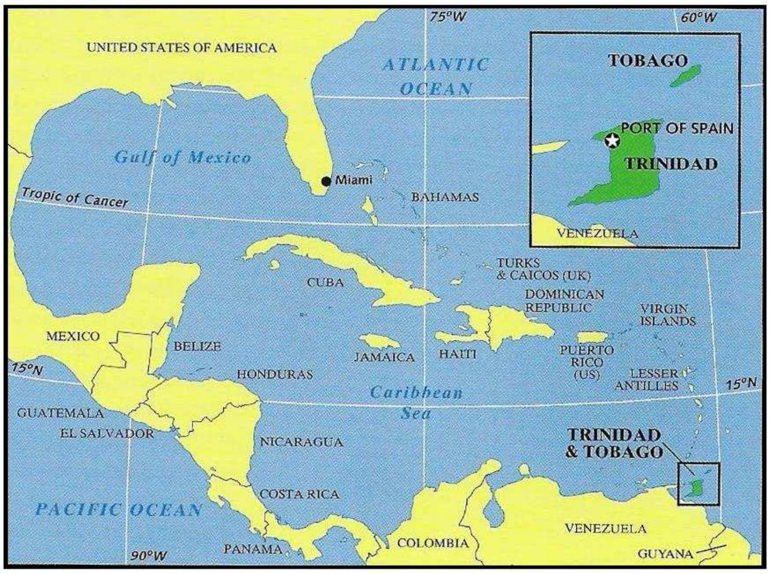


Figure 1: Location of Trinidad and Tobago in the Caribbean (Wood 2000)

developing country using the discrete choice experiment method.

2. The results of this study are used to provide policy implications for attributes linked to improvements in coastal water quality in Tobago.

3 Tobago's beaches and coastal water quality degradation

Trinidad and Tobago is a twin-island country, Tobago being the smaller of the two islands. It is located in the south-east corner of the Caribbean Sea, off the coast of Venezuela. (§ Figure 1). Tobago's beaches have historically been an important attraction for both overseas and domestic visitors. Its coastal environment provides users with a range of resources for activities, from traditional swimming to more specialised activities such as scuba diving, snorkelling, yachting and fishing. With approximately 42 beaches distributed over its 300 square kilometres of land area, beach-related activity is one of the most popular recreational activities on the island (§ Figure 2). Consequently, the economy of Tobago is heavily reliant on the tourism industry, this industry having become a major factor in its economic growth over the past 15 years (SEDU 2002). The tourism industry in Tobago accounted for 31% of the island's Gross Domestic Product (GDP) in 2004 (WTTC 2004). Furthermore, industry projections for 2005 showed that the this industry was expected to account for 46% of the island's GDP and provide 56.8% of the islands employment, making it one of the most tourism intensive economies in the world.

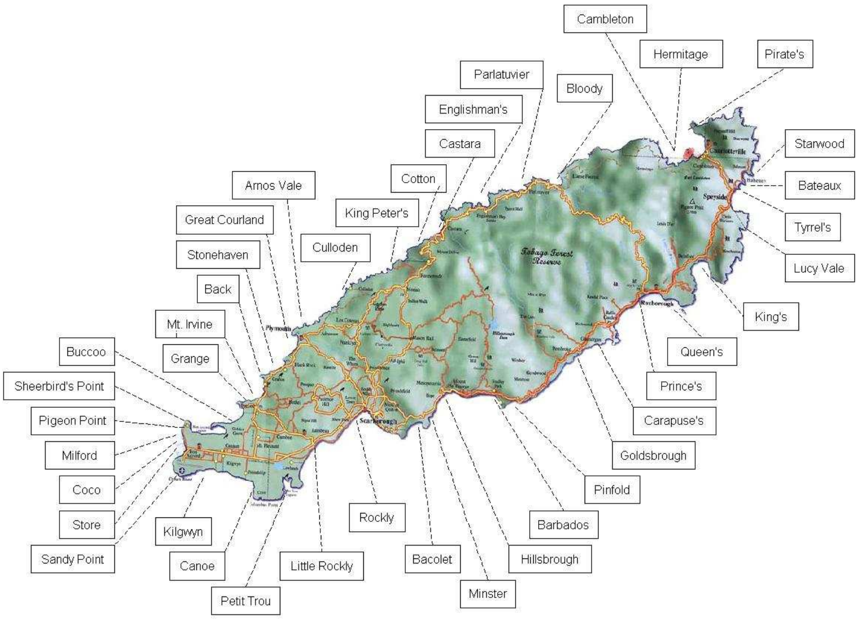


Figure 2: The 42 Beach Sites in Tobago

The tourism industry has and is expected to continue to bring substantial rewards to the island through the generation of employment, foreign exchange earnings and government revenues (Lalta & Freckleton 1993, WTTC 2004). However, considerable environmental problems have also emerged in the past two decades. These include coastal water eutrophication, harmful algal blooms, fish kills and loss of seagrasses and coral reefs (IMA 2006, Lapointe et al. 2004, Agard & Gobin 2000, Siung-Chang 1997). The main source of these problems has been identified as local land-based nutrient pollution. In a recent study conducted on coastal water quality, ecologists identified that the most considerable source of nutrient pollution is improperly treated sewage. Other sources include runoff due to increasing deforestation, agriculture and urbanisation (Lapointe 2003). Nutrient pollution and the consequent deterioration of coastal water quality has a direct impact on the recreational benefits to both the resident and visitor populations on this island. As a result, tourism related activities that depend on the quality of the coastal waters may be negatively impacted. Despite the partial awareness and documentation of the impact of degradation of coastal water quality, there exist no valuation estimates on the benefits of potential improvements to this natural resource.

4 Design of surveys and data collection

Two choice experiment surveys were designed for beach recreationists who were categorised as either snorkellers or nonsnorkellers. Snorkellers were defined as respondents who had snorkelled at least once before while nonsnorkellers were those who had never snorkelled. Both surveys had a common objective which was to determine the non-market value of the recreational benefits of attributes linked to improved coastal water quality for beach users.

Semi-structured interviews with scientists and policy makers in and out of the Caribbean region were used to generate a preliminary list of attributes. The challenge here was to ensure that the list did not only take into consideration the changes to the coastal water quality but also captured the public perception of what constituted various levels of improvement or deterioration. Six attributes were selected to describe improvements in coastal water quality for the nonsnorkellers while nine were used for the snorkellers, exclusive of the fee attribute. Three levels were used to represent each attribute according to the intensity of the proposed improvement. To maintain clarity in communication, after an initial detailed description, the three levels were referred to as high level policy action, low level policy action and no level of policy action (i.e. the status quo). The high level represented the greatest amount of policy intervention which implied a higher level of environmental quality while the low level represented a reduced amount of intervention and hence a lower level of environmental quality. Prop cards were used to help respondents visualise the levels of each attribute and the relative difference between these levels. Figure 3 shows the prop card showing the two levels for the coral cover attribute. The fee levels were derived using a combination of feedback from focus groups and the fee charged at the only non-free beach on the island (Pigeon Point Beach)[3]. The attributes and their levels are reported in Table 2.

The development of the CE questionnaires followed four stages: discussions with regional and international marine experts, focus groups, pilot studies and final pre-testing. At each stage, the questionnaire was improved to ensure that all new information was included in the final version, and that this information could be communicated with ease to the average respondent. Because the sample contained respondents from both developing and developed countries, separate focus groups were held with (1) members of the local population (nationals); (2) visitors to the island (non-nationals and nationals); and (3) non-nationals who were living permanently or temporarily in Tobago.

The final version of both questionnaires consisted of four main sections. The first section comprised

[3]This fee at Pigeon Point was set at TT$18.00 when the survey was administered. The levels of the entrance fees in the final survey were chosen to include amounts that were lower and higher than this fee. In particular, one fee was chosen which is significantly less than TT$18 (i.e. TT$10) because it was identified in the focus groups that TT$18 was too high a fee for locals.

CORAL COVER

This is the amount of coral cover while snorkelling.

1. No Program Present	2. Program One	3. Program Two
-		
No program for ensuring coral cover	Up to 45% coral cover	Up to 15% coral cover

Figure 3: Prop card for coral cover

of questions which sought to ascertain whether the respondent was an international visitor or a national of Trinidad and Tobago. It also consisted of questions regarding the respondents' frequency of use of beaches in Tobago, frequency of activities enjoyed at the beach, attitudes towards improving coastal water quality and preferences for beach characteristics. The second section began with an explanation of the hypothetical choice scenario.This entailed asking respondents to imagine having the option of a day of leisure and that there were only three options available on this day. The first two options represented beaches with which they could visit with varying levels of attributes at an additional cost. The third alternative captured the option that they could could not participate in any of the first two activities which involved paying entrance fees to visit two beaches. The first two alternatives described beaches with varying levels of attributes. The third alternative gave the respondents the option to choose not to visit either beach, for example choosing instead to engage in other recreational activities or staying at home.This cost was described in terms of a beach contribution fee to an non-governmental organization (NGO) with levels of TT$20, $10 and $25. The NGO would use the money for coastal water quality improvements which would benefit beach visitors. The third section contained follow up questions to determine the respondents' motivation for their choices. The fourth section contained questions which helped to identify the socioeconomic characteristics of the individuals.

The snorkeller respondents were presented with choice sets consisting of 9 attributes while the non-snorkeller respondents were presented with those consisting of 6 attributes (§ Figures 4 and 5).

