



# **Valuing User Preferences for Improvements in Public Nature Trails Around the Sundays River Estuary, Eastern Cape, South Africa**

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**ERSA working paper 353**

**June 2013**

Economic Research Southern Africa (ERSA) is a research programme funded by the National Treasury of South Africa.

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# Valuing User Preferences for Improvements in Public Nature Trails Around the Sundays River Estuary, Eastern Cape, South Africa

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June 24, 2013

## Abstract

Many valuations have been made of changes to in-estuary attributes but few have been made of out-of-estuary attributes. From a recreation perspective, an important type of out-of-estuary attribute is the availability of public paths by which to access attractive features of the estuary environment. This paper values an improvement in the level of public access in the form of an additional nature trail along the banks of the Sundays River Estuary in the Eastern Cape, but does not compare this value with the costs. By means of choice experiment modelling analyses it is estimated that in 2010 the marginal willingness-to-pay for an investment in a nature trail was R34 per user per annum. In order to determine whether the development of this trail is efficient, this benefit (R34 per user per annum) needs to be compared to the cost of the development, an analysis that remains to be done. However, this find does serve to provide guidance on how much funding could efficiently be allocated to such a development - about R1.22 million, assuming a social discount rate of 8.38%.

**Keywords:** estuary, willingness to pay, choice experiment, public access, recreational attributes

## 1 Introduction

The Sundays River Estuary is a major tourist attraction (Cowley, Childs & Bennett, 2009). Recreational activities that occur at the Sundays River Estuary generate values for various participants, most notably tourism revenues for local businesses. The demands of a growing population, however, have led to increased pressures on the estuary as a recreational outlet. This demand pressure jeopardising the sustainability of these environmental service flows. As

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the estuary's user population increases, decision makers and stakeholders face two important trade-offs with respect to these service flows. Firstly, they must trade-off improved public access to the attractions of the estuary against preserving the naturalness and undisturbed feel of the environment. Secondly, they must trade-off demand for public spending on improved public access with demand for public spending on other services, for example, housing and health (Hay, Hosking & McKenzie, 2008). Several concerns that must be kept in mind when determining the optimal level of public path provided at the Sundays River Estuary are (1) the protection of the existing fragile natural resources, (2) private property privacy concerns, (3) the safety and security provided for public use, and (4) the need for investment in the recreational appeal of the estuary (Vickey, 2003).

The Sundays River Estuary (33 ° 43'S, 25 ° 25'E) is situated in the Eastern Cape, approximately 40 kilometres (km) northeast of Port Elizabeth (see **FIGURE 1**). The estuary is approximately 20km long, is permanently open and discharges into Algoa Bay, in the Indian Ocean (MacKay & Schumann, 1990).

Public access at the Sundays River Estuary is subject to a number of restrictions – some of which are natural barriers and some of which are man-made. The former includes steep, inaccessible banks. The latter includes private residential properties on land adjacent to the banks of the estuary and private ownership of land adjacent to the estuary's banks (Cowley et al., 2009; Unit for Integrated Environmental and Coastal Management (IECM), 2010). The Cowley et al. (2009) study divided the recreational area of the Sundays River Estuary into six zones (see **FIGURE 2**).

Public access to the west bank of the estuary is limited by privately-owned farms (no public access save for farm staff), the N2 national highway (this permits access to pedestrians only), and the Mackay Rail Bridge, that is currently closed and permits only bicycle and pedestrian access (Cowley et al., 2009). Access to the east bank of the estuary, from the mouth of the estuary up to the Pearson Park caravan park, is restricted due to the presence of privately-owned land. Estuary users can only access this bank if they are prepared to pay an access fee. Access to this bank is further hampered by the existence of a steep, rocky cliff situated at the northern end of the east bank. This makes shore access difficult and dangerous during low tide and impossible during high tide (Cowley et al., 2009). Vehicle access does exist on the east bank, with the exception of the area beyond the parking lot, to the south of the ablutions. The north bank of the estuary, between the N2 Bridge and the Pearson Park caravan park, is largely residential. The estuary banks and riparian zone on this bank are frequented mostly by residents, but the area is accessible to the general public via a wide open grass space between the residential dwellings and the estuary. Vehicle access to the estuary is restricted to two distinct points: one near the petrol station in the north-east corner of the estuary, and the other at the slipway located adjacent to the N2. Except for these two access points, there are virtually no other vehicle access points along this stretch of the estuary (Cowley et al., 2009). The estuary bank to the north of the N2 highway is accessible by vehicle, but is restricted to the road that leads up to the Mackay

Rail Bridge. The east bank to the north of the N2 Bridge is mainly occupied by residential properties. The estuary banks along this stretch are also steep and inaccessible (Cowley et al., 2009). The area to the north of the Mackay Rail Bridge is hardly accessible by road.

In the vicinity of Colchester and Cannonville private jetties have proliferated in an ad-hoc manner along the northern bank of the Sundays River Estuary. Most of these jetties have been constructed on Municipal Public Open Space without authorisation. Although most of the jetties are situated on Municipal land, access is controlled by those who erected them.

In their status quo assessment report, Afri-Coast Engineers recommended that "... a continuous strip of green open space be preserved along the river banks (of the Sundays River Estuary) to form an aesthetic nature trail providing a valuable asset to the area for both local residents and tourists" (Afri-Coast Engineers, 2004). The green open space must constitute a sufficiently wide river frontage to allow for safe public access. The engineering company further recommended that "... negotiations should be initiated with the private land owners who own private land along the river edges (of the Sundays River Estuary) to investigate a mutually beneficial partnership to conserve this ecologically valuable land" (Afri-Coast Engineers, 2004). Other privately-owned land could be incorporated into conservancies, or bought by the Nelson Mandela Bay Municipality, in order to conserve these areas and to incorporate them into the Nelson Mandela Metropolitan Open Space System (Afri-Coast Engineers, 2004).

