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The influence of hurricane risk on tourist destination choice in the Caribbean

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Abstract Climate change could have major implications for the global tourism industry if changing environmental conditions alter the attractiveness of holiday destinations. Countries with economies dependent on tourism and with tourism industries reliant on vulnerable natural resources are likely to be particularly at risk. We investigate the implications that climate-induced variations in Atlantic hurricane activity may have for the tourism-dependent Caribbean island of Anguilla. Three hundred tourists completed standardised questionnaires and participated in a choice experiment to determine the influence hurricane risk has on their risk perceptions and decisions regarding holiday preferences. The hurricane season had been considered by 40 % of respondents when making their holiday choice, and the beaches, climate and tranquility of the island were more important than coral reef-based recreational activities in determining holiday destination choice. Choice models demonstrated that

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respondents were significantly less likely to choose holiday options where hurricane risk is perceived to increase, and significantly more likely to choose options that offered financial compensation for increased risk. However, these choices and decisions varied among demographic groups, with older visitors, Americans, and people who prioritize beach-based activities tending to be most concerned about hurricanes. These groups comprise a significant component of the island's current clientele, suggesting that perceived increases in hurricane risk may have important implications for the tourism economy of Anguilla and similar destinations. Improved protection of key environmental features (e.g. beaches) may be necessary to enhance resilience to potential future climate impacts.

1 Introduction

Tourism is one of the largest and most rapidly expanding economic sectors in the world, and is critically important for the local and national economies of many countries (Agnew and Viner 2001; Gössling and Hall 2006; Becken and Hay 2007). Mass tourism is highly sensitive to climatic variation because favourable environmental conditions are a major component of decision-making regarding holiday destinations, particularly for the dominant 'sun, sea and sand' tourism industry (Uyarra et al. 2005; Bigano et al. 2006; Becken and Hay 2007). Climate change could have significant implications for the global tourism industry by reducing the attractiveness of currently popular destinations and/or increasing favourable conditions in alternative locations (Lise and Tol 2002; Scott et al. 2004).

Tourist destinations that are particularly vulnerable to change are those with economies already dependent on tourism and reliant on international travel rather than local markets (Wall 1998; Maddison 2001). Moreover, destinations that attract visitors because of location-specific natural resources, principally coastal areas, islands and mountainous regions, are expected to be particularly vulnerable if changing climate affects those natural resources (Wall 1998). Small islands are frequently identified as places of significant concern as their economies often depend strongly on tourism, and because the coastal attractions on which island tourism is typically founded are vulnerable to sea level rise, storms and increasing sea temperatures (Lewsey et al. 2004; Becken and Hay 2007; Meheux et al. 2007; Mimura et al. 2007).

The Caribbean is one of the most tourism-dependent regions of the world, attracting 22.5 million annual stopover visitors (CTO 2005) and accounting for approximately 7 % of annual world tourist arrivals (Daye et al. 2008). The tourism sector is estimated to generate 14.8 % of the gross domestic product (GDP) of the Caribbean region and to employ 2.4 million people (15.5 % of total employment) (WTTC 2004). However, the economic contribution of tourism varies among islands; for example, tourism generates more than 70 % of GDP and employment opportunities in Antigua and Barbuda, the British Virgin Islands (BVI) and Anguilla but only 10 % in Puerto Rico, Haiti and Martinique (WTTC 2004). Like many tropical island holiday destinations, Caribbean tourism is predominantly dependent on coastal attractions such as beaches and coral reefs (Lewsey et al. 2004; Uyarra et al. 2005). Pronounced dependence on these natural resources means that the Caribbean tourism industry, and especially islands with economies strongly dependent on tourism, are likely to be particularly susceptible to climate change (Becken and Hay 2007; Mimura et al. 2007).

The climate change impacts of particular relevance for the Caribbean include rising sea levels, changes in the frequency and intensity of hurricanes, elevated sea surface temperatures and changing rainfall patterns (Becken and Hay 2007; Mimura et al. 2007). Very few studies have specifically examined the direct effects these impacts could have on Caribbean tourism. Most notably, Uyarra et al. (2005) show that at least 80 % of tourists visiting the Caribbean islands of Bonaire and Barbados would not return to these islands for the same holiday price if coral bleaching and reduced beach area occurred. The importance of Caribbean beaches for island economies was also demonstrated by Dharmaratne and Brathwaite (1998) who estimated the access value of the beaches on the west and south coasts of Barbados at US$13 million, indicating economic implications of beach loss resulting from sea level rise. Changes in hurricane activity in the Caribbean Sea would also be highly significant for the Caribbean tourism industry (Becken and Hay 2007), but little is known about the likely effects of changing extreme events upon tourism (Bigano et al. 2005).

Since 1995, increases in North Atlantic hurricane activity has led to ongoing debate about the relationship between increasing hurricane frequency and intensity, anthropogenic climate change and elevated sea surface temperatures (Goldenberg et al. 2001; Emanuel 2005; Trenberth 2005; Webster et al. 2005; Holland and Webster 2007). However, the vulnerability of the Caribbean region and its tourism industry to any increase in hurricane activity is unmistakable (Mimura et al. 2007). For example, the impact of hurricane Ivan on Grenada in 2004 resulted in the damage or loss of 90 % of hotel rooms on the island and led to US$108 million of damage (Mimura et al. 2007). These losses accounted for 29 % of Grenada's annual GDP (Becken and Hay 2007), and the impact of the same hurricane in the Cayman Islands led to economic damages estimated at 200 % of GDP (Young 2005). Similarly, in Anguilla, hurricanes Luis (1995) and Lenny (1999) inflicted severe damage to the island's tourism industry (ECLAT 2000; Young 2005), with estimated industry losses after Lenny of US$26.3 million (ECLAT 2000).

In addition to the direct impacts of extreme events on tourist destinations, indirect impacts on tourist perception of the risk of extreme events can influence destination choice (Bigano et al. 2005; Gössling and Hall 2006), and the success of holiday regions may be highly dependent on these perceptions (Eitzinger and Wiedemann 2007). The main objectives of this study were therefore to 1) understand the socio-economic characteristics and holiday preferences of tourists to the Caribbean island of Anguilla, 2) investigate the influence of hurricane risk on tourist destination choice and holiday preferences, and 3) examine how these vary between different groups of tourists visiting the island. The results of this study should provide evidence of the repercussions that changes in hurricane activity may have for the Anguillan tourism industry, with implications for other comparable Caribbean holiday destinations.

2 Methods

2.1 Study area

The study was carried out in Anguilla (18° 15' N, 63° 10' W), one of the islands of the Lesser Antilles chain in the Caribbean Sea. Anguilla has a land area of 91 km^2, a population of 13,900 and is one of the least densely populated islands (*c.* 153 people per km^2) in the region (CTO 2007). The topography is low-lying with the highest point 65 m above sea level (Carty and Petty 2000). The island lies in the centre of the Atlantic hurricane belt and the regional hurricane season runs from June to November (Mukhida and Gumbs 2008). Anguilla experiences a tropical storm or hurricane approximately once every 3 years (NOAA 2009), and over the last 50 years has been severely affected by three hurricanes; Donna in 1960, Luis in 1995 and Lenny in 1999 (Young 2005).

Tourism dominates Anguilla's economy, generating 72 % of the island's GDP and 80 % of total employment (WTTC 2004). Annual tourist arrivals to the island are approximately

78,000 (CTO 2007). The official tourist season runs from December to April (mean tourist arrivals during these months, 6903±950 SD). Tourist arrivals are typically lower throughout the June to November hurricane season (monthly mean 4559±2170 SD), and decline most substantially between September to November (monthly mean 2924±1705 SD; CTO 2009). Anguilla has developed as an up-market tourist destination since the late 1970s, and the white sand beaches, described as some of the most pristine in the Caribbean mean that tourist activities are primarily beach-based (Carty and Petty 2000).

2.2 Sampling and data collection

Questionnaires were completed with tourists visiting Anguilla between the peak holiday months of March and April in 2008. The study took place out of the hurricane season, but the demographic characteristics of tourists do not change appreciably throughout the year (Anguilla Tourist Board personal communication 2008), so these surveys should be representative of the whole tourist season. It is possible that tourists visiting Anguilla during the hurricane season may have different perceptions regarding hurricane risk. However, the numbers of tourists who visit during the hurricane months are far fewer compared with other times of the year, so their influence on the tourism industry is relatively low.