A DASH (-) represents that there is no program to control the levels of this factor at the beach

	BEACH A	BEACH B	NEITHER BEACH
Boats (near coastline)	-	2 Boats or less	I Choose to Visit Neither Beach
Marine Protected Area (absence or presence)	-	YES, TO VISIT ONLY, NO FISHING	
Coastline Development (hotels and homes)	Less than 25% developed	-	
Average Bathing Water Quality (chance of an ear infection)	Reduced chance	Increased chance	
Water Clarity (down to seabed)	Up to 10 meters	-	
Plastics (per 30meters of beach)	Less than 5 pieces	Up to 15 pieces	
Number of Snorkellers (per group)	-	Up to 15 per group	
Level of Coral Cover	Up to 45% coral cover	15% coral cover	
Abundance of Fish	Up to 60 fishes	-	
Contribution Fee (TT$)	TT$10.00	TT$25.00	TT$0
I would choose to visit	☐	☐	☐

TT$10.00 = US$1.40 = £0.90 **TT$25.00 = US$4.00 = £2.27**

Figure 4: Sample choice set for snorkellers experiments

DASH (-) represents that there is no program to control the levels of this factor at the beach

	BEACH A	BEACH B	NEITHER BEACH
Boats (near coastline)	-	Up to 7 boats	I Choose to Visit Neither Beach
Marine Protected Area (absence or presence)	-	YES, TO VISIT ONLY, NO FISHING	
Coastline Development (hotels and homes)	Less than 25% developed	-	
Average Bathing Water Quality (chance of an ear infection)	Reduced chance	Increased chance	
Water Clarity (down to seabed)	Up to 10 meters	-	
Plastics (per 30 meters of beach)	Less than 5 pieces	-	
Contribution Fee (TT$)	TT$10.00	TT$25.00	
I would choose to visit	☐	☐	☐

TT$10.00 = US$1.40 = £0.90 **TT$25.00 = US$4.00 = £2.27**

Figure 5: Sample choice set for nonsnorkellers experiments

An orthogonal fractional factorial design was created using Design Expert® which incorporated only the main effects and no interaction effects[4]. The alternatives for each choice set were generated using a cycled[5] design from the original fractional factorial design. A blocking strategy was employed for the snorkellers and nonsnorkellers choice experiments in order to reduce the number of choice tasks given to each respondent. Blocking involves introducing another orthogonal column to the design, the attribute levels of which are then used to segment the design (Hensher et al. 2005). In the snorkeller discrete choice experiment, the 27 choice sets were blocked into three versions containing 9 choice sets, each of which was given to a different respondent. In the non-snorkeller discrete choice experiments, the 17 choice sets were blocked into two blocks of 9 and 8 choice sets, each of which was also given to different respondents.

The valuation experiments were carried out on residents and tourists at the Crown Point International Airport in Tobago. As was the case for the study done by (Naidoo & Adamowicz 2005), a survey at an airport provided a convenience sample for our study. In this case it allowed us to survey foreign visitors, domestic visitors (Trinidadians) and locals (Tobagonians). The airport was chosen as the sample location to ensure that the sample of foreign visitors in particular would capture a representative geographic distribution. Our preliminary research indicated that visitors would visit a representative cross-section of Tobago's beaches. This is supported by the observation that most visitors take day trips or rent cars in order to visit a large number of beaches across the entire island. Tobago's small size makes it possible to view a large number of beaches across the entire island in one day trip. This observation was confirmed in our survey where we asked respondents which beaches they had visited. Nevertheless, it should be noted that while this sampling location was best suited for capturing visitors' preferences, it resulted in a more limited representation of locals. Further surveys of locals on the island could not be carried out due to budget restrictions. This is one of the limitations of this survey method that should be taken into consideration when deriving policy implications.

The sample analyzed in this paper consisted of 284 completed questionnaires through face-to-face interviews, of which 198 were completed by snorkellers and 86 by nonsnorkellers. Out of the snorkeller subsample, 14% were nationals while 86% were non-nationals. For the nonsnorkellers,

[4]An assumption was made that there were no significant interaction effects. This is justified following the results of Dawes & Corrigan (1974) who found that main effects typically account for 70 to 90 percent of explained variance Louviere et al. (2000). Including interaction effects would also have required respondents to complete even more choice cards than the 8 or 9 administered to consider main effects.

[5]A cycled design is also known as a shifted design and it was shown to be effective by Carlsson & Martinsson (2003). Ferrini & Scarpa (2007) showed it to be especially robust to situations in which no or little *a-priori* information on parameter values are available by .

70% were nationals while only 30% were non-nationals. This varied composition of non-nationals and nationals for both subsamples, was due to the finding that most nationals did not engage in snorkelling as a marine recreational activity. The descriptive statistics of both groups are presented in Table 3.

5 Econometric specification

In this analysis we first estimate the multinomial logit (MNL) model (McFadden 1974) as the general specification for both groups of recreationists. The MNL model is the most widely used in the field of choice modelling, which has been attributed to the ease and speed with which the model can be estimated. Despite its wide use, there are severe limitations to this model with respect to its ability to capture random taste heterogeneity across individuals, the panel nature of repeated choices and the well-known assumption of independence of irrelevant alternatives (Train 2003). Therefore, in the second phase of this analysis two more flexible econometric models are used, namely the mixed multinomial logit model (MXL) and latent class model (LCM). In the MXL model, each individual's tastes for an attribute is assumed to be random and defined from a specified distribution. Alternatively, the LCM model assumes that each individual belongs to exactly one group but that group membership is based on unobservable segmentation regarding tastes.

5.1 The Panel Logit with Continuous Mixing (MXL)

The continuous mixing panel logit formulation assumes taste intensities vary continuously across respondents and can be explored in two mathematically identical, yet conceptually different ways (Bastin et al. 2005, Koppelman & Bhat 2006, Train 2003). In particular, this model can be generated from two specifications: (1) the error component specification which allows flexible substitution patterns across the alternatives to be achieved through the relaxation of the IIA property (2) the random parameter specification that accommodates taste heterogeneity (Koppelman & Bhat 2006). There also exists hybrid models between the aforementioned two specifications, where both error components and random taste parameters are used in a single specification, such as in Scarpa et al. (2007*b*). The error components specification is used mainly in studies where the goal is to realistically represent substitution patterns by specifying variables that can induce correlations in alternatives in a parsimonious fashion (Train 2003). Studies that adopt this latter approach include those done by Brownstone & Train (1999), Herriges & Phaneuf (2002), Scarpa, Ferrini & Willis

(2005), Thiene & Scarpa (2008) and are more concerned with prediction (*ibid.*). The studies that used the random parameter panel specification are more concerned with modelling the pattern of tastes by allowing each attribute's coefficient to vary over respondents. These studies include Revelt & Train (1998), Train (1998), Bhat (1997). The MXL models specified in this paper are based on the random parameter specification.

5.2 The Panel Logit with Finite Mixing or Latent Class Model (LCM)

Preference intensity may vary in a 'lumpy' rather than in a smooth way across the population of interest. In some populations, preference values may coalesce around some intensities due to the particular nature of the populations, giving rise to a finite number of preference groups, each with strong homogeneity within them. The panel latent class model is suitable to address such circumstances. This model simultaneously classifies decision makers into segments and estimates their utility parameter conditional on segment membership (Swait & Sweeney 2000, Swait 1994). There are many variants of the latent class model which differ based on the variables specified to predict an individual's membership in a segment. These variables are indicators (observable to the analyst) of latent factors (unobservable) that can enter the membership likelihood function and be used to classify individuals into segments (Ben-Akiva et al. 2002). Studies which used psychometric and socioeconomic variables in the specification of their latent class models, and thereby capturing observed taste heterogeneity, include those by Boxall & Adamowicz (2002), Provencher et al. (2002), Morey et al. (2006), Milon & Scrogin (2006), Hynes et al. (2008), Ruto et al. (2008). Other studies allow for membership probabilities that are unrelated to observed socio-economic variables, such as Scarpa & Thiene (2005), Scarpa, Willis & Acutt (2005). In the latent class model specified in this study, no such observed characteristics enter the model and therefore only unobserved taste heterogeneity based on the influence of the attributes was captured here.

5.3 Individual-specific WTP

Both the LCM and MXL allows the the identification of the distribution of tastes in the subpopulation of people who make particular choices (Train 2003). These estimates are called 'individual-specific' or 'conditional' since they are derived based on the individual's known (within-sample) choices (Train 2003). For instance, using the LCM model it is possible to calculate the probability of an individual n being in a segment s conditional on the particular choices made by that individual. Given the probability of class membership Q_{ns} and the observed (sequence) of choices of an individual, Bayes' theorem can be used to derive an individual-specific set of probabilities (Q^*_{ns}) (Greene 2005, Scarpa & Thiene 2005). This is an ($n \times s$) matrix of probabilities that describes the probability of each n belonging to segment s based on the choices made by n. These can then be used to calculate individual-specific posterior estimates of the marginal WTP (as derived in (Scarpa & Thiene 2005)) and are calculated as:

$$WTP_{n,att} = \sum_{S} Q^*_{ns} \left(-\frac{\beta_{s,att}}{\beta_{s,cost}} \right) \quad (1)$$

where Q^*_{ns} is the probability of membership for of decision maker n in segment s and $\beta_{s,att}$ and $\beta_{s,cost}$ are the β estimates for attribute (att) and the cost respectively in class s. Individual-specific estimates from an LCM model specification are calculated in this study for the snorkeller group.

In the MXL model, if one of the parameters used in deriving WTP are random, then these calculations must take this into account. This can be done by calculating either unconditional and individual-specific level estimates. In the case of individual-specific estimates the WTP estimates are usually calculated using simulated values from the chosen distributions. If X_1 is a random draw from the distribution of an attribute with mean β_i and standard deviation σ_i and X_2 is a random draw from the cost distribution C with mean β_c and standard deviation σ_c, then the WTP for that draw is calculated as $(\beta_i + X_1\sigma_i)/(\beta_c + X_2\sigma_c)$. This is repeated for several draws with the resulting set of WTP values having their own mean and standard deviation.

