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Valuing Urban Tropical River Recreation Attributes Using Choice Experiments

Luis Santiago[1], John Loomis[2], Alisa V. Ortiz[1] & Ariam L. Torres[1]

[1] Graduate School of Planning, University of Puerto Rico, Río Piedras, Puerto Rico

[2] Agricultural and Resources Economics, Colorado State University, Fort Collins, Colorado

Correspondence: Luis Santiago, Graduate School of Planning, University of Puerto Rico, Río Piedras, Puerto Rico. Tel: 787-764-0000 ext. 85113. E-mail: luis.santiago47@upr.edu

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Abstract

While providing public access to rivers in urban areas is a first step, maintaining a high quality recreation experience can be expensive. Knowing the economic benefits of high quality recreation may help recreation managers in justifying budget increases and define priorities during a time of scarce resources. To provide that information we have conducted urban river recreation valuation using Choice Experiments (CE). We value user defined recreation attribute improvements for the following: reducing the presence of trash, increasing water clarity, reducing crowds and increasing vegetation. We also tested whether pro-environmental attitudes and behaviors influence visitors' Willingness to Pay (WTP) for improvements in environmental attributes. Three of the four attribute improvements were statistically significant (marginal values are provided in parenthesis): reduction of trash ($173), improving water clarity ($52), and reducing crowding ($28). The results can help managers justify improved trash removal and littering enforcement strategies, and advocate improvement of water quality by means of enacting and enforcing more strict regulations on littering, off-roading use, gravel pit discharges, and maximum visitation levels.

Keywords: Choice Experiment, environmental attribute valuation, watershed

1. Introduction and Background

Urban recreation areas are important to millions of people as the globe becomes increasingly urbanized. According to the United Nations (2015), 54% of the world's population resides in urban areas, and by 2050, this figure is expected to increase to 66%. The Americas are the most heavily urbanized in the World; 80% of the Latin American and Caribbean population is now considered urban. Puerto Rico's 2015 population density was estimated at 400 inhabitants per square kilometer, while the US mainland and Canada exhibited much lower densities; 40 and 4 inhabitants per square kilometer, respectively (The World Bank, 2015). Such rapid population growth had a direct impact on watershed resources. During the second half of the 20th century, Puerto Rico's coastal urban population grew rapidly, resulting in a reduction of forest cover along the island's coastal lowlands, and resulting in the degradation of groundwater and surface water resources (Barreto, 1997). Urban population growth was accompanied by less stringent enforcement of environmental laws compared to those of the U.S. mainland (Berman-Santana, 1996). Due to its urban character, the Manatí watershed is a location where ecosystem service degradation is evident. Its associated ecosystems have been impacted by coastal development, eutrophication, and debris disposal for decades but there have been minimal attempts to conduct formal attribute valuation studies that may help in the implementation of urban watershed management and conservation strategies.

There are two external conditions that make a recreation valuation exercise particularly relevant in Puerto Rico. A recent economic slowdown in Puerto Rico during the past five years has been so severe that it was accompanied by significant depopulation. Since economic growth and environmental protection are often seen as conflicting or competing goals, it is important to understand how residents value environmental attributes in the context of a prolonged economic downturn. Second, Puerto Rico experienced a prolonged drought during the year the study was conducted. An attribute valuation exercise of river recreation acquires more significance when water scarcity is apparent and real, not hypothetical. The former condition may diminish estimates, while the latter may have the opposite effect.

The focus of this paper will be to examine respondents' Willingness to Pay (WTP) for watershed environmental attributes as possible determinants in the context of an urban tropical watershed and a contracting economy. WTP is how economists measure economic values, and Choice Experiments are one of the standard techniques to measure it. Choice Experiments (CE) were developed from the marketing literature's conjoint analysis. The use of CE in environmental attribute valuation began in the 1990's, and its use has become prevalent (Adamowicz, Boxall, Williams, & Louviere, 1998; Boxall, Adamowicz, Swait, Williams, & Louviere, 1996). CE is a Stated Preference (SP) method designed to elicit economic responses to hypothetical scenarios that allow the estimation of preferences over attributes of environmental quality.

CE designs usually involve two or more side-by-side comparisons of several trip attribute bundles or program profiles. One of the trip attribute bundles or program profiles is generally the status quo with no added cost. To increase incentive compatibility, Carson and Grove (2007) recommend comparing only two trip profiles, one being the status quo baseline that is usually common to all of the comparisons. The overall study set of attribute bundles (including price) included in a study is usually built using an orthogonal and main effects design to keep the survey combinations manageable.