The questionnaires were carried out between 09.00 and 18.00 at three of the main beaches on the north, west and south coasts. Most hotels and guest houses are located on or near a beach, so survey locations were selected to represent the range of tourists visiting Anguilla, while also providing sufficient numbers of tourists to allow effective sampling; few people were encountered on four other major beaches away from the study beaches. The interviewer walked from one end of the beach to the other, approaching each person in turn, asking if they were on holiday and if they would participate in the survey. For groups of tourists, only one member of each group was surveyed. Beaches were visited between 6 and 21 times, with care being taken to survey people only once.

2.3 Questionnaire structure

The questionnaire consisted of four sections: a) questions to determine respondents' holiday attitudes and preferences (i.e. holiday activities in which respondents expected to participate while holidaying on the island, including going to the beach, sunbathing, beach walking, swimming, diving, snorkeling, fishing, water sports, eating fish and eating shellfish, and respondents' length of stay, seasonality of visit, reasons for visiting and accommodation); b) choice questions regarding hurricane risk; c) choice experiment follow-up questions to explore respondents' perceptions and motivations; and d) demographic information (i.e. age, nationality, gender, education, number of dependents, income) to relate to respondents' choice experiment responses, and to ensure the survey sample was representative. For the purpose of this study, the term 'hurricane' hereafter refers to the risk of any category of hurricane (using the Saffir-Simpson scale) or tropical storm.

2.4 The choice experiment method

Economists have developed a variety of techniques for estimating trade-offs between costs and benefits of environmental goods and services (Boxall et al. 1996; Bennett and Adamowicz 2001). One class of methods, known as 'stated preference' techniques includes the contingent valuation method and choice experiments. The most commonly used method has been contingent valuation (Boxall et al. 1996), which relies on direct survey questions to elicit values, typically by asking respondents to state their willingness to pay for a hypothetical change in the level of an environmental good (Hanley et al. 2001). Choice experiments have gained prevalence in environmental resource valuation studies (Hanley et al. 1998; Bennett and Blamey 2001; Carlsson et al. 2003), as they are more amenable to decisions involving multiple attributes (Glenn et al. 2010) and are suited to examining alternative changes in environmental goods (Hanley et al. 2001). Survey respondents are presented with a series of hypothetical choices ('choice sets') across alternative goods (Hanley et al. 1998), which are described in terms of attributes with varying levels. Usually one of these attributes is price (Hanley et al. 1998). If respondents choose a certain bundle of attributes, it is assumed that they prefer the levels of attributes in that bundle over those of the alternative (Lindberg et al. 1999).

While the contingent valuation method is a powerful and useful tool in deriving value estimates for natural resources, a choice experiment approach may be more useful in terms of determining the impact of hurricane risk on tourist destination choices. Tourist destination choices can be thought of as the selection from a set of alternatives, which is determined by multidimensional attributes or characteristics of the destinations, including hurricane risk. The experimental aspect of this method is advantageous because it provides information on the willingness of respondents to make trade-offs between the individual attributes, the relative importance of the attributes, and their likely responses to different situations (Boxall et al. 1996; Bennett and Blamey 2001). As multiple choice sets are typically presented to each respondent, individuals are given the opportunity to respond to a range of prices and attributes, creating a panel of responses from each respondent and larger effective sample size (Hanley et al. 2001; Scarpa and Rose 2008).

The first steps when developing choice questions involve characterizing the problem, then selecting appropriate attributes and levels. The two key variables that are used to describe hurricanes are their frequency and intensity (see Webster et al. 2005; IPCC 2007) and these variables were, therefore, used as the two hurricane attributes. The choice experiment also included a 'cost' attribute, which facilitates a monetary evaluation of other attribute levels. Limiting the choice experiment to three attributes helped to reduce the complexity of the experiment for the respondent. Although the scenarios presented in the choice experiment are hypothetical, the attributes and levels must be meaningful and relevant for respondents (Bennett and Blamey 2001). For this purpose, a pilot survey was carried out with 50 respondents, including 45 tourists and five key informants (three senior staff members from the Anguilla Department for Fisheries and Marine Resources (DFMR) and two experienced local fishermen), to gauge appropriate attribute levels and ensure the attributes and choice questions were meaningful and clear.

2.4.1 Choosing the attribute levels for the choice experiment

The 45 tourists were asked a series of questions to identify appropriate levels for the hurricane frequency and cost attributes. Respondents were first asked to describe the likelihood of hurricane occurrence that would prevent them from coming on holiday (using a ratio scale, in which a 1:100 risk equates to a hurricane being expected during 1 week for every 100 weeks visiting the same holiday destination). Respondents were then shown a series of cards with picture grids depicting likelihoods of hurricane occurrence ranging from 1:100, 5:100, 10:100, 15:100, 20:100, 30:100, 40:100 to 50:100. The cards were shuffled, shown separately to each respondent and for each card respondents were asked if they would choose to come on holiday. The cards were shuffled again and respondents were asked to describe each picture in terms of the level of hurricane risk they perceive, using the scale: very low, low, medium, high or very high. Finally respondents were asked to estimate the price of their current holiday (including travel to Anguilla and accommodation, per person/per week (pp/pw)). Information on gender, age and nationality was also collected from each respondent.

As the frequency of hurricane risk increased, the number of respondents who said they would not choose that holiday also increased. On average, hurricane frequencies of 1:100 and 5:100 were perceived ‘low risk’, 10:100 to 20:100 were ‘medium risk’ and 30:100 to 50:100 were ‘high risk’. At the 15:100 level, almost half (44 %) of respondents said they would choose not to come on holiday. However, for hurricane frequencies in excess of 10:100, the credibility of the experiment was increasingly questioned by respondents. Consequently, the levels selected for the questionnaire survey were 1:100 (which is closest to the current hurricane risk in Anguilla), 5:100 (between the upper and lower frequencies chosen) and 10:100 (the maximum risk many of the respondents considered meaningful).

The mean holiday price was US$2,525 pp/pw (±1142 SD) and holiday price ranged from US$500 to US$5,000 pp/pw. The cost attribute levels were chosen to reflect this mean, maximum and minimum holiday price, in order to capture a realistic range of price reductions for the choice experiment. Thus, levels included a baseline, which was called ‘No change’ (i.e. current price), and then a range of reductions from the mean holiday price, including 10 % (*c.* US$250 pp/pw), 20 % (*c.* $500), 50 % (*c.* $1,250) and 80 % (*c.* $2,000).

The ‘hurricane strength’ attribute levels were determined during the key informant interviews. These discussions helped to identify the main holiday characteristics affected by a hurricane, including the number of beach/swimming days lost and whether other outdoor activities and/or flights from the island would be possible. The key respondents were then asked to identify how a weak (tropical storm to category 1 hurricane), medium (category 2–3 hurricane), or strong (category 4–5 hurricane) might influence these key holiday characteristics.

2.4.2 The design and facilitation of the choice experiment

The choice experiment attributes and levels determined by the pilot survey (Table 1) were combined into 45 ($3\times3\times5$) different scenarios, one of which was the ‘status quo’ or current situation. These were presented as 45 ‘choice set’ cards, each consisting of the ‘status quo’ option and one of the alternative scenarios (see Supplementary Online Material Fig. S1, for an example choice set). A status quo situation is usually included in each choice set (Hanley et al. 2001) to determine whether respondents are willing to change from their current situation (Bennett and Adamowicz 2001). The status quo was always labelled ‘Option A’, and the alternatives were all labelled ‘Option B’. For each choice set, respondents were asked to choose between the two options.

To make the experiment manageable for respondents, a blocked factorial design was used (Bennett and Adamowicz 2001) in which respondents were presented with a subset of nine of the 45 choice sets. To ensure each alternative was seen by the same number of respondents, the 45 choice set cards were shuffled and nine were used for the first respondent, the next nine for the second respondent and so on, until all cards had been viewed. The choice set cards were then re-shuffled and the process was repeated five times, resulting in a sample size of criteria for this method (Bennett and Adamowicz 2001; Hensher et al. 2007). One choice set had identical attribute levels for Option A and Option B; so this card was always excluded, and one in every five respondents was therefore shown eight cards.