The National Water Act of 1998 governs public access to estuaries in South Africa, but is vague on how this public access must be managed and conserved (NWA, 1998). It states: "A person may, subject to this Act— ... (e) For recreational purposes - (i) use the water or the water surface of a water resource to which that person has lawful access; or (ii) portage any boat or canoe on any land adjacent to a watercourse...". The introduction of a nature trail fronting the banks of the Sundays River Estuary appears to be allowed for in the Act as it would be 'adjacent to the watercourse'. From a social perspective it would improve the quality of the public land fronting the water's edge, and make it more appealing for recreational shore fishing, as well as provide further areas for other recreational activities, such as bird watching or walking. But what would society (the users) be prepared to pay for the development of such a facility? This paper uses the choice experiment (CE) methodology to estimate the recreational user's willingness to pay (WTP) for this development, and by so doing, provides guidance to the estuary management authorities on what level of resources they can efficiently allocate to the path development project.

## **2 The CE Methodology**

### **2.1 Conceptual framework**

The CE method is a choice modelling technique that is used to measure user preferences for goods where goods are described in terms of attributes and levels

(Hanley, Koop, Alvarez-Farizo, Wright & Nevin, 2001). Respondents are presented with a number of different options made up of differing attributes and levels and asked to choose their most preferred. The theoretical background to the CE method dates back to Lancaster’s model of consumer choice (Lancaster, 1966) and random utility theory (Thurstone, 1927). It is argued that consumers enjoy utility not from the good as a whole, but rather from the attributes or characteristics that comprise this good (Lancaster, 1966). Random utility theory is the basis for analysing respondent behaviour within the context of a CE. It is based on the assumption that individuals make their choices based on the good’s observable attributes, together with a random element. Manski (1977) identified four sources of uncertainty contributing to the unobserved or random element of utility: effects of unobserved alternative attributes, effects of unobserved consumer characteristics (or taste variations), measurement errors, and the use of imperfect proxy (or instrumental) variables. Indirect utility for individual  $i$  in choice scenario  $q$  can be defined as:

$$U_{iq} = V_{iq}(\beta x_{iq}) + \varepsilon_{iq}, \quad (1)$$

where,  $x_{iq}$  is a vector of observed attributes, and  $\beta$  is a vector of the parameters to be estimated (Hanley et al., 2001). This indirect utility function comprises one observable component of utility,  $V_{iq}$ , and a random component,  $\varepsilon_{iq}$ . It is assumed that individuals make choices in order to maximise their utility. An individual ( $i$ ) will select alternative  $q$  if and only if (iff)  $U_{iq}$  is greater than the utility derived from any other alternative facing person  $i$  in the choice set  $C$ . This probability is formulated by:

$$P_i(q) = \Pr(U_{iq} \geq U_{ij}, \forall j \in C_i, q \neq j), \quad (2)$$

The utility of each alternative ( $q$  and  $j$ ) is divided into two parts, namely an observable component and a random element. Equation 2 is rewritten to include this information:

$$P_i(q) = \Pr(V_{iq}(\beta x_{iq}) + \varepsilon_{iq} \geq V_{ij}(\beta x_{ij}) + \varepsilon_{ij}, \forall j \in C_i, q \neq j), \quad (3)$$

Choice can be predicted by estimating the probability of individual ( $i$ ) ranking alternative  $q$  higher than any other alternative  $j$  in the set of choices available (Louviere, Hensher & Swait, 2000; Nam Do & Bennett, 2007). In order to derive this probability expression, an assumption needs to be made with regards to the distribution of the error term (Hanley et al., 2001). The error term is typically assumed to be independently and identically distributed (IID) with an extreme-value type 1 distribution (EV1):

$$P(\varepsilon_{iq} \leq t) = F(t) = \exp(-\exp(-t)), \quad (4)$$

This error term distribution implies that the probability of any option  $q$  being chosen can be expressed in terms of a logistic distribution (McFadden, 1974). This logistic distribution is known as the conditional logit (CL) model:

$$P = (U_{iq} \geq U_{ij}, \forall j \neq q) = \frac{\exp(\mu V_{iq})}{\sum_{j \in C} \exp(\mu V_{ij})}, \quad (5)$$

where there are  $a$  different alternatives in choice set  $C$ . The scale parameter,  $\mu$ , is typically assumed to be one (Ben-Akiva & Lerman, 1985). This model is restrictive in terms of its underlying assumptions. In addition to the IID assumption of the error term, it assumes that random components do not exhibit serial correlation, i.e. they are independent of irrelevant alternatives (IIA), that utility parameters are set, and that homogeneity of preferences across respondents is maintained (Bhat, Eluru & Copperman, 2000). In order to relax the IIA assumption, Bhat (1995) proposed a heteroscedastic extreme-value (HEV) model which allows different scale parameters across alternatives. The variances of the error terms are allowed to differ across all options. However the error terms of one alternative must have a scale parameter that is normalised to one for identification purposes (Bhat et al. 2000). The CL model can be adapted to allow for variance of the scale parameter ( $\lambda$ ) as shown in Equation 6:

$$P_{qi} = \frac{\exp(V_{qi}/\lambda_q)}{\sum_{j=1}^a \exp(V_{ji}/\lambda_j)} \quad (6)$$