CE designs, with their several side-by-side, orthogonally designed trip profiles, can obtain a significant amount of information per respondent, particularly when respondents are asked to indicate both their best and worst alternative. This gain in statistical efficiency is accompanied by two costs: (a) a cognitive challenge that can lead to respondent fatigue, casting doubt on the quality of responses after several choice set exercises; and (b) an increased hypothetical nature of the exercise, i.e., some of the combinations presented to respondents may not match any of their previous recreation experiences.

2. Literature Review

Even though there are several examples of environmental attribute valuation in the literature, the use of Choice Experiments as a method is not as frequent. First, a brief review of studies that have summarized results of CE use in the assessment of natural or environmental resource attributes will be presented. Second, studies on the link between environmental attitudes and WTP for changes in environmental attributes will be briefly discussed.

Choice Experiments have been conducted to assess natural resource attributes in diverse contexts, many considering green areas in Europe. Some of the intervening variables included vegetation, presence of bodies of water, and presence of litter. Czajkowski, Bartczak, Giergiczny, Navrud and Zylicz (2014) found that respondents were willing to pay to reduce litter in a Polish forest, passively protect the most ecologically valuable forests, and provide more recreation and tourist infrastructure. Respondents' WTP was estimated at 6.21 Euro for a partial reduction of forest litter, and 9.14 Euro for a full reduction.

Carlsson, Frykblom and Liljenstolpe (2003) identified attributes that increased a citizen's perceived value of Swedish wetlands. In that study, surrounding vegetation was not a significant wetland attribute. Horne, Boxall and Adamowicz (2005) used CE's to assess visitors' preferences for forest management in Finland. Results showed that visitors had strong preferences for the preservation of species richness and scenic beauty. More recently, Dallimer et al. (2014) estimated WTP for the spread of plants in riparian green spaces in Sheffield, UK. WTP for a 10% increase in plant cover ranged from 0.70 British Pounds (BP) to 15.22 BP, and estimates for a 25% increase ranged from 0.37 BP to 8.09 BP. Although socio-economic attributes were not highlighted in several of the studies, Abildtrup, García, Olsen and Stenger (2013) found that a visitor's age and income has an impact on the marginal WTP associated with French forest attributes.

The literature on CE for environmental attribute improvement within the context of developing countries seems to be scarcer. Katuwal (2012) conducted a CE exercise aiming to seek natural resource attribute valuation estimates within the context of a developing country, Nepal. In that case, increases in vegetation did not register an increase in marginal WTP among participants. A CE exercise was also conducted in Costa Rica, a location more similar in climate, vegetation and economic structure to Puerto Rico, to estimate WTP for recreation attributes at forest recreation sites. One of the selected attributes was an increase in ornamental plantings at natural pool sites, which was positive and significant, with an estimated marginal WTP of $2.81 USD to be added to current entrance fees (Vega & Alpízar, 2011).

3. Methods

The first step in a CE design is to identify the key attributes of the recreation site quality that matters to visitors. An intercept survey was used to conduct in person interviews in three watershed sites. A variation of this sampling technique has been previously used in tropical watershed studies with an underlying social-ecological framework (Santiago, Verdejo Ortiz, Santiago-Bartolomei, Meléndez-Ackerman, & García Montiel, 2014). Conducting

interviews *in situ* allows us to ensure respondents are experiencing nature while being surveyed on recreation attribute preferences.

Three one-kilometer circles defined survey sites along upstream, midstream and downstream locations (see Figure 1). Upstream survey efforts were concentrated in Toro Negro, a recreation area in the central mountainous region. It is mainly covered by forest and secondary vegetation, and includes several recreation and conservation areas where visitors can bathe in the river and enjoy picnics. Midstream, the second sampling site was the Juan A. Corretjer Linear Walkway, popular as a rest stop for people to enjoy the views, eat and exercise. The downstream survey site, the river basin outlet, is the location where the river meets the Atlantic Ocean. Alluvial and marine deposits rest over the northern limestone region where people enjoy fishing and surfing, among other recreational activities.