Before beginning the choice experiment, respondents were provided with contextual information and an explanation of the attributes and levels. Respondents were also taken through an example choice set, given a clear description of Option A and what a possible alternative option might look like.

Table 1 Levels of the hurricane and cost attributes used in the choice experiment. The lowest levels for each attribute (‘1 in 100’, ‘weak’ strength, and ‘no change’ in holiday cost were combined to form the status quo ‘Option A’)

Holiday attributes	Levels	Additional level details
Likelihood of hurricane	1 in 100	low chance
	5 in 100	medium chance
	10 in 100	high chance
Strength of hurricane	Weak	1–2 beach/swimming days lost
		Other outdoor activities possible
		Flights from the island
	Medium	3–4 beach/swimming days lost
		No other outdoor activities possible
		Flights from the island
	Strong	At least 7 beach/swimming days lost
		No other outdoor activities possible
		No flights from the island
Cost in US$ (pp/pw)	No change	
	$250 less	
	$500 less	
	$1250 less	
	$2000 less	

The questionnaire and choice experiment were piloted with 30 respondents, to ensure the survey was comprehensible to respondents and of acceptable length. In order to reduce the hypothetical nature of the experiment, the survey was carried out on beaches while respondents were experiencing their holiday (see Fish 2006). In addition, to inform respondents of the risks to which we were referring, respondents were asked to try and consider the following key points when they made their choices: that there is no risk to personal safety between options; that all other holiday characteristics remain the same between options; and to consider each option independently. Respondents’ were asked to consider that there would be no risk to personal safety between options, so that the choices they made could be directly related to the holiday attributes affected, and not to other influencing factors.

2.5 Statistical analyses

The choice experiment approach is typically described using random utility theory models, in which an individual presented with a choice of goods will choose the one that has the greatest ‘utility’, or value to them (Boxall et al. 1996; Lindberg et al. 1999). In this study, respondents were asked to choose between the current situation Option A, and a hypothetical alternative Option B. The cost or benefit associated with each choice made by the respondent is considered to be incorporated into the value of each Option B alternative. Binary logit models may be used to estimate the associated value of the attributes of the two alternatives (Boxall et al. 1996); where the dependent variable (y) is explained as the choice between the alternative scenarios Option B (1), or the status quo Option A (0). The probability (P) of a respondent choosing Option B over Option A can be modeled as a function of the attributes making up Option B, and the coefficients (βx) indicate the relative influence of each attribute (x) on the likelihood that each alternative Option B scenario (i) is chosen. The residual variation in the model is described as (e), and the model can be expressed as:

$$\mathrm{logit}(P) = y = \beta x_i + e \tag{1}$$

However, each respondent was presented with a bundle of 9 (or in some cases 8) choice sets, so responses from each individual were not independent of one another. Multilevel logistic regression models were therefore used to investigate the choice response and between-individual variation. A two level hierarchical structure was used, with the random component split into two parts: variation at the level of choice (e_i), and at the level of the individual (u_j). This can be expressed as:

$$\mathrm{y}_{\mathrm{ij}} = \beta x_{ij} + u_j + e_{ij} \tag{2}$$

The inclusion of cost in the attribute options presented to tourists enables the willingness to pay (WTP) for a particular value to be calculated. By specifying a linear form for the model, the WTP for an attribute level, relative to the baseline level, is found as the ratio of the coefficient on the attribute (β_{i}) to the coefficient on cost (β_{P}) (Hanley et al. 2001):

$$\mathrm{WTP} = -\beta_{\mathrm{i}}/\beta_{\mathrm{P}} \tag{3}$$

The model described in Eq. (2), was run using the multilevel modelling package MLwiN (Rabash et al. 2000) and included the three attributes (hurricane frequency, hurricane strength and cost of holiday). Twenty-three independent respondent variables (10 holiday activity preferences and 13 demographic characteristics) were collected from the questionnaires. As many of these variables were correlated, a Principal Components Analysis (PCA) with Varimax rotation (in order to load smaller numbers of variables onto each factor resulting in more interpretable clusters of factors (Field 2005)) was used to identify groups of individuals or preferences, and the resulting component scores were then used as predictor variables in the model. The distribution of data were checked in all cases to ensure that they were appropriate for the analyses.

The multi-level model was first run with data from all respondents, and then repeated with the respondents that always selected the status quo Option A excluded, because these respondents provide no information about changes in attribute levels (Fish 2006), and because the validity of their responses may be questionable. However, as there was no appreciable difference between the two models, we report only the initial model with larger number of respondents. The Wald test statistic was used to calculate Chi-squared and p values to test the significance of each attribute level and PCA factor coefficient. Odds ratios were calculated from the exponentials of the coefficients, and used with p values to interpret the model results and response trends. The odds ratios identify the relative importance of each attribute (compared to its baseline level) in establishing whether the alternative Option B was chosen over Option A. Odds ratios >1 indicate an increased likelihood of the alternative Option B being chosen.

The choice experiment responses were also used to estimate conditional logit and mixed logit models. While the conditional logit model treats coefficients for each attribute level as fixed, the mixed model permits examination of preference heterogeneity for attribute levels by treating the coefficients as random parameters (Hensher and Greene 2003). The mean and variance of the coefficients are estimated using simulated maximum likelihood assuming a normal distribution. The choice experiment prompted respondents to choose between an alternative trip and the current trip, therefore these models include an alternative specific constant (ASC) for the status quo.

Further potential sources of heterogeneity were also investigated by interacting demographic variables derived from the PCA, with the ASC and with variables measuring hurricane likelihood and strength. For the likelihood variable, the probability of a hurricane is treated as a continuous variable (named ‘hurricane probability’) taking on values of 0.01, 0.05 and 0.10. The strength variable contains components of days lost, ability to engage in outdoor activities and availability of flights off the island, any one of which may induce aversion in particular user groups. Therefore, three new variables were created to represent how each of these conditions may relate to hurricane strength. Specifically, ‘holiday lost days’ is set to values of 1.5, 3.5 and 7 for weak, medium and strong hurricanes respectively, while ‘outdoor activities’ is represented with an indicator variable equal to 1 for weak hurricanes and 0 for medium and strong hurricanes, and ‘flights’ is represented with an indicator variable equal to 1 for weak and medium hurricanes and equal to 0 for strong hurricanes. The values for each of the hurricane strength conditions relate to the attribute level details described in Table 1.

Willingness to pay (WTP) measures were estimated with the conditional and mixed logit model parameters, using the formulation in Eq. (3). As respondents had already acquired property rights to the current trip, the proper interpretation of WTP in this context is willingness to accept compensation (WTAC) for lost quality and additional risk associated with a hurricane. The Krinsky and Robb (1986) parametric bootstrapping method was used to derive 95 % confidence intervals for WTAC using 5,000 draws from a multivariate normal distribution.

3 Results

3.1 Characterising the tourists of Anguilla

A total of 300 tourists were surveyed in Anguilla during March and April 2008. The survey sample was 56 % female and predominantly American (78 %), which is likely to be representative of the whole tourist demographic in Anguilla. The modal age category was 45–54 years, with 69 % of respondents aged >45 years and 25 % with dependents <16 years old. Respondents in full time employment represented 48 % of the sample, while 24 % were self-employed and 15 % were retired. The majority of respondents (70 %) had a university degree, 12 % had a PhD/doctorate and 10 % had a vocational qualification. The majority of respondents were willing to state their income (93 %), and of these 38 % stated that they had an annual household income of over US$100,000, thus highlighting the up-market nature of this destination. Income was fairly evenly distributed among the other income brackets, although relatively few respondents (9 %) had less than US$40,000 household income per annum.

Sixty-five percent of respondents were visiting Anguilla for a period of 7 to 14 days and the mean holiday length was 10 days (±8.3 SD). The majority of respondents (61 %) had visited Anguilla previously and the number of prior visits ranged from 1 to 40 (mean ± SD = 6.5±5.8). Most visitors (86 %) had also visited other Caribbean islands before. Respondents’ previous visits to Anguilla were not evenly distributed throughout the year; with most visits in March (24 %) and April (15 %). While 14 % of respondents had previously visited Anguilla during the 6 month hurricane season (June to November), only 3 % had visited during the peak hurricane months of August and September.