The approach adopted in this paper is based on the individual-specific estimates following (Greene et al. 2005, Sillano & Ortuzar 2005, Scarpa et al. 2007*a*). This approach could be seen as more accurate as the distribution of taste is identifiable in the data for a particular individual rather than being an averaging of all the population as would be done when deriving the unconditional WTP values (Hensher et al. 2005). Using this approach, the estimator for the WTP for an attribute is obtained by finding the ratio of that attribute's distribution and the cost distribution weighted by the likelihood function. This can be approximated by simulation using R draws, thereby ensuring the WTP estimates are obtained conditional on the sequence of observed responses y_n and observed attribute values x_n for each decision maker[6].

[6]For a more detailed derivation see (Beharry 2008).

6 Estimation Results

The results of the MNL models used to analyse the preferences for 86 nonsnorkellers and 198 non-snorkellers are presented in Tables 4 and 5 respectively. Following this, the results of the latent class (LCM) and mixed logit (MXL) panel models used to account for unobserved taste heterogeneity are presented in Sections 6.1 and 6.2 respectively. Finally, individual-specific WTP estimates are reported using the parameter estimates from the chosen model specification in Section 6.3.

6.1 Latent class model

The LCM models for both groups of respondents were estimated initially over 2, 3, and 4 classes. Statistical criteria of model fit, namely Akaike Information Criteria (AIC)[7]

(AIC-3) (Andrews et al. 2002), were used in addition to the analyst's judgement to decide on the number of chosen classes which best described the respondent population. This analysis revealed that a two class model provided the best solution for both nonsnorkellers and snorkellers (§ Tables 6 and 7).

6.1.1 Snorkellers

The results from the LCM model suggest that there is considerable unobserved taste heterogeneity within the snorkellers (§ Tables 5). This could be explained by classifying the snorkellers into 2 classes. The first class representing 61% of the sampled population are most probably composed of more avid snorkellers because of their strong preferences for higher levels of fish abundance (FISH1), coral cover (CORAL1), vertical visibility (CLAR1) and both types of marine protected areas (MPA1 and MPA2). The second class, representing 39% of the population, could be classified as the more occasional snorkellers with individuals who did not exhibit very strong preferences for the presence of higher levels of coral cover (CORAL1), fish abundance (FISH1 and FISH2) and levels of vertical visibility (CLAR1 and CLAR2). Both classes, however, did have strong preferences for a low chance of infection (WQ2), up to 25% development (DEV2) and up to 5 pieces of plastic on the coastline (PLAS2).

[7]The AIC, AIC-3 and BIC Criteria are calculated as follows: (1)AIC = -2(LL - K) (2.44), (2) BIC = -LL + (K/2) * ln(N) and (3) AIC - 3 = -3(LL - K)and Akaike Information Criteria, where K is the number of estimated parameters, N is the number of individuals in the sample and LL is the log likelihood of the model. All such tests (AIC, AIC-3 and BIC) are useful guides, but often suggest different values for each model estimated against a different number of segments (Sarbo et al. 1997). As there is no clear answer as to which criterion should be preferred, the number of segments should be determined through a combination of statistical information and interpretation of the model results (Walker & Jieping 2007).

6.1.2 Nonsnorkellers

Using the responses from the nonsnorkellers, the 4-class model did not converge. This suggests that such a specification is unsuitable for the data. Although the 3-class model was statistically significant, however, this model had one class for which the fee parameter had a theoretically implausible sign. The 2-class model was also statistically significant but had an insignificant fee for class 1. In order to get some idea of model fit using the LCM model the fee parameter for the 2-class model was constrained to be equal to that of class 1 which had a significant fee parameter. This produced a 2-class restricted model which was statistically significant (§ Tables 6).However, for the parameters that were significant, it was observed that individuals in class 2 only expressed negative preferences for two attributes associated with a low level of environmental quality.

The AIC, AIC-3 and BIC criteria showed that there was significant improvement in model fit from the MNL model to the LCM(2) (§ Table 6). However, the results indicated that by constraining the fee parameter of class 1 of the 2-class model to be equal to the fee parameter of class 2, the majority of respondents fit into class 1 while class 2 is too small to produce significant estimates. This could be due to the smaller sample size of the non-snorkeller group. Nevertheless, the results suggests that the finite mixing approach might not be a good statistical model for this part of the sample.

6.2 The Mixed Multinomial Logit Model

The sensitivity of MXL estimates to the number of draws used for simulation was explored. This analysis revealed that the model based on 300 draws provided sufficiently good approximations for the estimates from both the nonsnorkellers and the snorkellers. For both groups of respondents, all attributes were first specified as random using the normal distribution. In order to ensure non-negative parameter estimates for the fee parameter, the distribution for the negative of this attribute was specified as log normal while all other attributes for both models were specified as normal. The results from these estimations revealed a number of parameters with insignificant standard deviations. This was used as the basis for selecting the random parameters (Hensher et al. 2005), that is, only those parameters with significant standard deviations were considered to be random. However, derivation of the WTP estimates for both restricted models specifying the fee parameter as log normal yielded implausibly high mean WTP estimates (see Scarpa et al. 2008, for a discussion of this problem and proposed solutions). The fee parameter was then specified using the constrained triangular distribution, which led to more behaviourally plausible WTP estimates, and also achieved the goal of a sign-constrained cost parameter (Hensher & Greene 2003). The final model was estimated with only the attributes which had significant standard deviations. These were all specified as normally distributed with the exception of the fee parameter which was specified as random with a constrained triangular distribution as explained above.

6.2.1 Nonsnorkellers

Table 4 shows the results of the MXL Model for the nonsnorkellers. Out of the 13 parameter estimates, 6 had significant standard deviations, indicating that there seemed to be considerable unobserved taste heterogeneity within this group of respondents. These six attributes were: a marine park which allowed fishing (MPA1); up to 75% development (DEV1); increased and reduced chance of contracting an ear infection (WQ1 and WQ2), vertical visibility of up to 5 metres (CLAR2) and the contribution fee for beach entrance (FEE). The results of the LCM model in Section 6.1 suggest that there is little unobserved taste heterogeneity within the non-snorkeller population. However, the MXL model revealed that there was significant unobserved taste heterogeneity within this population for six attributes. It can therefore be concluded that unobserved taste heterogeneity within the non-snorkeller population is not supported by the use of the LCM model.

6.2.2 Snorkellers

Table 5 shows the parameter estimates of the MXL Model for the snorkellers. Out of the 19 estimated parameters, 11 were found to exhibit significant variation across respondents for which all estimated mean coefficients were found to have the expected sign. Once again, the MMNL model revealed that snorkellers are willing to pay more to visit a beach which has both types of marine protected areas. Results of the estimates for 11 of the 19 parameters provide evidence of significant unobserved taste heterogeneity as they have statistically significant standard deviations. The fee attribute represents the parameter for which preferences vary the most.

The AIC, AIC-3 and BIC criteria shows that there is no significant improvement in model fit from the 2-class and 2-class restricted LCM models in comparison to the MXL model for the nonsnorkellers and snorkellers respectively. There is, however, a significant improvement in the MXL model in comparison to the MNL models for both groups of respondents (§ Table 6 and 7).

6.3 Model selection for calculation of WTP estimates

The results of the LCM and MXL models suggest that there is considerable unobserved taste heterogeneity within snorkellers for several attributes. The results of the LCM model suggest that the population of snorkellers includes two taste segments. An examination of the log-likelihood values indicated that the use of two latent classes did provide a significant improvement in the fit over the MNL model and the MXL model. The results indicate the that identifying groupings for a specialised activity such as snorkelling is easier than identifying groupings for non-specialised activities. Although this it may appear counter-intuitive since one would expect people engaged in specialised activity to have similar preferences, this results resonates with previous valuation studies on specialized outdoor activities, such as fishing (Provencher et al. 2002), rock-climbing (Scarpa & Thiene 2005) and kayaking (Hynes et al. 2008). This observation is as yet unexplained and therefore warrants further study.

Nonsnorkellers exhibit a similar, although rather weaker, suggestion of the existence of two classes. The statistical criteria suggests that the LCM provides a better fit than the MXL model. However, it is clear from the results that most of the nonsnorkellers all fall within one class. Given this observation, WTP values for the nonsnorkellers are based on parameter estimates of the non-snorkeller MXL model, while WTP estimates for snorkellers are based on parameter estimates from the 2-class LCM model.

6.4 Snorkellers - Individual-specific WTP Estimates from the LCM Model

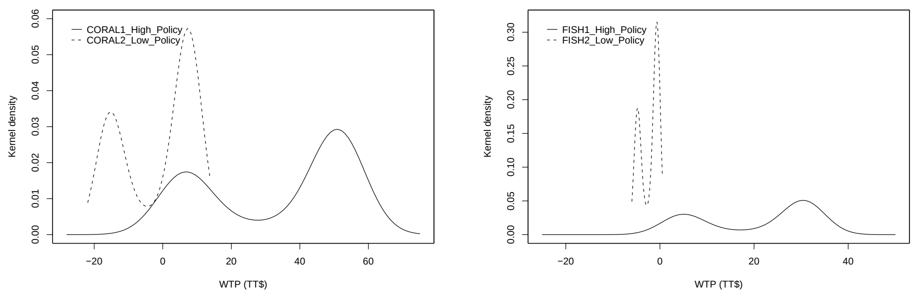
As described in Section 5.3, parameter estimates from the LCM model could be used to calculate individual-specific estimates conditional on the observed choices. These individual-specific estimates were used to calculate individual-specific WTP values which give a distribution of WTP values for each attribute. Kernel density plots allow convenient comparisons between individual-specific WTP values for the two classes and levels for each attribute (Bowman & Azzalini 1997). These are presented in Figure 8 to Figure 7. All attributes exhibit a bi-modal distribution because the sample is composed of respondents belonging to two classes with different taste intensities. This provides further evidence of the clear distribution of preferences within snorkellers.