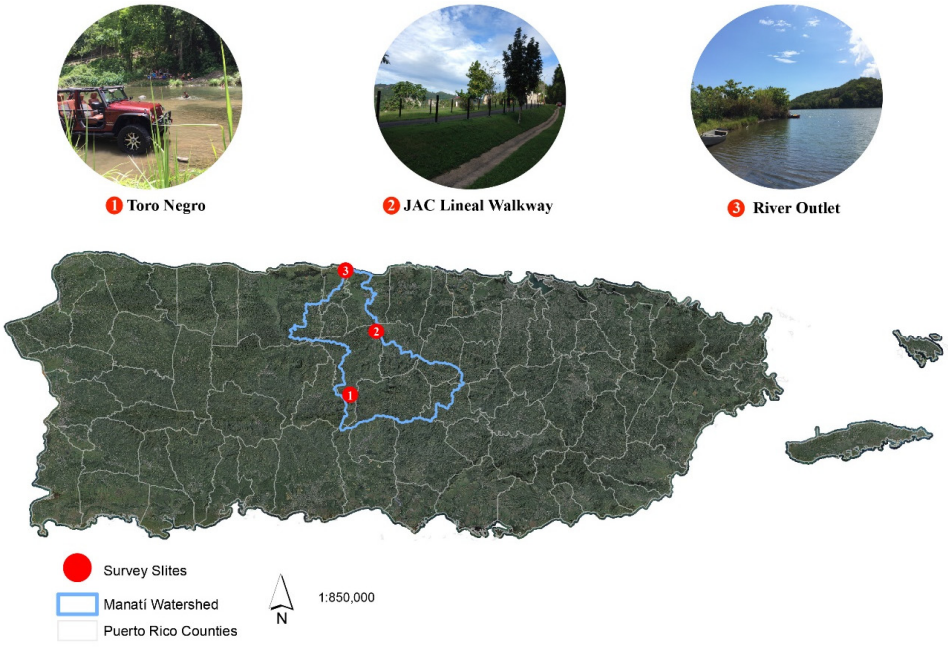

Figure 1. Survey Sites

Thus the first step was to identify which attributes were considered by recreationists when selecting watershed locations to visit in Puerto Rico. Forty (40) in-person interviews with open-ended questions were conducted in three Manatí watershed locations to identify attributes important to recreationists. The following were the four most frequently identified attributes: vegetation, trash, crowding, and water clarity. Pre-test results were used as input to design the CE questionnaire.

The CE design involved two side-by-side comparisons of three trip attribute bundles. Following Carson and Groves' (2007) recommendations for increasing incentive compatibility, just two trip profiles were compared, one being the status quo baseline that is usually common to all of the comparisons. The overall study set of attribute bundles (including price) included in the study was built using an orthogonal design to keep the survey combinations manageable.

The interviewer presented three subsequent trip attribute scenarios. The particular trip attribute profiles were selected randomly from twenty-four orthogonal trip attribute profiles. Each profile consisted of alternative levels of the four attributes (shown with pictures) and a pre-set bid amount. Given the orthogonal main effects design, rarely did the three combinations of trip attributes analyzed sequentially by the respondent match what was experienced the day of the interview.

The CE scenario asked the respondent to choose between two side-by-side trip attribute profiles. Thus in the CE treatment a total of eight pictures for each CE valuation choice task were shown at one time to the respondent. The baseline case was always the same in terms of the worst case level of attributes (as identified by pre-test respondents) with low vegetation, trash on the site, crowded conditions, and poor water clarity with an associated zero increase in travel cost. See Figure 2 for an example of a typical CE choice set. There were three choice sets sequentially shown to the respondent by the interviewer.

Attribute	*Base Condition*	*Condition A*
Vegetation		
Trash		
Crowding		
Water Clarity		
Additional Travel Cost to Visit with Condition A		$ZZ more per trip
Would you spend the additional travel costs with these Conditions at the River?		YES NO

Figure 2. Example Choice Set for Choice Experiment

A total of 202 in person interviews were conducted during the months of June to August of 2015. Sampling was balanced by day of the week, i.e., weekdays, weekends and holidays. The on-site refusal rate for in person interviews was 5%, only 10 people out of the combined sample of 212 refused to participate. The number of interviews conducted at each site was decided according to observed visitation levels and usage during the pre-test stage. A total of 93 interviews (46% of the total) were conducted in the Toro Negro site, the most visited location for watershed recreation. The remaining two sites were not as frequently visited; 57 interviews (28%) were conducted in the JAC Lineal Walkway, and the remaining 52 (26%) at the River Outlet.

4. Hypothesis Tests

We tested whether recreation related attributes were significant factors in the valuation of a visitor's recreation experience. All data was analyzed by a logit model. The stylized version of the model is:

$$\ln((\Pr Y)/\Pr(1-Y))=Bo+B1(\$Bid)+B2(Vegetation)+B3(Crowd)+B4(Trash)+B5(WaterClarity)+\ldots BnXn \quad (1)$$

where:

Y is the response to the bid amount (Yes or No).