The majority of respondents (80 %) were aware of the hurricane season and, of these, 84 % said hurricanes were most likely in September, 31 % knew the season started in June and 42 % knew it ended in November. Just 9 % of respondents thought that the hurricane season fell outside of the June to November period. The hurricane season was considered by 40 % of respondents when they made their current holiday reservation.

Among the reasons for visiting Anguilla during March and April, the attractive Caribbean climate and the unfavourable climate in home countries were ranked as the two most important, followed by the low hurricane risk during March and April, holiday cost and the timing of work or school holidays (Fig. 1). Specific reasons for choosing Anguilla as a holiday destination are shown in Fig. 2. Beaches and beach activities were rated in the top five by 92 % of respondents, and the climate and tranquility of the island were rated in the top five by 88 % and 84 % of respondents, respectively.

The 10 holiday activities were reduced by the PCA to four factors that describe related tourist preferences. The factor scores for each holiday activity indicate the preference for, and frequency with which tourists expect to participate in each activity (i.e. positive factor scores indicate higher frequency of use). The positive factor scores therefore broadly relate to four groups of people who like ‘beach activities’ (Factor 1), ‘eating seafood on holiday’ (Factor 2), ‘underwater activities’ (Factor 3), and ‘other water activities’ (Factor 4), and accounting for 18, 14, 13 and 13 %, respectively, of the total variance (Table 2).

The 13 respondent demographic variables were reduced by the PCA to six factors that describe related characteristics, of which the positive factor scores broadly relate to: ‘older, retired respondents with no children at home’ (Factor 1), ‘Americans (not Europeans)’ (Factor 2), ‘highly educated respondents’ (Factor 3), ‘left education early’ (Factor 4), ‘part-time employment and with children’ (Factor 5), and ‘high income and with children’ (Factor 6). These factors accounted for 15, 14, 12, 12, 11, and 10 %, respectively, of the total variance (Table 3).

3.2 Multilevel models of tourist choices of hurricane and cost attributes

All respondents (n=300) answered the choice questions, providing 2,640 responses for analysis (Table 4). The odds of choosing the alternative to the status quo, Option B, decreased significantly as both hurricane attributes increased. As the holiday price reduction

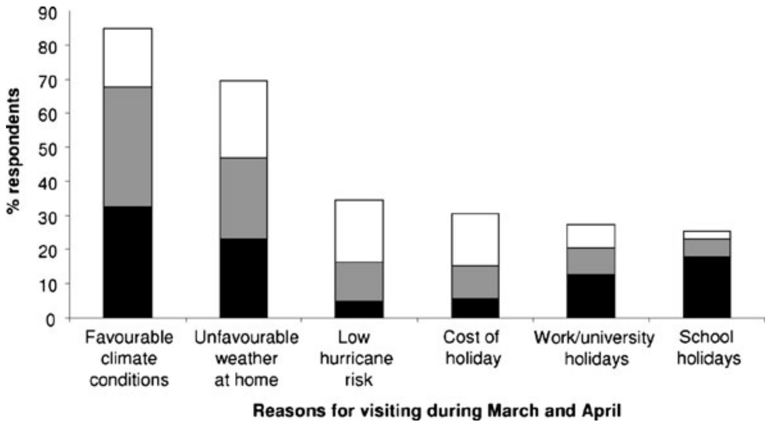

Fig. 1 Tourist reasons for visiting Anguilla during the survey period. Bars show the percentage of respondents ranking each factor first (*black bars*), second (*grey bars*) or third (*white bars*)

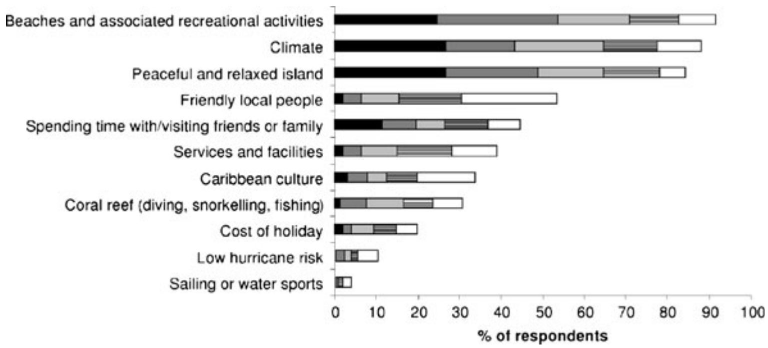

Fig. 2 Tourist reasons for choosing Anguilla as a holiday destination. Bars show the percentage of respondents ranking each factor in their top five reasons, ranked from first (*black*) to fifth (*white*)

increased, the odds of choosing Option B significantly increased. However, a reduction in holiday price overrides the effect of both hurricane attributes on respondents' choice decisions, as even the lowest holiday price reduction alters the probability of choosing Option B ('\$250 less' odds ratio = 61.50) more than the hurricane attributes ('5 in 100 frequency' odds ratio = 0.17 and 'medium strength' = 0.10, Table 4, Fig. 3).

The inclusion of the PCA factors relating to respondent holiday activity preferences (Table 2) and demographic characteristics (Table 3) did not appreciably alter the probabilities of choosing each hurricane and cost attribute (comparison of Tables 4 and 5). However, respondents who enjoy typical beach activities while on holiday; retired, older respondents with no young children; and Americans were all significantly associated with not choosing any given Option B alternative compared to Option A.

Table 2 Principal component factors describing holiday activity preferences of tourists in Anguilla. Factor scores for each holiday activity relate to tourists' responses on the frequency with which they expect to participate in each activity while on holiday (i.e. positive factor scores indicate higher frequency of use). Factor descriptions relate to the positive factor scores. Factor loadings >0.4 are highlighted in bold

Holiday activities	Principal components			
	Factor 1 Typical beach activities	Factor 2 Eating seafood while on holiday	Factor 3 Underwater holiday activities	Factor 4 Other water activities
Beach	**0.806**	−0.072	0.021	−0.150
Swim	**0.675**	−0.118	**0.451**	−0.057
Dive	−0.258	−0.004	**0.639**	0.196
Snorkel	0.177	0.073	**0.807**	−0.009
Fishing	−0.033	0.005	−0.012	**0.822**
Eat fish	0.134	**0.847**	−0.016	−0.049
Eat shellfish	−0.029	**0.782**	0.069	0.174
Sunbathe	**0.503**	0.199	−0.109	0.243
Water sports	0.133	0.112	0.165	**0.670**
Beach walking	**0.534**	0.117	−0.068	0.127

Table 3 Principal component factors describing the demographic characteristics of tourists in Anguilla. Factor descriptions relate to the positive factor scores. Factor loadings >0.4 are highlighted in bold

Demographic characteristics	Principal components					
	Factor 1 Retired, older, no children at home	Factor 2 Americans (not Europeans)	Factor 3 High levels of education	Factor 4 Left education early	Factor 5 Part-time employed, with children	Factor 6 High income, with children
Gender	−0.129	0.089	0.003	0.024	**0.692**	−0.357
Income	0.075	0.026	0.041	−0.082	−0.032	**0.813**
Children at home	**−0.437**	−0.044	−0.001	0.075	0.244	**0.501**
Age	**0.773**	0.168	0.040	0.125	−0.110	0.116
Left school age 18	0.075	−0.172	0.262	**0.677**	0.158	−0.140
Gained first degree	−0.085	0.137	**−0.876**	−0.317	−0.025	0.100
Gained doctorate	−0.057	0.050	**0.865**	−0.204	−0.087	0.139
Employed full-time	**−0.654**	0.103	0.058	0.080	**−0.612**	−0.099
Employed part-time	0.038	0.013	−0.045	−0.014	**0.709**	0.332
Retired	**0.860**	−0.090	0.004	−0.019	0.069	−0.110
American	0.035	**0.853**	0.003	**−0.438**	0.042	−0.035
Canadian	−0.016	−0.021	−0.135	**0.837**	−0.133	0.045
British/European	−0.014	**−0.971**	0.070	−0.079	−0.020	−0.026

3.3 Conditional and mixed logit models of tourist choices of hurricane and cost attributes

Results of the conditional logit and mixed logit models show that all attribute coefficients are highly significant, of the expected sign and indicative of aversion to higher levels of trip cost, hurricane likelihood and hurricane strength (Table 6). In consensus with the PCA, the mixed logit results (model 2) indicate significant preference heterogeneity for all levels of