The results from the individual specific WTP values from LCM model also reveal considerable heterogeneity between the two groups of snorkellers. The first class representing 61% of the sampled

Table 1: (Average) individual specific WTP estimates for snorkellers

	Individual specific WTP estimates (TT$)	
Attribute	Class one	Class Two
Up to 60 fishes	35.00	5.00
Up to 45 % coral cover	50.00	10.00
Vertical visibility of up to 10 meters	40.00	10.00
MPA which allows fishing	33.00	7.00
MPA which prohibits fishing	34.00	10.00
Plastics of up to 5 pieces	15.00	50.00
Low chance of ear infection	22.00	25.00
Low level of development	15.00	40.00

population and composed of the aforementioned avid snorkellers also had higher WTP for high levels of fish, coral cover, vertical visibility and both types of marine protected parks. Similarly the second class, representing 39% of the population and classified as the more occasional snorkellers did not have very high WTP values for the presence of high levels of coral, fish and vertical visibility attributes (§ Figures 6(a) to 7). For example, as as shown in Table 1, class one are willing to pay an average of 4 times as much than class two for attributes linked to snorkelling. Both groups, however, have high WTP values for low risk of an ear infection, low levels of development and very little plastic on the beach (§ Figures 8 to 10).



(a) (b)

Figure 6: Distributions of individual-specific WTP for (a) coral cover and (b) abundance of fish

6.5 Nonsnorkellers - Individual-specific WTP Estimates from the MXL Model

The parameter estimates derived from the MXL model can also be used to estimate individual-specific estimates which are conditional on the observed choices (§ Section 5.3). The results of this analysis are also presented using kernel density plots as shown in Figure 8 to Figure 9.

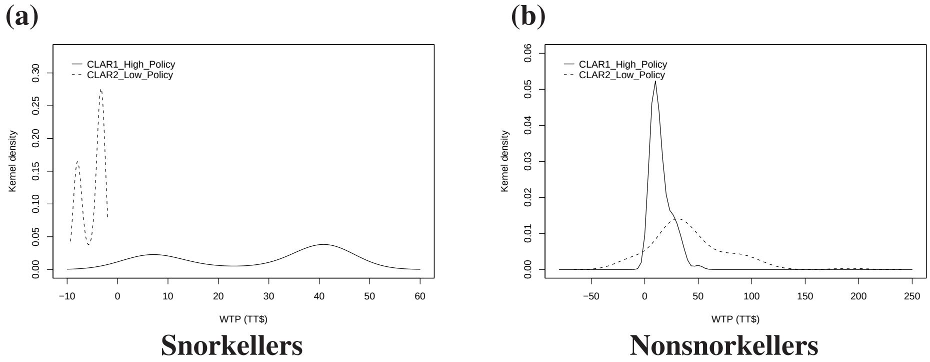


Figure 7: Distributions of individual-specific WTP for level of vertical visibility

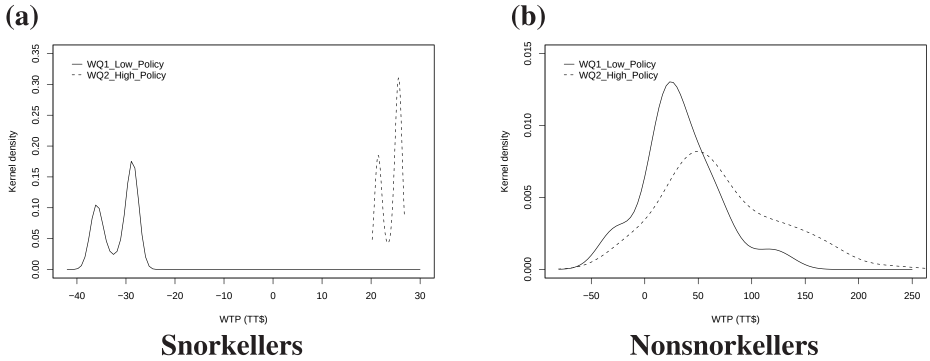


Figure 8: Distributions of individual-specific WTP for chance of an ear infection

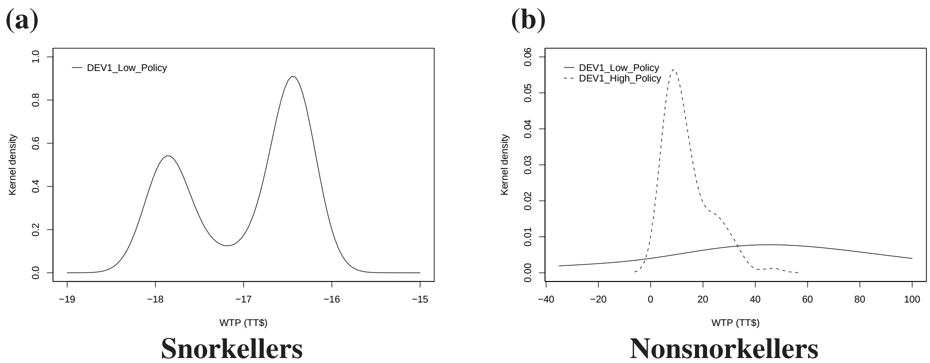


Figure 9: Distributions of individual-specific WTP for level of development

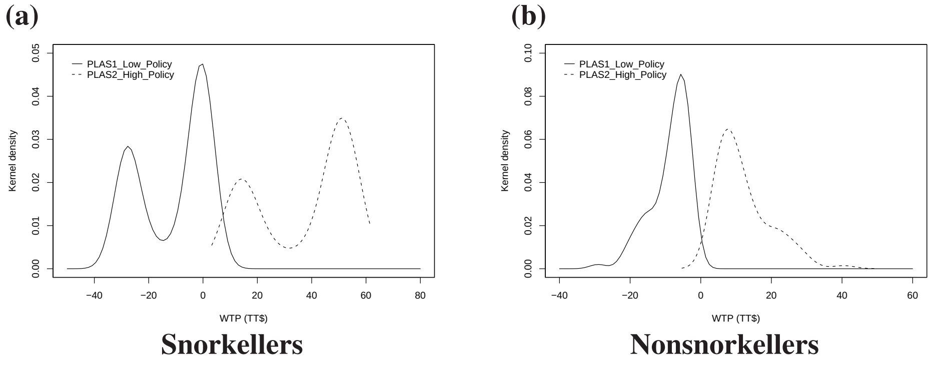


Figure 10: Distributions of individual-specific WTP for amount of plastics

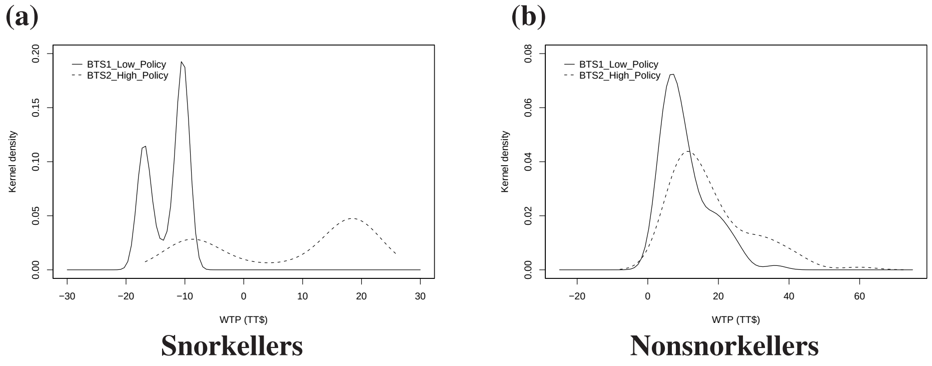


Figure 11: Distributions of individual-specific WTP for number of boats

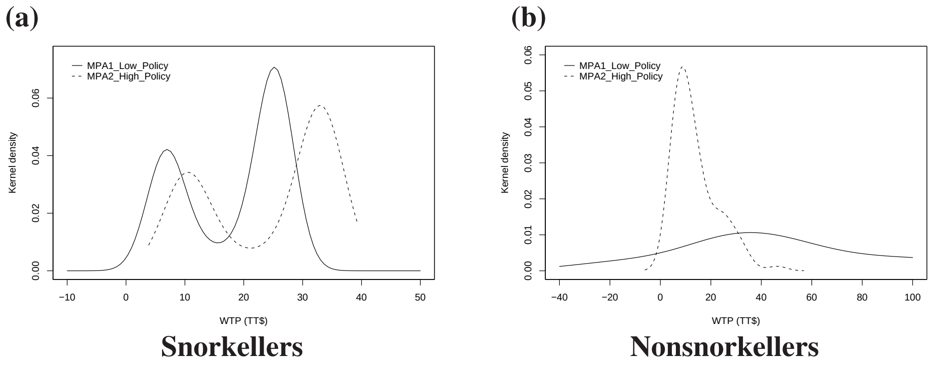
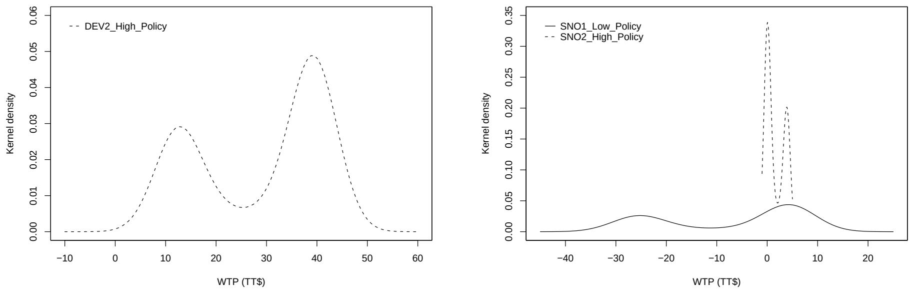


Figure 12: Distributions of individual-specific WTP for a marine protected park



(a) (b)

Figure 13: (a) Distributions of individual-specific WTP for up to 25 percent development (b) Distributions of individual-specific WTP for size of snorkeller group

The results show that there is much more overlap in WTP between the lower levels and higher levels of environmental quality for all attributes for nonsnorkellers in comparison to snorkellers (§ Figures 7 to 12). For instance, for the attribute representing the number of boats, there is considerable overlap of the WTP values over the positive orthant. Nonsnorkellers are willing to pay TT$14.00 on average to visit a beach with up to 2 boats near the coastline (BTS2) in comparison to an average of TT$8.00 for up to 7 boats near the coastline (BTS1). These results differ from those of the snorkellers, the majority of whom were not willing to pay to visit a beach with up to 7 boats near the coastline (§ Figure 11). One possible reason for this could be that most of the non-snorkeller population was made up of locals (64%) while most of the snorkeller population was made up of international visitors (89%). Visitors from more industrialised nations tend to demand pristine environments when they visit non-industrialised countries like Tobago (Mercado & Lassoie 2002). Therefore, in comparison to international visitors, local populations tend to be more tolerant of a lower level of environmental quality.