The HEV specification models the probability that an individual ( $i$ ) will choose the  $q$ th alternative in a choice set ( $C$ ), but relaxes the assumption of independence among the random components. Substituting  $z$  in place of  $(\varepsilon_i/\lambda_i)$ , the HEV specification of the choice estimation model is:

$$P_{qi} = \int_{z=-\infty}^{z=+\infty} \prod_{j \in C, j \neq 1} F \left[ \frac{V_{qi} - V_{ji} + \lambda_{qi}z}{\lambda_{ji}} \right] f(z) dz \quad (7)$$

The CL and HEV models do not allow variations to an attribute across individuals (Bhat et al. 2000). Unobserved respondent characteristics can, however, affect responses to the choice questions. If these unobserved characteristics are ignored, biased and inconsistent choice probability estimates could result (Bhat et al. 2000). These weaknesses are addressed in the random parameter logit (RPL) model, after making it superior to the CL model in terms of fit and overall welfare estimation (Carlsson, Frykblom & Liljenstolpe, 2003; Morey & Rossman, 2003; Birol, Karousakis & Koundouri, 2006). The RPL model generalises the CL model by allowing the coefficients of observed variables to vary randomly over individuals rather than being fixed (Hynes & Hanley, 2005). It achieves this by dividing the error component of the utility function in Equation 1 into two parts, so permitting the possibility that information relevant to making a choice, that is unobserved, induces correlation across alternatives in a choice situation (Hynes & Hanley, 2005). One component of the error term is correlated over alternatives. Another follows the IID assumption across alternatives and individuals (Goibov, Schmitz, Bauer & Ahmed, 2012):

$$U_{iq} = \beta X_{iq} + \eta_i X_{iq} + \varepsilon_{iq} \quad (8)$$

where  $X_{iq}$  is a vector of identifiable attributes of alternatives within a choice set,  $\beta$  is a vector of parameters unobserved for each individual that varies ran-

domly over individuals based on their tastes,  $\eta_i$  denotes a vector of standard deviation parameters representing individuals tastes relative to the average tastes in the population of individuals, and  $\epsilon_{iq}$  denotes the random portion of utility (Hynes & Hanley, 2005; Goibov et al., 2012). The probability of individual  $i$  choosing alternative  $q$  in choice set  $C$  is (Louviere et al., 2000):

$$P(q|\mu_i) = \frac{\exp(\alpha_{qi} + \theta_q z_i + \beta_{qi} x_{qi})}{\sum_{q=1}^Q \exp(\alpha_{qi} + \theta_q z_i + \beta_{qi} x_{qi})} \quad (9)$$

where  $\alpha_{qi}$  is a fixed or random alternative specific constant (ASC) with  $j = 1, \dots, J$  alternatives and  $i = 1, \dots, I$  individuals; and  $\alpha_j = 0$ ,  $\theta_q \mathbf{z}_i$  is a vector of non-random parameters responsible for individual characteristics,  $\beta_{ji}$  is a parameter vector that is randomly distributed across individuals;  $\mathbf{z}_i$  is a vector of individual-specific characteristics, income,  $\mathbf{x}_{ji}$  is a vector of individual-specific and alternative-specific attributes, and  $\mu_i$  is the individual-specific random disturbance of unobserved heterogeneity (Train, 1998).

In order to estimate this model, it is often assumed that the parameters  $\beta$  are either normally, triangularly, uniformly or log-normally distributed over the population of individuals (Bhat et al., 2000; Bhat, 2001). Normally distributed parameters, means and standard deviations of coefficients can determine to what extent respondents place positive or negative values on a change in an environmental attribute (Train, 2003).

## 2.2 Brief literature review

The literature that exists on the valuation of wetlands, estuaries and rivers is largely focussed on valuing specific attributes of interest within each site. Studies that make use of the CE methodology to value these attributes include Opaluch, Grigalunas, Diamantides, Mazzotta and Johnston (1999), Heberling, Shortle and Fisher (2000), Hanley et al. (2001), Economics for the Environment Consultancy (EFTEC) (2002), Hanley, Adamowicz and Wright (2002), Hearne and Salinas (2002), Landry, Keeler and Kriesel (2003), Eggert and Olson (2004), Windle and Rolfe (2004), Bateman, Cole, Georgiou and Hadley (2005), Birol et al. (2006), Huang, Poor and Zhao (2007), Kragt, Bennett, Lloyd and Dumsday (2007), Kragt and Bennett (2009), Smyth, Watzin and Manning (2009), and Beharry-Borg and Scarpa (2010). In South Africa, there have only been a few studies reported that make use of the CE technique to value environmental attributes. Most notably, it was applied in order to value improvements in freshwater inflows into the Kruger National Park catchment areas (Turpie & Joubert, 2004), and the Bushmans River Estuary (Oliver, 2010).

The value of improved public path access has not been addressed by many empirical studies. Kline and Swallow (1998) estimated WTP values for public access to Gooseberry Island, Massachusetts, USA. They did this through the use of the contingent valuation method (CVM). A study by Dyack, Rolfe, Harvey, O'Connell and Abel (2007) estimated the impact of different public access

situations on recreational value in the Murray River Basin, Australia. This study made use of both revealed and stated preference techniques to estimate non-market recreational values. A contingent behaviour survey was applied to ascertain how recreational users would adjust their use of the site in question if public access conditions changed. The conditions could change due to changes in management and/or the provision of additional tracks and facilities.