β is the logistic regression coefficient.

$Bid is the additional trip cost to visit the river with that scenario.

Vegetation is whether vegetation is dense or not.

Crowd is whether the river site is crowded or not.

Trash is whether trash is visible on the site or not.

Water Clarity is river water clarity, i.e., whether the water was clear or not.

Xn represents other covariates including respondent socio-demographic characteristics.

The following hypothesis test was conducted:

$$H_o: \beta_{\text{CE ATTRIBUTES}} = 0 \qquad H_A: \beta_{\text{CE ATTRIBUTES}} \neq 0 \quad (2)$$

where **β** is the logistic regression attribute coefficient.

5. Results

A single bounded binary logistic regression model was used to estimate attribute improvement values. A full model was initially specified. The dependent variable was defined as the response to the bid amount, and the independent variables included the bid amount, river recreation attributes, and socioeconomic variables (age, gender, education and income).

The socio-demographic profile of respondents reveals a balanced sample in terms of gender, with 47% male and 53% female participants. Out of the 202 participants, nearly all respondents were residents of Puerto Rico (98%), as the sampled recreation areas attract mainly local visitors. The average respondent was 42 years old, with 2 years of college education, and an annual personal income of $29,560. A full description of socio-demographic characteristics is provided in Table 1.

Table 1. Socio-Demographic Characteristics

	Average	Minimum Value	Maximum Value	Standard Deviation
AGE (years)	42	18	85	15
EDUCATION (years)	14	1	22	3
INCOME (US dollars)	$29,557	$2,500	$75,000	$21,981
	Women		Men	
GENDER	Count	Percentage	Count	Percentage
	107	53%	95	47%

Full regression models were run with the use of STATA statistical software. Results of the hypothesis tests are presented below (see Table 2). To conserve space and focus on the key results, we will focus on attribute coefficients in the following tables, but complete regression results are available from the lead author. Model reliability was examined by means of two key statistics, the McFadden's Pseudo-R^2 and the Hosmer and Lemeshow (HL) test. Our model's reported McFadden's R^2 was 0.27, a value that, according to guidelines

established by McFadden and Domencich (1975), falls within the range of what is considered a good fit. The reported HL chi-square value was 5.44, with a p-value of 0.71, which in logistic regression goodness of fit tests, indicates that there is no evidence the model provides a poor fit (Fagerland & Hosmer, 2012).

Table 2. Logistic Regression Results

	COEF	Standard Error	z	P(Z)	[95% Conf. Interval]		Odds Ratio
BID	-0.015	0.002	-5.95	0.000	-0.020	-0.010	0.985
VEGETATION	0.072	0.208	0.34	0.731	-0.336	0.479	1.074
CROWDING	0.407	0.208	1.96	0.050	-0.000	0.814	1.502
TRASH	2.540	0.225	11.28	0.000	2.010	2.981	12.678
WATER CLARITY	0.761	0.215	3.55	0.000	0.341	1.182	2.141
AGE	-0.007	0.007	-1.00	0.316	-0.019	0.006	0.993
EDUCATION	-0.052	0.041	-1.27	0.203	-0.131	0.028	0.950
INCOME	2.11e-06	5.37e-06	0.39	0.694	-8.41e-06	0.000	1.000
GENDER	-0.030	0.214	-0.14	0.887	-0.450	0.389	0.970

As expected, the bid amount is negative and statistically significant at the 1% level. This inverse relationship between the magnitude of the bid amount and the probability of the respondent choosing that alternative demonstrates internal validity of the application here. Specifically, this result conforms to the law of demand in which the higher the price, the less likely the product will be purchased. We measured the value attributed by respondents to an improvement in four attributes: reduction in trash, improved water clarity, reduced crowding, and increased vegetation. Results show that a reduction in trash and increased water clarity were statistically significant at the 1% level, while a reduction in crowding was significant at the 5% level. In all cases, the improved attribute condition exhibits the expected positive sign. The only statistically insignificant attribute is the reduction in vegetation at the recreation site. Socio-economic and demographic variables, specifically age, income, level of education and gender, were consistently not significant in regression results.

Table 3. Attribute Coefficients and Marginal Values

	COEF	P(Z)	MARGINAL VALUE
BID	-0.015	0.000	
VEGETATION	0.072	0.731	$4.88
CROWDING	0.407	0.050	$27.72
TRASH	2.540	0.000	$172.95
WATER CLARITY	0.761	0.000	$51.84

6. Discussion

Results for attribute statistical significance show that only one of the four watershed attributes tested, vegetation was not significant. The removal of trash and increased water clarity were both positive and significant at the 1% level. A decrease in crowding was also significant at the 5% level.