Table 4 Results of a multi-level model of the probability of tourists choosing each of the hurricane and cost attributes. The lowest level of each attribute is the baseline to which the other attribute levels are compared

Attribute	Level	Odds ratio	95 % confidence intervals		df	*p* value
			Lower	Upper		
Likelihood of hurricane	1 in 100	1	–	–	–	–
	5 in 100	0.17	0.12	0.24	1	<0.0001
	10 in 100	0.05	0.04	0.08	1	<0.0001
Strength of hurricane	Weak	1	–	–	–	–
	Medium	0.10	0.07	0.14	1	<0.0001
	Strong	0.03	0.02	0.05	1	<0.0001
Cost in $	No change	1	–	–	–	–
	250 less	61.50	15.41	245.43	1	<0.0001
	500 less	160.29	40.09	640.98	1	<0.0001
	1250 less	324.73	81.05	1301.15	1	<0.0001
	2000 less	549.50	136.87	2206.14	1	<0.0001

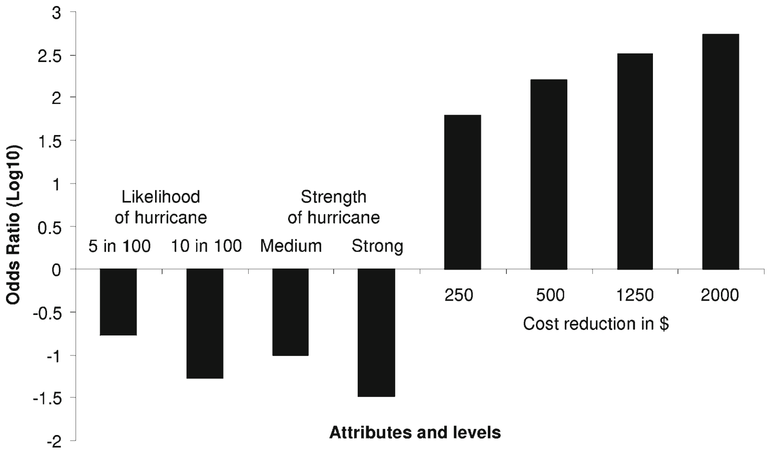

Fig. 3 Odds ratios for hurricane and cost attribute levels calculated from a multilevel model of the probability of choosing each attribute level. Bars depicting odds ratios >1 indicate an increase in the probability of Option B being chosen in preference to the status quo

Table 5 Results of a multi-level model of the probability of choosing each of the hurricane and cost attributes, in relation to PCA factors describing preference for different holiday activities and demographic characteristics of tourists. Factor descriptions relate to the positive factor scores. The lowest level of each attribute is the baseline to which the other attribute levels are compared. Significant PCA factors are highlighted in bold

Attribute	Level	Odds ratio	95 % confidence intervals		df	p value
			Lower	Upper		
Likelihood of hurricane	1 in 100	1	–	–	–	–
	5 in 100	0.17	0.12	0.25	1	<0.0001
	10 in 100	0.05	0.03	0.07	1	<0.0001
Strength of hurricane	Weak	1	–	–	–	–
	Medium	0.09	0.06	0.13	1	<0.0001
	Strong	0.03	0.02	0.05	1	<0.0001
Cost in $	No change	1	–	–	–	–
	250 less	58.67	14.40	239.13	1	<0.0001
	500 less	167.34	40.90	684.71	1	<0.0001
	1250 less	313.25	76.55	1281.77	1	<0.0001
	2000 less	504.21	122.73	2071.44	1	<0.0001
PCA factors						
Beach activities		0.72	0.56	0.92	–	**0.009**
Seafood on holiday		0.90	0.70	1.16	–	0.414
Underwater activities		0.92	0.71	1.18	–	0.497
Other water sports		1.08	0.85	1.36	–	0.528
Retired, older, no young children		0.73	0.57	0.95	–	**0.016**
Americans		0.74	0.58	0.93	–	**0.012**
Highly educated		0.85	0.66	1.08	–	0.178
Left education early		0.84	0.66	1.08	–	0.176
Part-time employed, with children		0.89	0.70	1.13	–	0.328
High income, with children		0.80	0.63	1.02	–	0.069

Table 6 Summary of results for the choice experiment applied to tourists in Anguilla, using fixed (conditional logit) and random (mixed logit) parameter models (*** denotes significance at the 1 % level, ** denotes significance at the 5 % level)

Variable	Parameter	Coefficient (standard error)	
		Conditional logit (model 1)	Mixed logit (model 2)
Cost	Mean	−0.0011***	−0.00226***
		(0.000075)	(0.00027)
Likelihood of hurricane 5 in 100	Mean	−1.386***	−2.957***
		(0.127)	(0.349)
	Standard deviation	–	−2.613***
			(0.544)
Likelihood of hurricane 10 in 100	Mean	−2.307***	−5.592***
		(0.147)	(0.783)
	Standard deviation	–	−3.798***
			(0.840)
Strength of hurricane Medium	Mean	−1.688***	−3.529***
		(0.128)	(0.395)
	Standard deviation	–	2.304***
			(0.582)
Strength of hurricane Strong	Mean	−2.564***	−6.078***
		(0.148)	(0.904)
	Standard deviation	–	3.626***
			(0.949)
ASC current trip	Mean	0.356***	−0.612***
		(0.127)	(0.236)
Log likelihood		−1103	−1077

attributes, identifying that retired individuals, older individuals with no children, Americans, and those that engage in beach related activities may respond differently than others in the sample.

Results of the mixed logit estimation with interactions are shown in Table 7. The negative sign on the ASC in the mixed logit models suggests that when hurricane attributes are accounted for and preferences are allowed to vary, individuals are willing to trade diminished quality for price concessions. The positive coefficient on the interaction between ‘retired’ and the status quo ASC, shows that retired individuals appear to have a unique aversion to the choice B alternative, indicating a general aversion to risk. However, as retired individuals comprised less than 14 % of the sample, and because the aversion is nominal, the deviation of their preferences from those of the sample is not enough to suggest general heterogeneity in the sample. Americans appear to be averse to higher hurricane likelihood, as indicated by the negative coefficient on the interaction term in the second column (model 4). Individuals who are more likely to engage in beach activities such as sunbathing, swimming or walking on the beach appear to be averse to lost days, and the possibility of engaging in outdoor activities (models 5 and 6).

The standard deviation of the highest hurricane strength coefficient becomes non-significant in model 5, indicating that aversion to lost holiday days is the likely source of heterogeneity

Table 7 Summary of results for the choice experiment applied to tourists in Anguilla, using random (mixed logit) parameter models with demographic and holiday variable interactions. Interactions between hurricane variables and demographic characteristics were also tested. Only significant interaction effects are reported (*** denotes significance at the 1 % level, ** denotes significance at the 5 % level, * denotes significance at the 1 % level)

Variable	Parameter	Coefficient (standard error)				
		Model 3	Model 4	Model 5	Model 6	Model 7
Cost	Mean	−0.0024***	−0.0022***	−0.0023***	−0.0022***	−0.0026***
		(0.0003)	(0.00027)	(0.00027)	(0.00025)	(0.00032)
Likelihood of hurricane 5 in 100	Mean	−2.997***	−2.264***	−2.953***	−2.901***	−2.371***
		(0.374)	(0.347)	(0.348)	(0.334)	(0.389)
	Standard deviation	−2.415***	−2.600***	−2.629***	−2.544***	−2.785***
		(0.558)	(0.545)	(0.541)	(0.518)	(0.566)
Likelihood of hurricane 10 in 100	Mean	−5.933***	−3.709***	−5.757***	−5.681***	−4.480***
		(0.874)	(0.668)	(0.827)	(0.807)	(0.848)
	Standard deviation	−4.063***	−3.371***	−4.065***	−4.065***	−4.433***
		(0.899)	(0.790)	(0.874)	(0.851)	(0.909)
Strength of hurricane Medium	Mean	−3.579***	−3.555***	−2.386***	−1.423***	−1.152
		(0.430)	(0.401)	(0.449)	(0.529)	(0.781)
	Standard deviation	2.208***	2.425***	1.541**	0.007	1.107
		(0.598)	(0.574)	(0.695)	(2.367)	(1.474)
Strength of hurricane Strong	Mean	−6.354***	−6.230***	−3.397***	−3.687***	−4.372***
		(0.972)	(0.918)	(0.859)	(0.846)	(1.063)
	Standard deviation	3.751***	3.791***	0.514	2.377**	0.626
		(0.982)	(0.930)	(2.700)	(1.067)	(2.108)
Current trip ASC	Mean	−0.706***	−0.614***	−0.602**	−0.618**	−0.699***
		(0.241)	(0.235)	(0.237)	(0.232)	(0.252)
Retired × current trip ASC	Mean	0.992**				1.096***
		(0.399)				(0.405)