7 Policy implications

By understanding how preferences vary between and within sub populations, policy makers are better able to manage this natural resource in a sustainable way and to strategically position the recreational product to accommodate these differences. By linking the management recommendations to WTP values, they can also gain an understanding of how different recommendations will be valued by different segments of users. The following subsections discuss the management or policy implications of improving the level of each attribute in Tobago.

Chance of infection or average bathing water quality

Parameter and WTP estimates have shown that both classes of snorkellers were willing to visit a beach with a low chance of contracting an ear infection but were much less willing to visit a beach with a high chance. Since sewage is the major pollutant of the coastal waters in Tobago, there is in fact a high risk that persons will contract ear infections while swimming in coastal waters. Sewage pollution in Tobago occurs due to inadequate sewage treatment (Louis et al. 2006, EMA 1999). There is an urgent need to invest heavily in the construction of adequate central sewerage facilities on the island to allow adequate disposal of sewage and wastewater. The cost of implementing these systems is not cheap and timescales may extend to several years. In the meantime however, the government can implement temporary measures to reduce the impact of sewage pollution such as the use of aquatic plants for tertiary treatment (Kanabkaew & Puetpaiboon 2005), the replacement of soakaway pits with sealed composting dry toilets to prevent leaching of nutrients into groundwater (Goreau & Thacker 1994) and the enforcement and regulation of trained operators to manage the private and public treatment plants (Louis et al. 2006).

Coastline Development

Both classes of snorkellers are much more likely to visit a beach with a low level of development than one with a high level of development. However, the results also suggest that there are two types of users, those that highly value a pristine and undeveloped beach and those who will still be willing to visit a beach that is highly developed. Within the last decade, Tobago has experienced strong development pressure. The majority of this development has taken place along the south-west coast while northern areas have remained relatively underdeveloped. Policy makers may want to minimise development on the south-west coast and manage any further development on the north coast using environmental planning guidelines. This would allow the two user groups to be satisfied with both developed and underdeveloped beaches on the same island.

Marine protected areas, fish abundance and coral cover

The results of this study show that both snorkellers and non-snorkellers prefer to visit a beach where an MPA in present. Both groups of recreationists have higher WTP for an MPA which does not allow fishing in comparison to one that does allow fishing. Also respondents have a higher WTP value for greater fish abundance and higher coral cover in comparison to the lower levels. An interesting point pertaining to these three attributes with reference to the two classes within snorkellers was that one class was willing to pay at least three times more than the other class on average for a higher level of environmental quality.

The results also showed that non-snorkellers were still willing to pay a premium to visit a beach which had access to an MPA. This suggests that the creation of more MPAs on this island could be successful. There are approximately 16 coral reef sites of varying sizes dotted around Tobago. Therefore, further research should be carried out to determine which sites should be designated as marine parks so that a marine reserve network can be created. For this to be successful, appropriate regulation and enforcement would be required here.

The results also show that MPAs which do not allow fishing (have no-take zones) elicited higher WTP values than ones which did. One possible reason for this is that recreationists perceive that no-take zones may increase the probability of seeing more coral cover and a greater fish abundance. Finally, the significant difference in WTP between the two classes of snorkellers suggests that the introduction of restricted access at certain sites based on a pricing policy could be one way to satisfy the demand for this type of more exclusive access.

The Buccoo Reef Marine Park located on the south-west of the island is currently the only MPA[8]It has also been affected by man-made stressors such as reef walking and anchor damage. However, the results of this study re-confirms that important that the impact of visitors is managed at the Buccoo Reef Marine Park and at any MPA's which may be designated in the future. Some improvements include the provision of mooring buoys and limiting the number of boats which are allowed to tie up to a mooring (Barker 2003) and the use of underwater cameras (Rouphael & Inglis 1997, Barker 2003).

Number of plastics

The results suggest that both snorkellers and non-snorkellers are less likely to visit a beach with a high level of plastics. Plastic litter is a major problem in Tobago as it is one of the most prevalent forms of litter which washes up along the coastline. The lack of plastic recycling facilities on the island means that there is no incentive to collect plastics. There is also a severe lack of waste disposal bins at beaches. At some of the more iconic beaches such as Store Bay, plastic litter is cleaned up

[8]There are draft plans to designate another MPA in the Speyside area (IMA 2001).

on a daily basis by local authorities. This has proven an inadequate management strategy since large amounts of plastics still wash ashore on a daily basis (Santos et al. 2005). Destination managers and the government should try to enhance waste disposal and collection facilities. One method of doing this is to increase the amount of trash bins on the beach. Public education programs and enforcement of legislation[9] which prohibits littering can also help minimise plastic levels.

Number of boats

Overall, both snorkellers and non-snorkellers are willing to pay more to visit a beach where there is a low number of boats near the coastline in comparison to a higher number. These results therefore indicate that policy makers should make effort to create proper mooring facilities for the users of recreational and fishing boats so that they are not moored near popular beaches. With the exception of a few beaches which have jetties[10] most of the beaches do not have launching sites. Fishermen and recreational boat users use a combination of practices for mooring their boats which include anchors, jetties or bringing their boats onto the shoreline. These practices can obstruct access to the beaches. Boat operators form part of two industries that are important in Tobago: fishing and recreational tours. The latter is an integral part of the tourism product offered on this island. However, the results of this study suggest that it is important to have proper facilities for boat mooring and management as this benefits not only the boat operators but also the public perception of the beaches.

Vertical visibility or clarity

The results of this study show that vertical visibility is an important aspect of beach quality for snorkellers. Indeed, both groups of respondents have positive WTP values for high vertical visibility and negative values for low vertical visibility. However, non-snorkellers are in general less averse to low vertical visibility. This can be explained by the fact that a low level of visibility was defined as visibility of 5 metres, a value which is suitable for most recreational activities apart from snorkelling and scuba diving.

If policy makers would like to attract the niche tourism markets of tourism for snorkelling and scuba diving, then a high level of water vertical visibility is important. Due to its location down-current from the Orinoco river, Tobago's waters are naturally cloudier than destinations such as Barbados or St. Lucia which are higher up the Caribbean chain of islands. The implementation of proper sewage

[9]Litter Act, Chp. 30:52 (Act No. 27 of 1973, amended by 10 of 1981) - The Act prohibits littering, *inter alia*, of public places.

[10]The beaches which have jetties include Pigeon Point Beach, Anse Bateaux, Parlatuvier, Castara and Man O' War Beaches.

treatment and taking measures to monitor and reduce agro-chemical pollution will also improve the vertical visibility of the waters.

Number of snorkellers per group

This study suggests that respondents had a mix of preferences for this attribute. Recent research has shown that people's perceptions of crowding in marine environments are affected by their level of experience (Inglis et al. 1999). For example, respondents who are more experienced snorkellers are less tolerant of the number of persons around them than novices. Since one third of respondents in this survey were novices and two thirds were experienced snorkellers, the variation of preferences could be explained by this phenomenon. It is clear from these results that more research is needed to understand how people perceive crowding in marine environments. There is substantial research showing that crowding in marine environments affects the quality of marine life (Barker 2003, Rouphael & Inglis 1997, Hawkins et al. 1999). By educating users about why snorkelling in small groups is better for the environment, policy makers have an opportunity to manage snorkelling activities to ensure that minimal damage is caused by over-crowding.

8 Conclusion

This paper reported the results of two discrete choice experiment surveys carried out on two groups of beach recreationists. The purpose of the surveys was to determine the WTP estimates of snorkellers and non-snorkellers for improvements to coastal water quality on the island of Tobago. The results from the analysis suggest that within the two groups most of the respondents were more willing to pay to visit a beach with attributes associated with a higher level of environmental quality and were willing to pay less to visit one with a lower level of environmental quality.

In order to investigate the presence of unobserved taste heterogeneity, the MXL and LCM models were specified for both groups of respondents. BIC and AIC tests were used to compare the MXL and LCM model specifications. These two specifications outperformed the MNL model in all cases. In addition, an examination of the significant standard deviation estimates in the MXL models and the presence of classes in the LCM models revealed the presence of unobserved taste heterogeneity. In the case of snorkellers, a 2-class LCM model provided a significant improvement in fit over the MNL and MXL model specifications for nine attributes.In the case of nonsnorkellers, the results of the LCM model suggest that most of the nonsnorkellers fall within one class and therefore finite mixing is not a good statistical fit for this model. As a result the continuous distribution of the MXL model provided the most explanatory power and revealed unobserved taste heterogeneity for six attributes.