### 3 CE Design and Application

#### 3.1 CE format and attributes

Interviews were conducted with experts as well as members of the Sundays River Ratepayers Association. These interviews identified the most important issues facing recreational users of the Sundays River Estuary and specified them in terms of attributes with differing levels. One of the key problems identified related to the lack of adequate public access to the estuary. Based on these discussions, and following the steps outlined by Hasler, Lundhede, Martinsen, Neye and Schou (2005), a questionnaire was developed and pre-tested through a pilot survey. Following this pilot survey, some editorial changes were made to the questionnaire in order to improve its clarity and reduce the overall cognitive burden on the respondent. The CE section of the edited questionnaire included three management attributes, namely ‘Physical size of fish stocks caught’, ‘Boat congestion’ and ‘More public access?’ These three attributes had two qualitative levels each. The qualitative attributes were used because respondents related better to these – they were less cognitively demanding (see also Hasler et al. 2005). The fourth attribute represented the payment vehicle and was defined as an annual environmental levy added on to the existing boat license fee structure. This cost variable was expressed by four different Rand values in the CE. It was found to be the most understandable and least controversial option out of those discussed in the focus groups. Attributes selected for this study and their corresponding levels are presented in **TABLE 1** below.

The two alternatives presented to the recreational users of the estuary were different combinations of these three management attributes and their levels with a cost value attached. For the purposes of this study, a status quo or ‘opt out’ alternative was not included. The reason for this was twofold. It was difficult to define a status quo option as some of the current recreational uses pertaining to the estuary can be defined as illegal, for example, bag and size limits in the fishery are currently not being adhered to. In addition, it was thought unnecessary to include a status quo (opt out) alternative when the purpose of the study was to guide policy-making (Hasler et al., 2005).

An introductory section was provided at the beginning of the CE questions to familiarise the respondent with the different management attributes and their levels. Information on the CE payment was also presented so that the respondents were aware of the payment vehicle, as well as the need to consider the constraints on the household’s budget. The assumptions with respect to the



payment were (1) that the costs of implementing the policy alternatives would be covered by the recreational users of the estuary, and (2) that all users would contribute equally to the implementation of the scenarios by means of a fixed annual sum per household.

### 3.2 Designing the CE choice sets

Overall, four attributes were defined. Three of these attributes had two levels each, and one had four levels. A full factorial design ( $2 \times 2 \times 2 \times 4 = 32$ ) was generated using SPSS, yielding 32 different treatment combinations or alternatives. These alternatives were randomly allocated to 32 different questionnaires. Each questionnaire contained four choice sets, and within each choice set, the respondent had to make a choice (trade-off) between two alternatives. Two alternatives were adopted in this case as more than two per choice set can result in ‘respondent fatigue’ (Bateman, Carson, Day, Hanemann, Hanley, Hett, Jones-Lee, Loomes, Mourato, Ozdemiroglu, Pearce, Sugden & Swanson, 2002). A sample choice set is provided in **FIGURE 3**, in which Option B was selected.

### 3.3 Sample design and data collection

The population of interest with respect to the Sundays River Estuary was all users and potential users of the recreational services provided by each estuary. The sample frame, however, could not be compiled, as this population does not reveal itself until it visits the estuary. As it was impossible to identify a sample frame, the closest to this objective was knowledge of the sample population and use of this knowledge to sample select. This form of non-list sampling can be used when the target population refers to visitors to a beach, or in this case, an estuary (Bateman et al., 2002; Dillman, Smyth & Christian, 2009). It entails on-site sampling, and is known as an intercept survey (Bateman et al., 2002). Two approaches to the determination of sample size in choice modelling exercises are often proposed (Hensher, Rose & Greene, 2005): the use of probability sampling and rule of thumb. Probability sampling is very often abandoned due to practical considerations (budget and time constraints). A ‘*rule of thumb*’ approach was used to calculate the minimum sample size required to estimate a model of choice using unlabelled experiments and design attributes only - a sample of 50 respondents each exposed to 16 choice sets is thought to be capable of yielding meaningful and significant results (Bennett & Adamowicz, 2001). This translates into a sample of 200 respondents if they are offered 4 choice sets each.

The face-to-face interview method is the most common approach to use when valuing recreational sites (Lee & Han, 2002). This personal interview method was adopted for this study. Although costly, it affords the interviewer the best opportunity to encourage the respondents to cooperate with the survey. The interviewer is also given an opportunity to explain complex information and valuation scenarios to the respondent – which is very important in the CE setting (Mitchell & Carson, 1989). The Sundays River Estuary questionnaire was

administered on-site by four trained interviewers during August, 2010. Interviewers approached every  $n^{th}$  potential respondent and asked them if they would be willing to spend approximately 15 minutes filling in the questionnaire. In total, 175 completed questionnaires were collected, a number below the recommended sample size, but still considered adequate in order to estimate 'robust' models (Hensher et al., 2005).

## 4 Results

### 4.1 Socio-economic characteristics

Selected socio-economic results revealed that most of the visitors surveyed came from areas less than 50km away from the estuary, were male, over the age of 35, had a matric qualification with university exemption, and earned an average annual income of R184 000. Of these respondents, most came from Port Elizabeth (59%). Permanent residents of the estuary, living in Colchester and Cannonville, accounted for approximately 21% of the sample.

### 4.2 CE results

Three different choice model specifications were estimated for the CE: a CL model, an HEV model and an RPL model. The LIMDEP NLOGIT Version 4.0 programme was used in all these estimations. **TABLE 2** reports the estimation results of the three model specifications.

The coefficients in all three models have the correct signs, a priori, and are significantly different from zero at the 95% confidence level (at the least). The cost attribute parameter is as expected i.e. significant and has a negative sign in all three models estimated. The probability that an alternative would be chosen was reduced: the lower the physical size of the fish stock, the higher the amount of boat congestion, the lower the amount of public access available, and the higher the environmental quality levy.