Table 7 (continued)

Variable	Parameter	Coefficient (standard error)				
		Model 3	Model 4	Model 5	Model 6	Model 7
	Standard deviation	2.542***				−2.641***
		(0.789)				(0.782)
American × ‘hurricane probability’	Mean		−22.691***			−26.113***
			(6.223)			(7.398)
	Standard deviation		−0.221			0.359
			(26.713)			(23.934)
Beach activity × ‘holiday lost days’	Mean			−0.573***		0.030
				(0.197)		(0.422)
	Standard deviation			0.729***		0.713***
				(0.196)		(0.216)
Beach activity × ‘outdoor activities’	Mean				2.152***	2.866*
					(0.557)	(1.466)
	Standard deviation				2.209***	−1.490
					(0.574)	(1.206)
Log likelihood		−1072	−1069	−1074	−1073	−1055

among respondents. A similar result is found in model 6 with outdoor activities and hurricanes of medium strength. When all individually significant interactions are included (model 7) the medium strength variable becomes non-significant and the heterogeneity of aversion to high strength disappears, indicating that the sources of aversion and heterogeneity have been captured by other variables in the model. Loss of significance on other parameters indicates likely multicollinearity between the 'American', 'holiday lost days' and 'outdoor activities' variables. The notably smaller log-likelihood value indicates that other models are preferred in terms of goodness-of-fit.

Interestingly, the 'flights' indicator variable did not produce significant interaction effects for any group (and hence is not included in Table 7). Indeed it appears that it is the prospect of lost days or the inability to engage in outdoor activities that produces the aversion to hurricane strength by respondents, rather than the possibility of not being able to fly home. Furthermore, the relative magnitudes of the coefficients on the hurricane attributes suggest that increasing hurricane strength is slightly more of a concern to respondents than increasing likelihood of hurricane.

3.4 Tourists' willingness to accept compensation (WTAC) for lost quality and additional risk associated with a hurricane

Mean willingness to accept compensation (WTAC) values and 95 % confidence intervals are reported for models 1 and 2 (Table 8). Given the mean holiday cost of US$2,525, the WTAC values suggest that respondents would have to be fully compensated for a high probability of a hurricane strike, or an occurrence of a strong hurricane relative to the status quo. Another interpretation is that a high likelihood of a hurricane or the prospect of a high strength hurricane each represents reservation conditions for respondents, suggesting that on average, they would be indifferent between engaging in these trips at no cost and not engaging in the

Table 8 Tourists' average willingness to accept compensation (US dollars) for increased hurricane risk (likelihood and strength levels) relative to the baseline attribute level. Results are based on the choice experiment applied to surveyed tourists in Anguilla

		Mean	95 % confidence intervals	
			Lower	Upper
Conditional logit (model 1)	Likelihood of hurricane 5 in 100	1246.53	990.52	1502.55
	Likelihood of hurricane 10 in 100	2075.18	1732.30	2418.06
	Strength of hurricane medium	1518.43	1239.34	1797.52
	Strength of hurricane strong	2306.65	1938.39	2674.90
Mixed logit (model 2)	Likelihood of hurricane 5 in 100	1308.89	1031.29	1586.49
	Likelihood of hurricane 10 in 100	2475.35	1872.59	3078.11
	Strength of hurricane medium	1562.15	1270.67	1853.63
	Strength of hurricane strong	2690.39	2046.86	3333.91

trip at all. Although not reported here, lower mean WTAC values are produced from models which include interactions between demographics and hurricane attributes (models 4, 5, and 6). These models separate groups of respondents who are acutely averse to particular aspects of hurricane risk and remove the premium they are willing to pay from the sample average. For example, the interaction terms in models 5 and 6 suggest that those who engage in beach activities would have to be compensated US$249 for each additional day lost due to hurricane strength and roughly US$978 for the loss of outdoor activities. When these premiums are accounted for, the willingness to pay values are quite similar across model specifications.

3.5 Influences of hurricane and cost attributes on respondent choices

Of the 300 respondents who participated in the choice experiment, 82 % (n=247) opted for the alternative Option B at least once. The hurricane and cost attributes influenced decision-making differently (Table 9). Although the hurricane and cost attributes were stated to influence the decisions of 255 and 212 respondents, respectively, respondents also stated that the attribute on which they focused most strongly was hurricane likelihood (49 respondents), hurricane strength (111 respondents) and the cost attribute (31 respondents). A similar trend was apparent among those who always chose Option A (hurricane likelihood: n=38; hurricane strength: n=23; cost attribute: n=2; Table 9).

Of the stated reasons for choosing Option B in preference to Option A, the most common (44 % of respondents) was that good weather and being able to go to the beach are the most important elements for their holiday (see Supplementary Online Material Table S1). Thus, an alternative holiday, Option B, which may jeopardize these holiday characteristics, would be less attractive. Personal safety, risk aversion, and being concerned about hurricanes were the next most common reasons that influenced respondents' choices. Only 4 % of respondents explicitly stated that hurricanes did not concern them. On the other hand, comparatively few respondents (8 %) stated that their decisions were predominantly influenced by cost, i.e. whether or not they would receive a price reduction for their holiday. Similarly, respondents who always chose the status quo, Option A, stated that decisions were primarily based on concerns regarding hurricanes, safety, and the importance of good weather, rather than holiday price (Table S1).

Table 9 The number of respondents that considered each hurricane or cost attribute and the number that focused strongly on each attribute for (a) all 300 respondents and (b) respondents who always chose Option A

Influence of attributes on respondent decision-making	(a) Total sample of respondents (n=300)		(b) Only respondents that chose Option A (n=53)	
	Number	%	Number	%
Attribute considered				
Likelihood of hurricane	255	85.6	48	90.6
Strength of hurricane	255	85.6	41	77.4
Cost	212	71.1	25	47.2
Attribute focused on strongly				
Likelihood of hurricane	149	50.3	38	71.7
Strength of hurricane	111	37.5	23	43.4
Cost	31	10.5	2	3.8

4 Discussion

Tourists visiting the island of Anguilla are highly responsive to changing hurricane risk and holiday price. Indeed, all of the model results show that tourists are significantly less likely to choose holiday options where hurricane risk is perceived to increase. The multilevel model results indicate that a reduction in holiday price overrides the negative effect of increased hurricane risk for many tourists' decision-making, and the logit models also indicate that cost is the most significant variable. Interestingly, lost days and the inability to engage in outdoor activities are key factors that contribute most significantly to the aversion to hurricane strength by respondents, rather than the possibility of not being able to fly home. Risk perception also varied among different demographic groups, with older individuals, Americans, and people who prioritize beach activities while on holiday, tending to be most concerned about hurricanes.

4.1 Tourist characteristics

The results from this study suggest however, that the majority of tourists visiting Anguilla are American, older than 45 years, and with relatively high levels of education and income. In addition, the most important criteria for choosing Anguilla as a holiday destination are the beaches, the climate and the tranquility of the island, consistent with the environmental features and up-market tourism promoted on the island (Carty and Petty 2000; ATB 2009). Given that these predominant demographic groups (older individuals, Americans and 'beach lovers') are the types of tourists that are most concerned about hurricane risk (Table 5), these results suggest that perceived increases in hurricanes may have important implications for the tourism industry in Anguilla.

The hurricane season was not the dominant reason for the seasonality of travel to this destination. However, the risks associated with hurricanes are clearly a contributing factor in the choice of holiday, as 40 % of respondents considered the hurricane season when choosing Anguilla as a holiday destination. With a predominance of American visitors to the island (CTO 2009), and the impact hurricanes have in the United States (NOAA 2009), awareness and concerns regarding hurricanes is not surprising.