The parameter estimates from the chosen model specifications were used to calculate individual-specific WTP estimates. The individual-specific WTP estimates were depicted and contrasted for each level of attribute. These results revealed that in the case of snorkellers, a large variation could be observed between positive and negative WTP values for the two attribute levels representing the higher and lower levels of environmental quality. On the other hand, in the case of the nonsnorkellers, there was a significant amount of overlap between the two levels of the same attribute over the positive orthant. One reported implication of this result was that, in comparison to the snorkeller respondents, nonsnorkellers were more willing to pay for attributes representing a lower level of environmental quality.

The individual-specific WTP estimates were examined in order to derive policy implications for improvements to coastal water quality. The advantage of having used more flexible econometric models to capture unobserved taste heterogeneity is that it allows the tailoring of policies for each attribute and recreator group. For example, it was found that there were two subgroups of snorkellers. Therefore, this means that it is possible to consider a pricing policy that differentiates between the activities engaged by the beach recreationists. However, it would not be feasible to charge different rates for beach access. An alternative might be to charge different rates for access to different snorkelling sites depending on reef health (e.g. coral cover and fish abundance). In addition, an examination of the WTP estimates could also reveal similarities of tastes between the two groups. In the case of snorkellers, by examining attributes between the two groups derived from the LCM model, it is possible to identify those attributes for which both classes of snorkellers have strong positive or negative preferences. The MXL model also allows the identification of those attributes for which there is least unobserved taste heterogeneity of preference by observing the standard deviation surrounding the parameter estimates. This analysis reveals that both groups of respondents had strong positive or negative preferences for the attributes representing the chance of contracting an ear infection, level of development, presence of a marine protected area and the level of plastics on the coastline.

On small island states like Tobago where financial resources are limited and conflicting development interests exist, it may be more important to focus on policies which deliver benefits to the largest cross section of beach recreationists and subsequently focus on policies which deliver benefits to subgroups. In this case the results suggest that the policy makers should first focus on (1) reducing the health risks of the coastal waters, (2) ensuring that there is proper planning and development control, (3) aiding in the creation of more MPAs, and (d) actively implementing and enhancing solid waste collection programs. These improvements will have spill-over effects on other aspects of the environment such as improvement of vertical visibility and an increase in coral cover and fish abundance. Secondly, they could implement strategies and programs which help to further reduce the adverse impacts of recreational use. These include provision of adequate facilities for boaters and managing the behaviour of reef users. Further education can also help with the effective implementation of any management program. It is important to note however, that these policy options should be further analysed through economic evaluation tools such as cost-benefit muilticriteria studies.

Table 2: Attribute definitions, levels and variable names

Attribute	Definition	Variable Names and Levels	
Number of boats	Number of recreational and fishing boats near the coastline	BTS1_Low_Policy	Up to seven boats allowed near coastline
		BTS2_High_Policy	Up to 2 boats allowed near coastline
		No policy option (status quo)	No policy to limit the number of boats near the coastline
Marine protected area	Presence of type of marine protected area	MPA1_Low_Policy	A marine protected area where you can (tour, swim, snorkel, dive) and fish
		MPA2_High_Policy	A marine protected area where you can (tour, swim, snorkel, dive) but no fishing
		No policy option (status quo)	No policy that enforces restrictions on activities in an MPA
Coastline development	Percentage of coastal development on the coastline	DEV1_Low_Policy	Up to 75% development allowed on the coastline
		DEV2_High_Policy	Up to 25% development allowed on the coastline
		No policy option (status quo)	No policy that limits the development activities on the coastline
Average bathing water quality	Risk of contracting an ear infection from swimming in polluted water	WQ1_Low_Policy	Increased chance of contracting an ear infection from swimming in polluted water
		WQ2_High_Policy	Reduced chance of contracting ear infection from swimming in polluted water
		No policy option (status quo)	No policy that indicates the quality of the bathing waters
Clarity	Level of Vertical Visibility	CLAR11_High_Policy	Vertical Visibility of up to 10 metres
		CLAR2_Low_Policy	Vertical Visibility of up to 5 metres
		No policy option (status quo)	No policy that ensures clarity of coastal waters
Plastic debris	Number of plastics per 30 metres of coastline	PLAS11_Low_Policy	Up to 15 pieces per 30 metres of coastline allowed
		PLAS2_High_Policy	Less than 5 pieces allowed per 30 metres of coastline allowed
		No policy option (status quo)	No policy that ensures that plastic litter is picked up
Number of snorkellers	Number of snorkellers allowed per group	SNO1_Low_Policy	Up to 15 snorkellers allowed per group or per instructor
		SNO2_High_Policy	Up to 5 snorkellers allowed per group or per instructor
		No policy option (status quo)	No policy that limits size of snorkeller groups
Coral Cover	Percentage of coral cover available for viewing while snorkelling	CORAL1_High_Policy	Can view up to 45% coral cover while snorkelling
		CORAL2_Low_Policy	Can view up to 15% coral cover while snorkelling
		No policy option (status quo)	No policy to ensure that coral cover is at a certain level
Abundance of Fish	Number of fish available for viewing while snorkelling	FISH1_High_Policy	Can view up to 60 fishes while snorkelling
		FISH2_Low_Policy	Can view up to 10 fishes while snorkelling
		No policy option (status quo)	No policy to ensure that number of fish is at a certain level
Fee	Contribution Fee to Beach Authority	FEE	TT$10, TT$20, TT$25

Table 3: Socioeconomic characteristics of the respondents

Description of data	Snorkellers	Nonsnorkellers
Percentage of residents and local visitors from Trinidad	11%	64%
Percentage of international visitors	89%	36%
Average age	38.6	39.4
Percentage of males	53.54%	47.67%
Percentage of females	46.36%	52.33%
Average Income	TT$ 339 43	TT$ 204 72
Education (with University education)	45.96%	20.23%
Employment (with full time employment)	72.73%	61.63%

Table 4: Parameter Estimates from MNL, LCM and MXL Models for Nonsnorkellers

	Parameter Estimates from MNL, LCM and MXL Models for NonSnorkellers									
	MNL		LCM				MXL			
			Class 1		Class 2					
	Est.	t-stat	Est.	t-stat	Est.	t-stat	Est.	t-stat	Std. Dev.	t-stat
BTS1_Low_Policy	0.179	1.5	0.346	2.6	-2.853	-3.4	0.5227	3.0870		
BTS2_High_Policy	0.397	3.0	0.488	3.5	0.804	1.1	0.8670	4.9960		
MPA1_Low_Policy	-0.025	-0.2	0.128	1.0	-34.050	0.0	0.0118	0.0590	0.927	3.8
MPA2_High_Policy	0.238	1.9	0.377	2.8	2.763	0.0	0.6708	3.9230		
DEV1_Low_Policy	-0.197	-1.5	-0.114	-0.8	-3.585	-3.1	-0.3873	-1.4950	1.501	5.3
DEV2_High_Policy	0.274	2.2	0.339	2.4	0.907	1.3	0.6729	4.0130		
WQ1_Low_Policy	-0.622	-4.6	-0.575	-4.0	-6.177	0.0	-1.0880	-4.6920	1.118	4.3
WQ2_High_Policy	0.487	4.0	0.580	4.3	31.395	0.0	0.9405	4.7820	0.951	4.0
CLAR2_Low_Policy	0.031	0.2	0.114	0.8	-0.015	0.0	0.1855	0.9320	0.631	2.2
CLAR1_High_Policy	0.469	3.9	0.602	4.7	0.775	1.0	0.7247	4.2680		
PLAS1_Low_Policy	-0.312	-2.4	-0.201	-1.5	-34.062	0.0	-0.4215	-2.5240		
PLAS2_High_Policy	0.296	2.4	0.414	3.0	-33.146	0.0	0.5874	3.4610		
Fee	-0.025	-3.7	-0.018	-2.6	-0.018	-2.6	-0.0942	6.6270	0.094	6.6
Number of Observations	2193		2193				2193			
Number of Individuals	86		86				86			
Prob. of Membership			83%		17%					
Number of Params. (K)	13		27				19			
Log Likelihood (LL)	-747.35		-660.7526				-684.631			
Akaike Information 3	2281.05		2063.26				2110.89			