In the case of the CL model, the significant coefficients can be interpreted by estimating their odds ratios. This is done by calculating the antilog - the value of 10 to the power of the coefficient's value - of the various coefficients. Odds interpretation indicates how an increase (decrease) in an attribute's level would result in a change in the probability of choosing an option which includes this increase (decrease). With respect to the attribute of interest, i.e. public access, an increase in public access will result in an increase in the probability of a respondent choosing this option by 2%. The explanatory power of the CL model is measured by the Pseudo  $R^2$ . At 22% this is a good fit for CE-type studies - Louviere et al. (2000) suggested that anything between 0.2 and 0.4 can be considered very good.

In order to relax the IIA assumption inherent in the CL specification, an HEV model is estimated. The HEV specification relaxes the assumption of independence among the random components (Bhat, 1995). The odds interpre-

tation reveals that an increase in public access will result in an increase in the probability of a respondent choosing this option by 3%.

The CL and HEV models do not allow sensitivity variations to an attribute across individuals (Bhat et al. 2000). Unobserved respondent characteristics can, however, affect responses to the choice questions. To address this problem, the RPL model was estimated. Consistent with recommendations made by Hasler et al. (2005), all parameters except the cost parameter were treated as random and assumed to be normally distributed. Cost was specified as fixed, and not randomly distributed, because in this case, the distribution of the marginal WTP for an attribute is simply the distribution of that attribute's coefficient. Results reveal that the estimated RPL model shows statistically insignificant attribute coefficients. This indicates statistically similar preferences for attributes across respondents, implying a largely homogenous recreational user group of mostly boat users.

### 4.3 Estimation of WTP values

Measures of welfare can be calculated from the estimated coefficients in the form of marginal WTP values (Goibov et al., 2012). More generally, the marginal rates of substitution between the different attributes can be calculated from the ratios of the coefficients. The marginal WTP value for public access calculated was for a change from limited recreational appeal to an improvement in the recreational appeal of the estuary through the introduction of a path access along the estuary banks. **TABLE 3** reports the implicit prices, or marginal WTP, for each of the Sundays River Estuary's recreational attributes estimated using the Delta method (Wald procedure) in LIMDEP NLOGIT Version 4.0 (Greene, 2007). This procedure automates the process of estimating standard errors for non-linear functions, such as marginal rates of substitution (Suh, 2001). As parameter coefficients are stochastic in nature, confidence intervals are also estimated. These prices are based on the RPL model coefficients.

The WTP for more public access in the form of a path access or nature trail along the banks of the Sundays River Estuary was R34.00 per user per annum.

## 5 Conclusion

The Sundays River Estuary is a common property resource controlled by the state. It is not controlled by a marine protected area, a closed area or a national park but by the relevant municipality i.e. the Sundays River Municipality. Laws and regulations that relate specifically to this estuary are often breached and poorly enforced (Cowley et al., 2009). The absence of effective administration results in a situation whereby many of the advantages attributable to state management are lost, inducing problems of open access at the Sundays River, including high recreational demand. This recreational demand puts pressure on existing public facilities and the estuary space. Improving access to the various attractions of the estuary is one way to increase its accommodative capacity.

The current lack of public access to the Sundays River Estuary holds back its overall recreational appeal as a tourist destination.

In an assessment report by Afri-Coast Engineers (2004), it was recommended that the development of a nature trail or path access along the river banks be investigated. The introduction of a nature trail fronting the banks of the Sundays River Estuary would be an attractive complementary investment for both local residents and tourists. This investment would improve the recreational appeal of the estuary's banks and open up further areas for other recreational activities, such as bird watching and walking (Afri-Coast Engineers, 2004). To determine whether this project is efficient, however, information is required on the main group of current users' WTP, in the form of additional boat license fees, for the project, and costs involved for the projects implementation. The application of the CE method revealed that the marginal WTP for an investment in a nature trail was estimated to be R34 per user per annum. Although users are willing to pay R34 per annum to implement such a project, it cannot be determined whether this investment is efficient as project cost information was not collected. It is recommended that a cost-benefit analysis be conducted on the feasibility of this project at a later date. However, this finding does serve to provide guidance on how much funding could be allocated to such a development.

Total WTP for this development can be calculated by multiplying the number of registered boat owners, by the WTP per user per annum, which is R34. Given that in 2010 there were 900 boat users registered at the private Pearson Park slipway and about 2100 non-registered users (3000 in total), the present value (PV) of this project is:

$$PV = \frac{\text{Annual total WTP}}{\text{Social Discount rate}} \quad (10)$$

Assuming a social discount rate of 8.38% (the average 10 years and over bond yield in 2010) it would have been efficient to spend about R1.22 million on this development in 2010 (South African Reserve Bank (SARB), 2013).

#### **Acknowledgement**

We gratefully acknowledge the Water Research Commission's financial support. We would also like to thank the members of the reference group for valuable comments, insights and suggestions. This study formed part of a bigger research initiative under the auspices of the Water Research Commission (WRC) of South Africa. The research initiative is entitled "The application of choice modelling (CM) techniques to guide the management of estuaries in South Africa – case studies of the Kromme, Nahoon, Sundays and Gonubie Estuaries" (WRC Project No. KSA5/1924).

## **References**

- [1] Afri-Coast Engineers. (2004). *Colchester Status Quo Assessment Report*. Port Elizabeth: Nelson Mandela Metropolitan Municipality, Report No.

P1577/01.