4.2 Tourist responses to changing risks of hurricane impact

The choice experiment indicates that respondents are progressively less likely to choose holiday options when the 'likelihood of a hurricane' or 'strength of hurricane' attributes increase. Respondents were also highly price-responsive and progressively more likely to choose options with increased hurricane risk where monetary compensation increases from the status quo. Interestingly, only 30 % of respondents mentioned cost as an influencing factor in decision-making (with just 8 % stating cost as the main focus; Table S1). However, all model results (Tables 4, 5 and 7) indicate that cost was by far the most significant factor in determining whether respondents chose an Option B alternative in preference to the status quo Option A.

4.3 Factors influencing holiday choice preferences

The probability associated with choosing each hurricane or cost attribute was not consistent with respondents' perceptions of the importance of each attribute in terms of personal decision-making. For example, models of choice experiment responses (Tables 4 and 5) show that a price reduction is more likely to influence respondents' decisions compared to either of the hurricane attributes. By comparison, the open-ended 'follow-up' questions indicated that respondents focused most strongly on the likelihood of hurricane attribute to determine whether or not to choose Option B in preference to Option A, followed by the strength of hurricane and cost attributes (Table 9). In addition, the logit models highlighted that certain demographic groups were more averse to the strength of hurricane, in comparison to the likelihood of hurricane attribute (Table 7). A common human preference for negative information, or a 'negativity bias' (Eitzinger and Wiedemann 2008) may have resulted in a focus on the hurricane attributes and associated negative consequences rather than the more positive cost attribute. Respondents' explanations for their decision-making (see Table S1) also suggest that they may place greater weight on negative information (Eitzinger and Wiedemann 2008).

The factor analyses demonstrated that different types of tourist tend to exhibit differing holiday preferences, and especially in relation to tourism-related risks. For example, it has been suggested that learning theory may provide an explanation for certain differences in the way risk is perceived among different groups of people (Simpson and Siguaw 2008). Risk-aversion among older people may differ from younger people, as a consequence of greater personal life experiences or through the experience of learning from others (Simpson and Siguaw 2008). The reduced likelihood of choosing any given alternative holiday option over the status quo by tourists from the 'older and retired' group, is consistent with this, and with the finding that a preference for tourism-related risk can decrease with age (Gibson and Yiannakis 2002).

Specific holiday activities, environmental features and climatic conditions are often important factors in determining the attractiveness of tourist destinations (Lise and Tol 2002; Uyarra et al. 2005; Hamilton et al. 2009). In this study, Americans and people who enjoy beach activities were less likely to choose alternative holiday options in place of the status quo, and thus appear to place greater emphasis on selecting hurricane-free holidays. Furthermore, the loss of beach days and outdoor activities were both holiday attributes that were shown to be significantly more important to respondents than the possibility of not being able to fly home because of a hurricane event.

4.4 Implications of increased hurricane risk for tourism

This study suggests that, if hurricane activity on Anguilla increases, or is perceived to increase, many tourists may seek alternative holiday destinations. In addition, the types of tourist that would be less likely to visit if the current holiday conditions change ('older, retired', Americans, and 'beach lovers'), represent the main tourist groups that currently holiday in Anguilla. As 61 % of respondents in this study were repeat visitors, a change in tourist behavior could be very significant for the island's tourism industry. Whilst risk-averse choice decisions among respondents' are perhaps to be expected, the results of this study are important to highlight which segments of Anguilla's tourism market are most likely to be influenced by possible changes.

It is difficult to predict changes in tourist behavior accurately in response to environmental change (Lise and Tol 2002), or the impacts that environmental change may have on the relative attractiveness of individual island destinations (Uyarra et al. 2005). However, tourists have been shown to change their behaviour if the climate or environmental attractiveness alters or if tourism-related risks increase. For example, arrivals to Grenada and the Cayman Islands fell by 4 and 35 % respectively after hurricane Ivan in 2004. It is likely that other destinations in the region, unaffected by the hurricane benefitted from those more severely affected (Daye et al. 2008). Indeed, addressing the changing comparative and competitive advantages between destinations is crucial to fully understanding the influence of environmental change on the relative attractiveness of Caribbean islands. It should be noted that due to the possibility of tourist substitution between islands, region-wide impacts on the tourism industry may be less significant than local impact. That is, losses to one island may be offset by gains to another. Examination of such substitution effects is an important area for future study.

In response to a change in tourist demand, tour operators may also be able to switch products. However, suppliers of tourism services, or the owners of hotels or resorts are typically much less flexible (Lise and Tol 2002). The luxurious resorts that cater for the tourism industry in Anguilla target organized and independent mass tourists, who tend to be among the most risk-averse and therefore likely to change holiday plans if risk is perceived (Lepp and Gibson 2003). Thus, although tourists and tourist operators may be able to adapt their behaviour in the face of perceived risk and/or unfavourable environmental changes, the same may not be said for local tourist providers and local tourism economies (Lise and Tol 2002). However, this study also suggests that if local tourist providers are able to reduce their cost, or offer compensation for loss of holiday days and activities, they may be able to adapt to increasing hurricane risk because tourists are highly receptive to price.

In this study we considered only the influence that tourists' perceptions of increasing hurricane activity may have on holiday choice decisions. However, the direct impacts of extreme events, such as damage to key environmental features and infrastructure also affect tourism demand and capacity (ECLAT 2000; Birkland et al. 2006; Becken and Hay 2007). For example, infrastructure and property damage on Anguilla caused by hurricane Lenny in 1999 continued to constrain the tourism sector for up to 2 years after the hurricane impacted (ECLAT 2000). Considering that most of the visitors to Anguilla currently visit outside of the hurricane season, there may in fact be fewer implications for visitors' decision-making, provided that the current tourism season is not impinged on substantially. Indeed, if rising incidence or strength of hurricanes result in greater damage to attractive tourism resources and infrastructure, then this may have a greater impact on tourist decision-making compared to the concerns of experiencing a hurricane directly. Additionally, whether tourists' decisions are affected by hurricane activity or any other environmental impact will also, in reality, depend on the alternative holiday options available.

Caribbean islands in general are dependent on tourism as the major source of revenue, and are susceptible to hurricane impacts, thus the results of this study are likely to apply to other Caribbean islands. Most tourists visit Anguilla outside of the hurricane season, which is certainly a significant advantage for the island. Anguilla's tourist demographic is also mainly interested in beaches, which have the potential to recover from extreme events naturally or with artificial beach nourishment (Browder 2002; Hayasaka et al. 2009; Houser and Hamilton 2009). Compared to tourism destinations fundamentally reliant on climate-sensitive ecosystems, such as the reef-based tourism island of Bonaire (Uyarra et al. 2005), Anguilla's tourism industry is perhaps relatively more resilient. Nevertheless, the response of the tourism industry to climate change impacts remains uncertain, and our results have shown increased hurricane activity could significantly affect tourist revenues and tourism economies on this island. For that reason, enhancing the island's socio-ecological resilience to future climate change is crucial (Adger et al. 2005; Hughes et al. 2005). Achieving this through effective environmental protection and management, together with sympathetic and sustainable development would help to protect key environmental resources and provide long-term economic benefits to the natural resource-dependent tourism industry.