Table 5: Parameter Estimates from MNL, LCM and MXL Models for Snorkellers

	Parameter Estimates from MNL, LCM and MXL Models for Snorkellers									
	MNL		LCM				MXL			
			Class 1		Class 2					
	Est.	t-stat	Est.	t-stat	Est.	t-stat	Est.	t-stat	Std. Dev.	t-stat
BTS1_Low_Policy	-0.197	-2.3	-0.147	-1.3	-0.596	-4.2	-0.330	-2.5		
BTS2_High_Policy	0.136	1.7	0.275	2.6	-0.333	-2.4	0.166	1.4		
MPA1_Low_Policy	0.125	1.5	0.369	3.4	0.221	1.5	0.291	2.1	0.180	4.141
MPA2_High_Policy	0.289	3.6	0.483	4.6	0.340	2.5	0.646	5.4		
DEV1_Low_Policy	-0.411	-4.7	-0.236	-2.2	-0.622	-4.0	-0.707	-4.5	0.185	5.15 5
DEV2_High_Policy	0.376	4.9	0.573	5.5	0.415	3.6	0.722	5.4	0.165	5.420
WQ1_Low_Policy	-0.421	-4.8	-0.411	-3.5	-1.259	-7.2	-0.980	-5.3	0.197	7.633
WQ2_High_Policy	0.459	5.9	0.370	3.6	0.741	6.2	0.667	5.0	0.182	4.713
CLAR2_Low_Policy	-0.215	-2.6	-0.045	-0.4	-0.281	-1.9	-0.205	-1.6	0.239	2.5 81
CLAR1_High_Policy	0.311	3.9	0.600	5.5	0.209	1.5	0.700	5.8		
PLAS1_Low_Policy	-0.166	-1.9	0.001	0.0	-0.991	-6.4	-0.459	-2.9	0.195	6.408
PLAS2_High_Policy	0.514	6.4	0.749	6.9	0.451	3.6	0.908	6.5	0.169	5.314
SNO1_Low_Policy	-0.119	-1.4	0.070	0.7	-0.910	-5.9	-0.324	-2.2	0.192	5.578
SNO2_High_Policy	0.108	1.3	0.221	2.1	0.139	1.1	0.118	1.0		
CORAL2_Low_Policy	-0.110	-1.3	0.113	1.1	-0.554	-3.6	-0.168	-1.3		
CORAL1_High_Policy	0.464	5.7	0.748	6.8	0.187	1.4	0.829	5.9	0.166	5.768
FISH2_Low_Policy	-0.092	-1.1	-0.008	-0.1	-0.169	-1.2	-0.082	-0.7		
FISH1_High_Policy	0.240	2.9	0.447	4.2	0.147	1.1	0.556	4.5		
Fee	-0.023	-5.8	-0.014	-2.9	-0.035	-5.5	-0.058	8.0	0.007	8.043
Number of Observations	5346		5346				5346			
Number of Individuals	198		198				198			
Prob. of Membership			61%		39%					
Number of Params. (K)	19		39				30			
Log Likelihood (LL)	-1742.915		-1578.906				-1604.02			
Akaike Information 3	5285.75		4853.72				4902.06			

Table 6: Model Specification Criteria for nonsnorkellers

	Model Specification for Nonsnorkellers				
Parameter	MNL	LCM (Restricted)	LCM (2)	LCM (3)	RPL
Log Likelihood	-747.35	-660.75	-660.18	-631.77	-684.631
Number of Parameters (K)	13	27	27	41	19
Number of Individuals(N)	86	86	86	86	86
AIC	1520.70	1375.51	1374.37	1345.54	1407.26
AIC - 3	2281.05	2063.26	2061.55	2018.31	2110.89
BIC	1552.61	1441.77	1440.63	1446.17	1453.89

Table 7: Model Specification Criteria for Snorkellers

	Model Specification for Snorkellers			
Parameter	MNL	LCM (2)	LCM (3)	RPL
Log Likelihood	-1742.92	-1578.91	-1542.25	-1604.02
Number of Parameters (K)	19	39	59	30
Number of Individuals(N)	198	198	198	198
AIC	3523.83	3235.81	3202.50	3268.04
AIC - 3	5285.75	4853.72	4803.75	4902.06
BIC	3586.31	3364.05	3396.51	3366.69

References

Agard, J. & Gobin, J. (2000), *The Lesser Antilles Trinidad and Tobago*, Seas at the millenium: An environmental evaluation, pp. 627–641.

Andrews, R., Ansari, A. & Currim, I. (2002), 'Hierchical bayes vs. finite mixture conjoint analysis models: A comparison of fit, prediction, and partworth recovery', *Journal of Marketing Research* **39**, 87–98.

Barker, N. H. L. (2003), Ecological and socio-economic impacts of dive and snorkel tourism in St. Lucia, West Indies, PhD thesis, University of York, U.K.

Barton, D. (1998), Applying NOAA Panel Recommendations to contingent valuation studies in developing countries? A case study of coastal water quality in Costa Rica. Discussion Paper Number 24 by Department of Economics and Social Sciences, Agricultural University of Norway.

Bastin, F., Cirillo, C. & Hess, S. (2005), 'Evaluation of optimisation methods for estimating mixed logit models', *Transportation Research Record* **1921**, 35–43.

Beharry, N. (2008), Valuing benefits of improved coastal water quality for beach recreationists in Tobago : A discrete choice experiment application, PhD thesis, University of York, U.K.

Bell, F. & Leeworthy, V. (1990), 'Recreational demand by tourists for saltwater beach days', *Journal of Environmental Economics and Management* **18**, 189–205.

Ben-Akiva, M., Walker, J., Bernardino, A., Gopinath, D., Morikawa, T. & Polydoropoulou, A. (2002), *Integration of choice and latent variable models*, In: Perpetual motion: Travel behaviour research opportunities and application challenges, chapter 13, pp. 431–470.

Bhat, C. (1997), Incorporating observed and unobserved heterogeneity in urban work travel mode choice modeling. Working paper by The Department of Civil Engineering, The University of Texas at Austin.

Bin, O., Landry, C., Ellis, C. & Vogelsong, H. (2004), Some consumer surplus estimates for North Carolina beaches. Working paper by East Carolina University, U.S.A.

Bockstael, N., Hanemann, W. & Kling, C. (1987), 'Estimating the value of water quality improvements in a recreational demand framework', *Water Resources Research* **23**, 951–960.

Bockstael, N., McConnell, K. & Strand, I. (1989), 'Measuring the benefits of improvements in water quality: The Chesapeake Bay', *Marine Resource Economics* **6**, 1–18.

Bowman, A. & Azzalini, A. (1997), *Applied smoothing techniques for data analysis: The kernel approach with S-Plus illustrations*, Oxford University Press.

Boxall, P. & Adamowicz, W. (2002), 'Understanding heterogeneous preferences in random utility models: A latent class approach', *Environmental and Resource Economics* **23**, 421–446.

Brownstone, D. & Train, K. (1999), 'Forecasting new product penetration with flexible substitution patterns', *Journal of Econometrics* **89**, 109–129.

Carlsson, F. & Martinsson, P. (2003), 'Design techniques for stated preference methods in health economics', *Health Economics* **12**, 281–294.

CSO (2001), 'The annual statistical digest', The Central Statistical Office of Trinidad and Tobago.

Dawes, R. & Corrigan, B. (1974), 'Linear models in decision making', *Psychological Bulletin* **81**, 95–106.

EFTEC (2002), Valuation of benefits to England and Wales of a revised bathing water quality directive and other beach characteristics using the choice experiment methodology, Technical report, Economics for the Environment Consultancy Limited (EFTEC), Department for Environment, Food and Rural Affairs, U.K.

Eggert, H. & Olsson, B. (2005), Heterogeneous preferences for marine amenities: A choice experiment applied to water quality. Working Paper by The Department of Economics, Göteborg University.

EMA (1999), Annual report of the Environmental Management Authority (EMA). Prepared by The Environmental Management Authority of Trinidad and Tobago.

Feenberg, D. & Mills, E. (1980), *Measuring the benefits of water pollution abatement*, Academic Press: New York.

Ferrini, S. & Scarpa, R. (2007), 'Designs with a-priori information for nonmarket valuation with choice-experiments: A monte carlo study', *Journal of Environmental Economics and Management* **53**, 342–363.

Freeman, A. M. (1979), The benefits of air and water pollution control: A review and synthesis of recent estimates, Technical report, Council on Environmental Quality, Washington D.C., U.S.A.

Freeman, A. M. (1995), 'The benefits of water quality improvements for marine recreation: A review of the empirical evidence', *Marine Resource Economics* **10**, 385–406.

Goffe, P. L. (1995), 'The benefits of improvements in coastal water quality: A contingent approach', *Journal of Environmental Management* **45**, 305–317.

Goreau, T. & Thacker, K. (1994), Coral reefs, sewage, and water quality standards. Paper prepared for The Caribbean water and wastewater association conference, Kingston, Jamaica.

Greene, W. (2005), *Nlogit 4.0 reference guide*.

Greene, W., Hensher, D. A. & Rose, J. (2005), *Using classical simulation-based estimators to estimate individual WTP values*, In: Applications of simulation methods in environmental and resource economics, chapter 2, pp. 17–32.

Hawkins, J., Roberts, C., Hof, T. V., Meyer, K. D., Tratalos, J. & Aldam, C. (1999), 'Effects of recreational scuba diving on Caribbean coral and fish communities', *Conservation biology* **13**, 888–897.

Hensher, D. & Greene, W. (2003), 'The mixed logit model: The state of practice', *Journal of Transportation* **30**, 133–176.

Hensher, D., Rose, J. & Greene, W. H. (2005), *Applied Choice Analysis - A Primer*, Cambride University Press.

Herriges, J. A. & Phaneuf, D. J. (2002), 'Inducing patterns of correlation and substitution in repeated logit models of recreation demand', *American Journal of Agricultural Economics* **84**, 1076–1090.

Huang, J. & Poor, P. (2004), Welfare measurement with individual heterogeneity: Economic vauation of beach erosion control programs. Working Paper by The University of New Hampshire, U.S.A.

Hynes, S., Hanley, N. & Scarpa, R. (2008), 'Effects on welfare measures of alternative means of accounting for preference heterogeneity in recreational demand models', *American Journal of Agricultural Economics* **91011-1027**, 90.

IMA (2001), A management plan for the Speyside reefs marine park, Tobago. Draft report prepared by The Institute of Marine Affairs.

IMA (2006), Development of a National Programme of Action (NPA) for the protection of the marine environment from land-based sources and activities . Background paper by The Institute of Marine Affairs of Trinidad and Tobago.

Inglis, G. J., Johnson, A. & Ponte, F. (1999), 'Crowding norms in marine settings: A case study of snorkelling on the Great Barrier reef', *Environmental Management* **24**, 369–381.

Kanabkaew, T. & Puetpaiboon, U. (2005), ‘Aquatic plants for domestic wastewater treatment: Lotus (Nelumbo nucifera) and Hydrilla (Hydrilla verticillata) systems’, *Songklanakarin J. Sci. Technol.* **26**, 749–756.