- [2] Baird, D. (2002). *Estuaries of South Africa*. Port Elizabeth: University of Port Elizabeth.
- [3] Bateman, I.J., Carson, R.T., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Özdemiroglu, E., Pearce, D.W., Sugden, R. & Swanson, J. (2002). *Economic Valuation with Stated Preference Techniques. A Manual*. Cheltenham: Edward Elgar Publishing.
- [4] Bateman, I.J., Cole, M.A., Georgiou, S. & Hadley, D.J. (2005). Comparing contingent valuation and contingent ranking: A case study considering the benefits of urban river water quality improvements. *Journal of Environmental Management*, 79 (2006), pp. 221 – 231.
- [5] Beharry-Borg, N. & Scarpa, R. (2010). Valuing quality changes in Caribbean coastal waters for heterogeneous beach visitors. *Ecological Economics*, 69(5), pp. 1124 – 1139.
- [6] Ben-Akiva, M. & Lerman, S. (1985). *Discrete Choice Analysis: Theory and Application to Travel Demand*. Cambridge: MIT Press.
- [7] Bennett, J. & Adamowicz, W. (2001). Some fundamentals of environmental choice modelling. In Bennett, J. & Blamey, R.K. (eds.) *The Choice Modelling Approach to Environmental Valuation*. Cheltenham: Edward Elgar Publishing (pp. 37 - 69).
- [8] Bhat, C.R. (1995). A Heteroskedastic Extreme Value model of intercity travel mode choice. *Transportation Research B*, 29(6), pp. 471 - 483.
- [9] Bhat, C.R., Eluru, N. & Copperman, R.B. (2000). Flexible model structures for discrete choice analysis. In Hensher, D.A. & Button, K. J. (eds.) *Handbook of Transport Modelling, Vol. 1: Handbooks in Transport*. Oxford: Pergamon Press (pp. 71 - 90).
- [10] Bhat, C. R. (2001). Quasi-random maximum simulated likelihood estimation of the mixed multinomial logit model. *Transportation Research B*, 35(7), pp. 677 - 695.
- [11] Birol, E., Karousakis, K. & Koundouri, P. (2006). Using a choice experiment to account for preference heterogeneity in wetland attributes: the case of Cheimaditida wetland in Greece. *Ecological Economics*, 60(1), pp. 145 – 156.
- [12] Carlsson, F., Frykblom, P. & Liljenstolpe, C-J. (2003). Valuing wetland attributes: an application of choice experiments. *Ecological Economics*, 47(1), pp. 95 – 103.

- [13] Cowley, P.D., Childs, A-R. & Bennett, R.H. (2009). *A Survey of Fishery Resource Utilisation and Recreational Activities on the Sundays Estuary, With Implications for Management*. Grahamstown: South African Institute for Aquatic Biodiversity, World Wildlife Fund – South Africa Report.
- [14] Dillman, D.A., Smyth, J.D. & Christian, L-M. (2009). *Internet, Mail and Mixed-Mode Surveys: The Tailored Design Method*. New Jersey: Wiley and Sons.
- [15] Dyack, B., Rolfe, J., Harvey, J., O’Connell, D. & Abel, N. (2007). *Valuing Recreation in the Murray: An Assessment of the Non-Market Recreational Values at Barmah Forest and the Coorang*. CSIRO: Water for a Healthy Country National Research Flagship.
- [16] Economics for the Environment Consultancy Ltd (EFTEC). (2002). *Valuation of Benefits to England and Wales of a Revised Bathing Water Quality Directive and Other Beach Characteristics Using the Choice Experiment Methodology*. London: EFTEC, Report to the Department for Environment, Food and Rural Affairs.
- [17] Eggert, H. & Olsson, B. (2004). *Heterogenous Preferences for Marine Amenities: A Choice Experiment Applied to Water Quality*. Goteborg: Goteborg University. (Department of Economics Working Papers in Economics series no. 126).
- [18] Goibov, M., Schmitz, P.M., Bauer, S. & Ahmed, M.N. (2012). Application of a choice experiment to estimate farmers preferences for different land use options in Northern Tajikistan. *Journal of Sustainable Development*, 5(5), pp. 1 – 16.
- [19] Greene, W.H. (2007). *NLOGIT: Version 4.0, User manual*. New York: Econometric Software, Inc.
- [20] Hanley, N., Koop, G., Alvarez-Farizo, B., Wright, R. & Nevin, C. (2001). Go climb a mountain: an application of recreation demand modelling to rock climbing in Scotland. *Journal of Agricultural Economics*, 52, pp. 36 – 52.
- [21] Hanley, N., Adamowicz, W. & Wright, R. (2002). *Do Choice Experiments Pass the Scope Test? A Test of Scope Experiment Examining the Benefits of Water Quality Improvements*. Paper presented at the EAERE/AERE World Congress: Monterey, California.
- [22] Hasler, B., Lundhede, T., Martinsen, L., Neye, S. & Schou, S.J. (2005). *Valuation of Groundwater Protection Versus Water Treatment in Denmark by Choice Experiments and Contingent Valuation*. Denmark: National Environmental Research Institute. NERI Technical Report No. 543. [On-line]. Available: <http://technical-reports.dmu.dk> (Accessed 15 February 2010).

