A Recreational Valuation of the Freshwater Inflows into the Keurbooms Estuary by means of a Contingent Valuation Study[1]

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ABSTRACT

This paper reports on a contingent valuation made of the freshwater inflow into the Keurbooms Estuary near Plettenberg Bay, South Africa, in April 2001. The value of this water was estimated in terms of the services yielded to recreation users of the estuary, to be between R0,012/m^3 and R0,046/m^3. This value is currently lower than what farmers are willing to pay for the water in this area, as measured by the income *capitalisation* method, namely R0,125/m^3, but may increase in the future as more and more South African estuaries are undermined through upstream river water abstraction, and recreational substitutes are diminished. A willingness-to-pay function was also estimated and show annual levies paid and investment in goods to access the estuary services to be important determinants of willingness-to-pay.

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1   INTRODUCTION

The water of the Keurbooms River near the Southern Cape town of Plettenberg Bay, South Africa, is demanded both for use in the town and in the estuary, where its inflow is needed to preserve environmental services used for recreation. The estuary (Fig. 1) derives its freshwater supplies through inflows from the Keurbooms and Bitou rivers (Hosking *et al.*, 2002). These inflows are determined by many factors; two important management ones being discretionary dam water releases and the actions of the Working for Water Programme (an alien vegetation clearing programme) in the upper reaches of the catchments of these rivers. At the current rate of freshwater inflows the estuary mouth is kept open, but it is alleged by scientific reports on estuaries along this part of the South African coast (Wooldridge, 2000) that decreases of freshwater inflows below this rate would cause the mouth to choke with sediment leading to a reduced tidal prism – water flows in and out of the mouth. Reduced freshwater inflows and the sand movement around the mouth, created by waves and longshore drift, can lead to complete

mouth closure within days. Mouth closure tends to occur for long periods of time (i.e. for the bulk of the year).

For the duration of the closure of the estuary mouth the following negative ecological impacts would occur:

- the disappearance of foraging birds in the intertidal areas;
- a reduction in the total area available for boating around the mouth of the estuary (below the bridge on the N2) due to a drop in water level and shallowing of the lower estuary;
- a reduction in availability of mudprawn, which is the major bait organism for fishers, of 25 per cent per annum, with a total loss after 4 years of the 70 million mudprawn currently available;
- a reduction in estuary fish availability (for example, spotted grunter and dusky cob) for recreational angling because no regeneration would take place;
- the total loss of migratory fish in the estuary (those that move between the estuary and the ocean), such as garrick (leervis) and shad (elf), for recreational fishing;
- a reduction in water frontage space along the banks of the estuary and exposure of large expanses of sand and mud;
- an increase in decaying aquatic vegetation (weedbeds) due to exposure;
- a total loss of fishing habitat in the mouth channel of the estuary for shore based and/or boat fishing; and
- a total loss of marine fish species that use the estuary as a nursery area (Bennet, 1989; Blaber & Whitfield, 1976; Huizinga & Slinger, 1996; Reddering, 1988; Whitfield, 1989; Whitfield & Kok, 1992; Wooldridge, 2000).

As a result of these negative ecological impacts, negative economic impacts occur. Wooldridge (2000) maintains that the degree of confidence regarding the occurrence of the ecological impacts upon mouth closure is 100 per cent. These negative ecological impacts also have negative economic consequences. The residential and holiday recreational attractiveness of the Plettenberg Bay area would be reduced, and this is the point on which this paper sought to make a contribution.

The contribution is in the form of deriving a measure of this reduction in recreational value in Rand using the contingent valuation method (CVM)[2]. The CVM was applied by administering willingness-to-pay questionnaires to 150 selected respondents in the area during April 2001. This number contributed about 5 per cent of the sample population. Given the smallness of the sample size the

potential for error exists in the results. The respondents were asked what they were prepared to pay for a project that would maintain the freshwater inflows at their current level so as to prevent the negative ecological impacts (listed above) consequent upon closure of the Keurbooms Estuary mouth.

2   APPLYING THE THEORY OF CVM TO THE KEURBOOMS

As a consequence of reduced freshwater inflows into the Keurbooms Estuary and increasing consumption demand for water in the Plettenberg Bay area, at some point (in the near future) the mouth of the Keurbooms Estuary will close. When this happens a whole range of environmental services on which recreation is dependent will be negatively affected (as listed above).

The hypothesis of this study is that the people who use these services are prepared to pay to prevent these negative impacts from occurring, or would be prepared to accept compensation if it did occur, which would leave them as well off as they were before the closure.