Koppelman, F. S. & Bhat, C. (2006), A self intructing course in mode choice modeling: multinomial and nested logit models, Technical report, Prepared for U.S. Department of Transportation, Federal Transit Administration.

L. Burke, S. Greenhalgh, D. P. & Cooper, E. (2008), Coastal Capital - Economic Valuation of Coral Reefs in Tobago and St. Lucia, Technical report, WRI.

L. M. Brander, P. V. B. & J.Cesar, H. S. (2007), ‘The Recreational Value of coral reefs: A meta-analysis’, *Ecological Economics* **63**, 209–218.

Lalta, S. & Freckleton, M., eds (1993), *Caribbean tourism and the world economy*, In: Caribbean economic development: The first generation, chapter 19, pp. 262–279.

Landry, C. E., Keeler, A. & Kriesel, W. (2003), ‘An economic evaluation of beach erosion management alternatives’, *Marine Resource Economics* **18**, 105–127.

Lapointe, B. (2003), Impacts of land-based nutrient pollution on coral reefs in tobago, Technical report, Division of Marine Science, Harbor Branch Oceanographic Institution.

Lapointe, B., Matzie, W. & Barile, P. (2004), ‘Anthropogenic nutrient enrichment of seagrass and coral reef communities in the lower Florida Keys USA: Discrimination of local versus regional nitrogen sources’, *Journal of Experimental Marine Biology and Ecology* **298**, 275–301.

Leeworthy, V. R. & Wiley, P. (1991), Recreational use value for island beach state park. Unpublished paper by The National Oceanic and Atmospheric Administration (NOAA).

Lindsey, G. & Holmes, A. (2002), ‘Tourist support for marine protection in Nha Trang, Viet Nam’, *Journal of Environmental Planning and Management* **45**, 461–480.

Louis, G., Magpili, L. & Singleton, A. (2006), Capacity assessment and mapping of the municipal sanitation infrastructure in Tobago . Working paper by The University of Virginia, Systems and Information Engineering, U.S.A.

Louviere, J., Hensher, D. & Swait, J. (2000), *Stated choice methods analysis and applications*, Cambridge University Press.

Machado, F. & Mourato, S. (1999), Improving the assessment of water related health impacts: Evidence from coastal waters in Portugal. Working paper by CSERGE, University of East Anglia, U.K.

Massey, D. (2002), Heterogeneous preferences in random utility models of recreation demand, PhD thesis, University of Delaware, U.S.A.

McConnell, K. (1977), 'Congestion and willingnes to pay use', *Land Economics* **53**, 185–195.

McFadden, D. (1974), *Conditional logit analysis of qualitative choice behavior*, Frontiers of Econometrics, Academic Press, U.S.A.

Mercado, L. & Lassoie, J. (2002), 'Assessing tourist's preferences for recreational and environmental management programs central to the sustainable development of a tourism area in the Dominican republic', *Environment, Development and Sustainability* **4**, 253–278.

Milon, J. & Scrogin, D. (2002), *Heterogeneous preferences and complex environmental goods: The case of ecosystem restoration*, In: Recent advances in environmental economics, chapter 13, pp. 286–308.

Milon, J. W. & Scrogin, D. (2006), 'Latent preferences and valuation of wetland ecosystem restoration', *Ecological Economics* **56**, 162–175.

Morey, E., Thacher, J. & Breffle, W. (2006), 'Using angling characteristics and attitudinal data to identify environmental preference classes: A latent class model', *Environmental and Resource Economics* **34**, 91–115.

Naidoo, R. & Adamowicz, W. (2005), 'Biodiversity and nature-based tourism at forest reserves in Uganda', *Environment and Development Economics* **10**, 159–178.

Parsons, G., Massey, D. M. & Tomasi, T. (2000), 'Familiar and favorite sites in a random utility model of beach recreation', *Marine Resource Economics* **14**, 299–315.

Parsons, G. & Thur, S. (2008), '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**, 593–608.

Provencher, B., Baerenklau, K. & Bishop, R. C. (2002), 'A finite mixture model of recreational angling with serially correlated random utility', *American Journal of Agricultural Economics* **84**(4), 1066–1075.

Revelt, D. & Train, K. (1998), 'Mixed logit with repeated choices: Households' choices of appliance efficiency level', *The Review of Economics and Statistics* **80**, 647–657.

Rouphael, A. & Inglis, G. (1997), 'Impacts of recreational scuba diving at sites with different reef topographics', *Biological conservation* pp. 329–336.

Ruto, E., Garrod, G. & Scarpa, R. (2008), 'Valuing animal genetic resources: a choice modeling application to indigenous cattle in Kenya', *Agricultural Economics* **38**, 89–98.

Santos, I., Friedrich, A., Wallner-Kersanach, M. & Fillmann, G. (2005), 'Influence of socio-economic characteristics of beach users on litter generation', *Ocean and Coastal Management* **48**, 742–752.

Sarbo, W. D., Ansari, A., Chintagunta, P., Himmelberg, C., Jedidi, K., Johnson, R., Kamakura, W. & P. Lenk, K. S. (1997), 'Representing heterogeneity in consumer response models 1996 choice conference participants', *Marketing Letters* **8**, 335–348.

Scarpa, R., Campbell, D. & Hutchinson, W. (2007*a*), 'Benefit estimates for lanscape improvements: sequential Bayesian design and respondent's rationality in a choice experiment', *Land Economics* **83**(4), 617–634.

Scarpa, R., Campbell, D. & Hutchinson, W. G. (2007*b*), 'Benefit estimates for landscape improvements: sequential Bayesian design and respondents rationality in a choice experiment study', *Land Economics* **83**(4), 617–634.

Scarpa, R., Ferrini, S. & Willis, K. (2005), *Performance of error component models for status-quo effects in choice experiments*, In: Applications of simulation methods in environmental and resource economics, chapter 13, pp. 247–267.

Scarpa, R. & Thiene, M. (2005), 'Destination choice models for rock climbing in the Northeastern Alps: A latent-class approach based on intensity of preference', *Land Economics* **85**, 426–44.

Scarpa, R., Thiene, M. & Train, K. (2008), 'Utility in WTP space: a tool to address confounding random scale effects in destination choice to the Alps', *American Journal of Agricultural Economics* **90**, 994–1010.

Scarpa, R., Willis, K. & Acutt, M. (2005), *Individual-specific welfare measures for public goods: A latent class approach to residential cutomers of Yorkshire Water*, In: Econometrics Informing Natural Resource Management, pp. 316–337.

Secretariat, C. (2000), Report of the Commonwealth Secretariat, World Bank joint task force on small states, London, Technical report, Commonwealth Secretariat.

SEDU (2002), Environmental management insertion in tourism sector policies in the Caribbean, Technical report, The Sustainable Economic Development Unit (SEDU) Department of Economics, University of the West Indies, St. Augustine Campus Trinidad and Tobago.

Silberman, J. & Klock, M. (1988), 'The recreation benefits of beach nourishment', *Ocean and Shoreline Management* **11**, 73–90.

Sillano, M. & Ortuzar, J. D. (2005), 'Willingness-to-pay estimation with mixed logit models: Some new evidence', *Environment and Planning A* **37**, 525–550.

Siung-Chang, A. (1997), 'A review of marine pollution issues in the Caribbean', *Environmental Geochemistry and Health* **19**, 44–45.

Swait, J. (1994), 'A structural equation model of latent segmentation and product choice for cross-sectional revealed preference data', *Journal of Retailing and Consumer Service* **1**, 77–89.

Swait, J. & Sweeney, J. C. (2000), 'Perceived value and its impact on choice behaviour in a retail setting', *Journal of Retailing and Consumer Services* **7**, 77–88.

Sweden, K., ed. (2000), *An economic and ecological analysis of the Bonaire Marine Park*, In: Collected essays on the economics of coral reefs.

Thiene, M. & Scarpa, R. (2008), 'Hiking in the alps: exploring substitution patterns of hiking destinations', *Tourism Economics* **14**(2), 263–282.

Tongson, E. & Dygico, M. (2004), 'User fee system for marine ecotourism: The Tubbataha Reef Experience', *Coastal Management* **32**, 17–23.

Train, K. (1998), 'Recreation demand models with taste differences over people', *Land Economics* **74**, 230–239.

Train, K. (2003), *Discrete choice methods with simulation*, Cambridge University Press: New York.

UNEP (2003), GEO Latin America and the Caribbean: Environment Outlook, Technical report, UNEP Regional Office for Latin America and the Caribbean, Mexico.

Vaughn, W., Paulsen, C., Hewitt, J. & Russell, C. (1985), The estimation of recreation-related water pollution control benefits: swimming, boating, and marine recreational fishing, Technical report, Submitted by Resources for the Future to U.S. Environmental Protection Agency.

Walker, J. L. & Jieping, L. (2007), 'Latent lifetsyle preferences and household location decisions', *Journal of Geographical Systems* **25**, 77–101.

Wielgus, J., Chadwick-Furman, N. E., Zeitouni, N. & Scechter, M. (2003), 'Effects of coral reef attribute damage on recreational welfare', *Marine Resource Economics* **18**, 225–237.

Williams, I. D. & Polunin, N. (2000), 'Differences between protected and unprotected reefs of the western Caribbean in attributes preferred by dive tourists', *Environmental Conservation* **27**(4), 382–391.

Wood, L. (2000), *Diving and snorkelling, Trinidad and Tobago*, Lonely planet publications: Australia.

WTTC (2004), Trinidad and Tobago the impact of travel and tourism on jobs and the economy, Technical report, The World Travel and Tourism Council.

Zylick, T., Bateman, I., Georgiou, S., Markowska, D. A., Dziegielewska, A., Turner, R., Graham, A. & Langford, I. (1995), Contingent valuation of eutrophication damage in the Baltic sea. Working paper by CSERGE, University of East Anglia, U.K.