- [23] Hay, D., Hosking, S.G., & McKenzie, M. (2008). *Estuaries, Economics and Freshwater: An Introduction*. Pretoria: Water Research Commission.
- [24] Hearne, R. & Salinas, Z. (2002). The use of choice experiments in the analysis of tourist preferences for ecotourism development in Costa Rica. *Journal of Environmental Management*, 65(2), pp. 153 – 163.
- [25] Heberling, M., Shortle, J. & Fisher, A. (2000). *The Effect of the Number of Choice Sets on Responses in a Stated Choice Survey*. Paper presented at the American Agricultural Economics Association Annual Meeting: Miami, Florida.
- [26] Hensher, D., Rose, J.M. & Greene, W.H. (2005). *Applied Choice Analysis: A Primer*. Cambridge: Cambridge University Press.
- [27] Huang, J., Poor, P.J. & Zhao, M.Q. (2007). Economic valuation of beach erosion control. *Marine Resource Economics*, 22(3), pp. 221 – 238.
- [28] Hynes, S. & Hanley, N. (2005). *Analysing Preference Heterogeneity using Random Parameter Logit and Latent Class Modelling Techniques*. Ireland: The National University of Ireland, Galway. (Environmental and Natural Resource Economics Research Unit, Working paper series no. 91).
- [29] Kline, J.D. & Swallow, S.K. (1998). The demand for local access to coastal recreation in Southern New England. *Coastal Management*, 26(3), pp. 177 – 190.
- [30] Kragt, M.E., Bennett, J., Lloyd, C. & Dumsday, R. (2007). *Comparing Choice Models of River Health Improvement for the Goulburn River*. Paper presented at the 51<sup>th</sup> Conference of the Australian Agricultural and Resource Economics Society: Queenstown, Australia.
- [31] Kragt, M.E. & Bennett, J.W. (2009). *Using Choice Experiments to Value River and Estuary Health in Tasmania with Individual Preference Heterogeneity*. Canberra: Australian National University. Environmental Economics Research Hub Research, Report No. 0916.
- [32] Lancaster, K. (1966). A new approach to consumer theory. *Journal of Political Economy*, 74(2), pp. 132 - 157.
- [33] Landry, C.E., Keeler, A.G. & Kriesel, W. (2003). An economic evaluation of beach erosion management alternatives. *Marine Resource Economics*, 18, pp. 105 – 127.
- [34] Lee, C.K. & Han, S.Y. (2002). Estimating the use and preservation values of national parks' tourism resources using a contingent valuation method. *Tourism Management*, 23(5), pp. 531 – 540.
- [35] Louviere, J.J., Hensher, D.A. & Swait, J.D. (2000). *Stated Choice Methods: Analysis and Application*. Cambridge: Cambridge University Press.

- [36] Mackay, H.M. & Schumann, E.H. (1990). Mixing and circulation in the Sundays River Estuary, South Africa. *Estuarine Coastal Shelf Sciences*, 31(2), pp. 203 - 216.
- [37] Manski, C. (1977). The structure of random utility models. *Theory and Decision*, 8(3), pp. 229 - 254.
- [38] McFadden, D. (1974). Conditional logit analysis of qualitative choice behaviour. In Zarembka, P. (ed.) *Frontiers in Econometrics*, New York: Academic Press (pp. 105 - 142).
- [39] Mitchell, R.C. & Carson, R.T. (1989). *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Washington D.C.: Resources for the Future.
- [40] Morey, E.R. & Rossmann, K.G. (2003). Using stated-preference questions to investigate variations in willingness to pay for preserving marble monuments: classic heterogeneity, random parameters, and mixture models. *Journal of Cultural Economics*, 27(4), pp. 215 - 229.
- [41] Nam Do, N.T. & Bennett, J. (2007). *Estimating Wetland Biodiversity Values: A Choice Modelling Application in Vietnam's Mekong River Delta*. Canberra: The Australian National University. (Economics and Environmental Network, Working paper series no. EEN0704).
- [42] National Water Act (NWA). (1998). *Act Number 36 of 1998*. Pretoria: Department of Water Affairs and Forestry - Government printers.
- [43] Oliver, C. (2010). *Comparing a contingent valuation of the river inflows into the Bushmans estuary with a choice experiment valuation*. Unpublished MSc dissertation. Port Elizabeth: Nelson Mandela Metropolitan University.
- [44] Opaluch, J., Grigalunas, T., Diamantides, J., Mazzotta, M. & Johnston, R. (1999). *Recreational and Resource Non-market Values for the Peconic Estuary System*. Peacedale, RI: Economic Analysis Inc.
- [45] Smyth, R.L., Watzin, M.C. & Manning, R.E. (2009). Investigating stakeholder preferences for managing Lake Champlain using a choice experiment. *Journal of Environmental Management*, 90(1), pp. 615 - 623.
- [46] South African Reserve Bank (SARB). (2013). Quarterly Bulletin, No. 267. Pretoria: South African Reserve Bank.
- [47] Suh, J. (2001). *An economic evaluation of environmental recovery of the skier-dominated area in the Mount Togyu National Park in South Korea*. Unpublished PhD thesis. Queensland: The University of Queensland.
- [48] Thurstone, L. (1927). A law of comparative judgement. *Psychological Review*, 34, pp. 273 - 286.



- [49] Train, K.E. (1998). Recreation demand models with taste differences over people. *Land Economics*, 74, pp. 230 – 239.
- [50] Train, K.E. (2003). *Discrete choice methods with simulation*. Cambridge: Cambridge University Press.
- [51] Turpie, J.K. & Joubert, A. (2001). Estimating potential impacts of a change in river quality on the tourism value of Kruger National Park: An application of travel cost, contingent and conjoint valuation methods. *Water South Africa*, 27(3), pp. 387 – 398.
- [52] Unit for Integrated Environmental and Coastal Management (IECM). (2010). *Regional Estuarine Management Programme: Sundays River Management Plan*. Port Elizabeth: Nelson Mandela Metropolitan University.
- [53] Vickey, N. (2003). *Understanding and Providing Public Access to Connecticut's Coast*. Report prepared by School of Forestry and Environmental Studies, Yale University.
- [54] Windle, J. & Rolfe, J. (2004). *Assessing Values for Estuary Protection with Choice Modelling using different Payment Mechanisms*. Paper presented at the 48<sup>th</sup> Annual Conference of the Australian Agricultural and Resource Economics Society: Melbourne, Australia.