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References

Adger WN, Hughes TP, Folke C, Carpenter SR, Rockström J (2005) Social-ecological resilience to coastal disasters. Science 309:1036–1039

Agnew M, Viner D (2001) Potential impacts of climate change on international tourism. Tour Hosp Res 3 (1):37–60

ATB (2009) Official website of the Anguilla Tourist Board. Available at http://www.anguilla-vacation.com/. Accessed 15 November 2009

Becken S, Hay JE (2007) Tourism and climate change: risks and opportunities. Channel View Publications, UK

Bennett J, Adamowicz V (2001) Some fundamentals of environmental choice modelling. In: Bennett J, Blamey R (eds) The choice modelling approach to environmental valuation. Edward Elgar Publishing, Cheltenham

Bennett J, Blamey R (2001) The choice modelling approach to environmental valuation. Edward Elgar Publishing, Cheltenham

Bigano A, Goria A, Hamilton JM, Tol RSJ (2005) The effect of climate change and extreme weather events on tourism. In: Lanza A, Markandya A, Pigliaru F (eds) The economics of tourism and sustainable development. Edward Elgar Publishing

Bigano A, Hamilton JM, Tol RSJ (2006) The impact of climate on holiday destination choice. Clim Chang 76:389–406

Birkland TA, Herabat P, Little RG, Wallace WA (2006) The impact of the December 2004 Indian Ocean tsunami on tourism in Thailand. Earthquake Spectra 22:S889–S900

Boxall PC, Adamowicz WL, Swait J, Williams M, Louviere J (1996) A comparison of stated preference methods for environmental valuation. Ecol Econ 18:243–253

Browder AE (2002) Sand search and beach restoration at Pensacola Beach, Florida. In: Tait L (ed) 15th annual national conference on beach preservation technology, Proceedings. Florida Shore & Beach Preservation Association, Tallahassee

Carlsson F, Frykblom P, Liljenstolpe C (2003) Valuing wetland attributes: an application of choice experiments. Ecol Econ 47:95–103

Carty B, Petty C (2000) Anguilla: tranquil isle of the Caribbean. Macmillan Eductaion Ltd, London

CTO (2005) Caribbean Tourism Organisation, Caribbean tourism performance review. Available at http://www.onecaribbean.org/content/files/2005tourismperformancereview.doc. Accessed 7 January 2010

CTO (2007) Caribbean Tourism Organisation, individual country statistics, 2007 Anguilla. Available at http://www.onecaribbean.org/statistics/countrystats. Accessed 15 November 2009

CTO (2009) Caribbean Tourism Organisation, individual country statistics, 2008 Anguilla. Available at http://www.onecaribbean.org/statistics/countrystats. Accessed November 15 2009

Daye M, Chambers D, Roberts S (2008) Caribbean tourism: new perspectives. In: Dayes M, Chambers D, Roberts S (eds) New perspectives in Caribbean tourism. Routledge, London

Dharmaratne GS, Brathwaite AE (1998) Economic valuation of the coastline for tourism in Barbados. J Travel Res 37:138–144

ECLAT (2000) Anguilla: an assessment of the economic and other damages caused by hurricane Lenny November 1999. Economic Commission for Latin America and the Caribbean, Caribbean Development and Cooperation Committee, United Nations

Eitzinger C, Wiedemann P (2007) Risk perceptions in the alpine tourist destination Tyrol: an exploratory analysis of residents' views. Tourism Manag 28:911–916

Eitzinger C, Wiedemann PM (2008) Trust in the safety of tourist destinations: hard to gain, easy to lose? new insights on the asymmetry principle. Risk Anal 28:843–853

Emanuel K (2005) Increasing destructiveness of tropical cyclones over the past 30 years. Nature 436:686–688

Field A (2005) Discovering statistics using SPSS, 2nd edn. SAGE Publications Ltd, London

Fish MR (2006) Coastal development and sea-level rise: impacts on sandy beaches and sea turtles. PhD Thesis, University of East Anglia, Norwich, U.K

Gibson H, Yiannakis A (2002) Tourist roles: needs and the lifecourse. Ann Tourism Res 29:358–383

Glenn H, Wattage P, Mardle S, Van Rensburg T, Grehan A, Foley N (2010) Marine protected areas–substantiating their worth. Mar Policy 34:421–430

Goldenberg SB, Landsea CW, Mestas-Nunez AM, Gray WM (2001) The recent increase in Atlantic hurricane activity: causes and implications. Science 293:474–479
Gössling S, Hall CM (2006) Uncertainties in predicting tourist flows under scenarios of climate change. Clim Chang 79:163–173
Hamilton JM, Maddison D, Tol RSJ (2009) Climate preferences and destination choice: a segmentation approach. FNU-working paper 90
Hanley N, Wright RE, Adamowicz V (1998) Using choice experiments to value the environment: design issues, current experience and future prospects. Environ Resour Econ 11:413–418
Hanley N, Mourato S, Wright RE (2001) Choice modelling approaches: a superior alternative for environmental valuation? J Econ Surv 15:435–462
Hayasaka D, Fujiwara K, Box EO (2009) Recovery of sandy beach and maritime forest vegetation on Phuket Island (Thailand) after the major Indian Ocean tsunami of 2004. Appl Veg Sci 12:211–224
Hensher DA, Greene WH (2003) The mixed logit model: the state of the practice. Transportation 30(2):133–176
Hensher DA, Rose JM, Greene WH (2007) Applied choice analysis: a primer. Cambridge University Press, U.K
Holland GJ, Webster PJ (2007) Heightened tropical cyclone activity in the North Atlantic: natural variability or climate trend? Philos Trans R Soc A-Math Phys Eng Sci 365:2695–2716
Houser C, Hamilton S (2009) Sensitivity of post-hurricane beach and dune recovery to event frequency. Earth Surf Process Landf 34:613–628
Hughes TP, Bellwood DR, Folke C, Steneck RS, Wilson J (2005) New paradigms for supporting the resilience of marine ecosystems. TREE 20:380–386
IPCC (2007) In: Solomon S, Qin D, Manning M, Chen Z, Marquis M, Averyt KB, Tignor M, Miller HL (eds) Climate change 2007: the physical science basis. Contribution of working group 1 to the forth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, U.K. and New York, USA
Krinsky I, Robb AL (1986) On approximating the statistical properties of elasticities. Rev Econ Stat 68:715–719
Lepp A, Gibson H (2003) Tourist roles, perceived risk and international tourism. Ann Tourism Res 30:606–624
Lewsey C, Cid G, Kruse E (2004) Assessing climate change impacts on coastal infrastructure in the Eastern Caribbean. Mar Policy 28:393–409
Lindberg K, Dellaert BGC, Rassing CR (1999) Resident tradeoffs: a choice modeling approach. Ann Tourism Res 26:554–569
Lise W, Tol RSJ (2002) Impact of climate on tourist demand. Clim Chang 55:429–449
Maddison D (2001) In search of warmer climates? the impact of climate change on flows of British tourists. Clim Chang 49:193–208
Meheux K, Dominey-Howes D, Lloyd K (2007) Natural hazard impacts in small island developing states: a review of current knowledge and future research needs. Nat Hazard 40:429–446
Mimura N, Nurse L, McLean RF, Agard J, Briguglio L, Lefale P, Payet R, Sem G (2007) Small islands. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE (eds) Climate change 2007: impacts, adaptation and vulnerability. Cambridge University Press, Cambridge
Mukhida F, Gumbs JC (2008) Linking the social with the natural: a socio-economic review of Shoal Bay and Island Harbour, Anguilla. Report by Anguilla National Trust and Anguilla Department of Fisheries and Marine Resources
NOAA (2009) National Oceanic and Atmospheric Administration, National Hurricane Centre. Available at http://www.nhc.noaa.gov/. Accessed 10 November 2009
Rabash J, Browne W, Goldstein H, Yang M, Plewis I, Healy M (2000) A user's guide to MLwiN. Centre for Multilevel Modeling, Institute for Education, University of London, U.K
Scarpa R, Rose J (2008) Design efficiency for non-market valuation with choice modelling: how to measure it, what to report and why. Agric Resour Econ 52:253–282
Scott D, McBoyle G, Schwartzentruber M (2004) Climate change and the distribution of climatic resources for tourism in North America. Clim Res 27:105–117
Simpson PM, Siguaw JA (2008) Perceived travel risks: the traveler perspective and manageability. Int J Tour Res 10:315–327
Trenberth K (2005) Uncertainty in hurricanes and global warming. Science 308:1753–1754
Uyarra MC, Côté IM, Gill JA, Tinch RRT, Viner D, Watkinson AR (2005) Island-specific preferences of tourists for environmental features: implications of climate change for tourism-dependent states. Environ Conserv 32:11–19

Wall G (1998) Implications of global climate change for tourism and recreation in wetland areas. Clim Chang 40:371–389

Webster PJ, Holland GJ, Curry JA, Chang HR (2005) Changes in tropical cyclone number, duration, and intensity in a warming environment. Science 309:1844–1846

WTTC (2004) The Caribbean: the impact of travel and tourism on jobs and the economy. World Travel and Tourism Council, London, UK. Available at http://www.wttc.org/eng/Download_Centre/#. Accessed 8 November 2009

Young S (2005) Hurricane hazards in Anguilla. Government of Anguilla