Even though it was frequently mentioned in the pre-test as one of the four most important attributes to river recreationists, the various model results consistently did show that an improvement in vegetation did not have a significant effect on the likelihood of obtaining a positive bid response. We believe enough vegetation may have been already present in the Base Condition, so visitors didn't value additional vegetation. This could also be due to the likelihood that people may want sun while swimming in the cold river water or sunbathing before and afterwards.

The estimation of the corresponding attribute marginal values allows us to understand which attribute improvements are most valued by respondents (see Table 3). Marginal values were calculated dividing the attribute coefficient by the absolute value of the bid coefficient. Trash removal was by far the most valued attribute improvement, with a marginal value of $173. The second most valued attribute was an improvement in water clarity, with a lower marginal value of $52. The last statistically significant attribute improvement was a reduction in the agglomeration of individuals at the recreation area. The marginal value was the lowest, estimated at $28.

Loomis and Santiago (2013) conducted a similar Choice Experiment for a different but comparable context: beach recreation. The study was conducted in five beaches in Northeast Puerto Rico in 2010, with participation from 213 respondents. The four attributes selected by beach recreationists in a pre-test were wave height, water clarity, trash and crowding. Using a similar pre-test, river recreationists selected three of the same attributes as beach respondents: trash, crowding and water clarity. It is important to mention that in both cases, users did not select attributes from a list, but were responding to an open-ended question. Due to the differences in recreation venues, we expected to find more differences in attribute selection. The consistency in responses is evidence of the importance placed by recreationists to these particular recreation site attributes.

Comparing the significance of results in both studies, reductions of trash and water clarity were significant for both beach and river recreationists. The marginal value for water clarity improvement was nearly identical, $51 for beach recreationists and $52 for river recreationists. Marginal values for trash reduction differed significantly; it increased from $98 for beachgoers to $173 for river recreationists. Finally, crowding was not significant in the beach CE, but acquired significance in the river study, with a marginal value of $28.

7. Conclusion

We found a consistent and statistically significant positive valuation for improvements in three of the four attributes tested: trash reduction, increased water clarity, and reduced crowding levels. Such data may inform government agencies and NGO's in proposing resource allocation strategies, either at the watershed level, or more specifically for a particular recreation site.

Trash collection efforts are not consistent in many recreation sites. The results of this study show that it should be a priority to provide adequate trash collection and enforce littering regulations at recreation sites. The Puerto Rico Department of Natural and Environmental Resources has the capacity to enforce littering regulations.

Water clarity is highly valued as well, so any efforts to improve water quality and reduce turbidity are also a priority to site users. Informal consultations with experts in the region have led us to identify two main sources of turbidity that can be regulated: the use of off-roading vehicles and gravel pit activity in the mid and upper watershed. In both instances, the Department of Natural and Environmental Resources has the capacity to regulate such activity. Resulting reductions in turbidity upstream will add value to recreational activities downstream.

Finally, reducing crowds during peak visitation periods is of value to users, so strategies to ensure maintaining an appropriate number of users while ensuring appropriate carrying capacities and sustainable practices at recreation sites should be considered. Some of these measures can include pricing strategies to control access and reduce crowding at existing recreation areas managed by the Puerto Rico Department of Natural and Environmental Resources.

Given the importance of photos to assess attribute improvements, more attention should be paid to determining whether photos are as accurate as possible in portraying attribute improvements. For instance, in future studies it may be important to make differences in vegetation between scenarios more apparent. We think that in retrospect we needed to show lower levels of vegetation in the base case scenario.

The consistency of results across Choice Experiment studies does indicate the usefulness of the method in estimating attribute valuation. Even though it was applied in different recreation contexts, result for both Puerto Rico beach and river sites show consistency. Three of the four main attributes were identical across studies (trash, water clarity and crowding), the same two attribute improvements were statistically significant in both studies (trash and water clarity), and out of those two attributes, the estimated marginal values for one (water clarity) were nearly identical. The method seems to produce robust results that may be of value to recreation site managers.

Urban recreation areas are important to thousands if not millions of people. Increasingly the world's populations are concentrated into urban areas and so the importance of managing the areas is substantial. The Choice Experiment method has the capability not only to value the recreation experience in monetary values but also inform the manager which attributes of the recreation experience are most valued. In this way managers can prioritize management strategies, allocating funding to those most important to visitors.

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