**TABLE 1: The CE attributes and their levels**

<b>Indicator/attribute</b>	<b>Levels</b>	<b>Description of levels</b>
Physical size of fish stocks caught	Mostly small fish now	Catch and retain whatever fish species you want 'today'
	None now but bigger and more fish next year	Keep no undersize fish now but more and bigger fish next year
Congestion	Hear and see few boats	The recreational user sees and hears a few boats
	Hear and see many boats	The recreational user sees and hears many boats
More public access	Yes	Establish a path access along the banks of the estuary
	No	Do not establish a path access along the banks of the estuary
Cost	R0	A fixed annual sum added to the existing boat license fee. This added sum will be directed back to the Sundays River fishery as a fishery quality levy
	R45	
	R90	
	R120	

*Source: Authors*

**TABLE 2: Estimation results of the CE**

Variables	CL		HEV		RPL	
	Coeff.	Std err.	Coeff.	Std err.	Coeff.	Std err.
Physical Size of Fish	1.59225259**	.14157877	1.79113653**	.23779355	1.95816676**	.53555192
Congestion	-.34136177**	.13044418	-.40008933*	.15818898	-.39402824*	.15836246
Public Access	.34253510**	.12461801	.39809588**	.15093428	.38157738**	.14429206
Cost <sup>1</sup>	-.01033063**	.00144555	-.01192456**	.00214754	-.01126248**	.00194773
<b>Standard deviation of random parameters</b>						
Physical Size of Fish					1.18863441	.97650395
Congestion					.28761409	.69802099
Public Access					.18711344	1.08321161
No. of Respondents	175		175		175	
No. of Choice Sets	700		700		700	
Pseudo R <sup>2</sup>	.22091		.2394251		.2386784	

**Source:** Results from statistical analysis

\*indicates that parameter is statistically significant at the 5% level. \*\* indicates significance at the 1% level

1. Cost was specified as a non-random parameter in the RPL.

**TABLE 3: Marginal WTP (MWTP) for attributes (Rands)**

Attribute	Marginal WTP value
Physical Size of Fish Stock	174 (95; 253)
Congestion	-35 (-62; -8)
Public Access	34 (8; 59)

**Source:** Authors

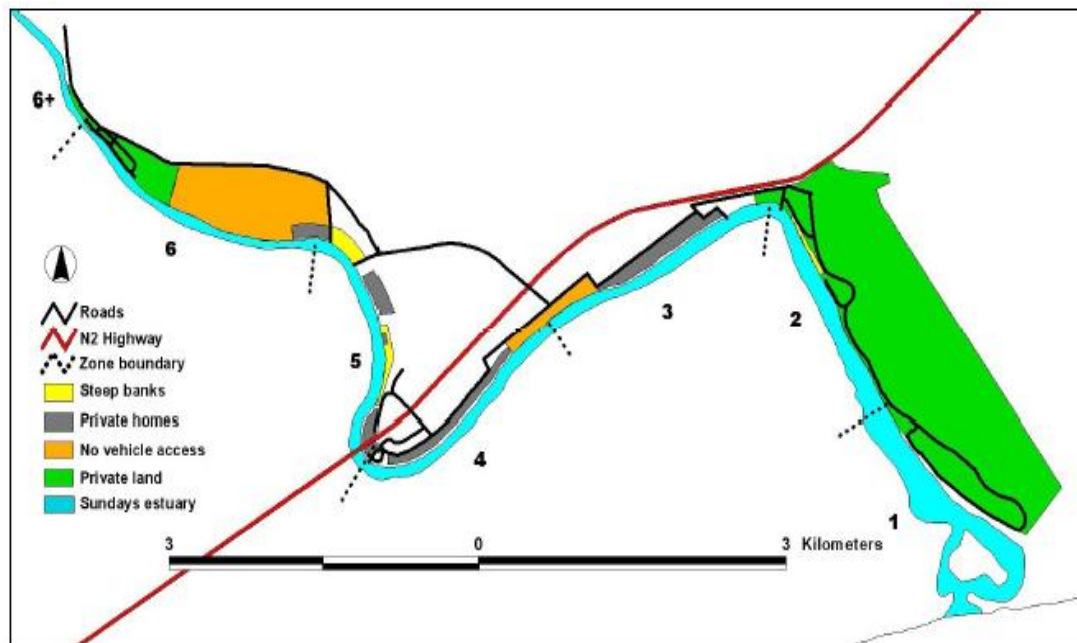
\* 95% confidence intervals in parentheses.

**FIGURE 1: The Sundays River Estuary**



*Source: Baird (2002)*

**FIGURE 2: Spatial zones of the Sundays River Estuary**



*Source: Cowley et al. (2009)*

**FIGURE 3: Sample choice set**

<b>Attribute</b>	<b>Option A</b>	<b>Option B</b>
Physical size of fish stocks caught	Mostly small fish now	None now but bigger and more fish next year
Congestion	Hear and see few boats	Hear and see few boats
More public access	Yes	No
Cost to you(R)	R45	R0
<b>I would choose (TICK ONE BOX ONLY):</b>		√

*Source: Authors*