Figure 1 The Keurbooms and Bitou estuaries
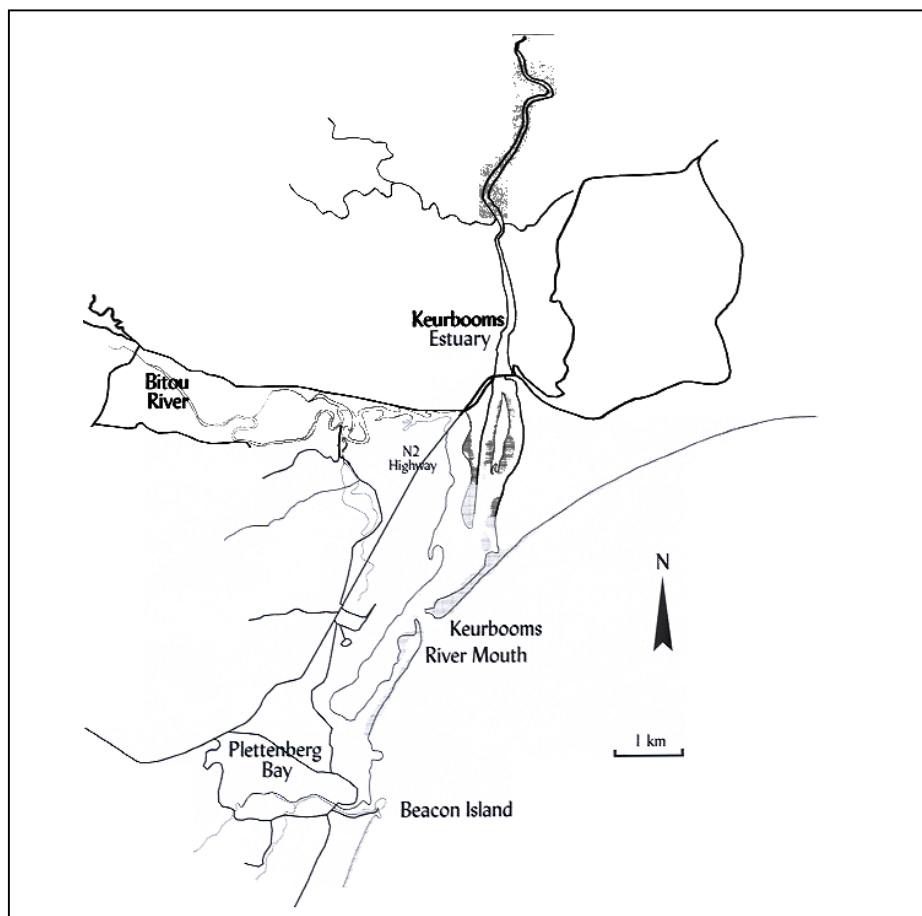
These people include those people who currently use the Keurbooms Estuary, those people who value it for their children, those people who value it simply as an option for them to use in the future, and those people who value it simply because it is there. Respondents were asked to value the increment of freshwater flowing into the estuary in terms of the recreational value it yields in the estuary. If this water was instead abstracted from the river it could be used for consumptive purposes in the town of Plettenberg Bay.

The value of these services can be determined from responses of the affected people to questions of what they were willing to pay to prevent the loss of these services or what they would be willing to accept to compensate them for the loss (Hanemann, 1999). These questions usually elicit responses of different magnitudes with stated willingness-to-accept typically exceeding actual willingness-to-pay. This paper applied the more conservative willingness-to-pay approach, and deemed the average willingness-to-pay to be the price of the river freshwater inflows into the Keurbooms Estuary.

3   RESEARCH DESIGN

Contingent valuation method is a survey technique that is used to place monetary values on products and services for which market prices do not exist or do not reflect the real value of the good/service (Tietenberg, 2000). Respondents are presented with hypothetical scenarios and asked questions about the amount of money they would be prepared to spend to make them become reality. The values that are derived are "contingent" upon the realisation of the scenarios (Hanley and Spash, 1993). Ciriacy-Wantrup (1952) was one of the first proponents of CVM. Davis (1963) used CVM to derive the recreational value of woodlands in the United States of America. It has been refined both theoretically and empirically during the 1970s, 1980s, and even in the 1990s, mainly in the United States of America, where it has been most frequently employed to generate values for environmental amenities (e.g. sport fishing) and public goods (e.g. national parks). Some skepticism has been expressed regarding the usefulness of CVM in a developing country context (Dixon & Sherman, 1990). According to Whittington (1996) it was believed a decade ago that CVM could not be carried out in developing countries for reasons related to the overwhelming problems experienced in soliciting answers to hypothetical questions from low-income and possibly illiterate respondents. A number of studies have, however, shown that meaningful CVM studies can be applied to developing countries (Georgiou *et al.*, 1997; Whittington, 1996). Most of the CVM studies conducted in developing countries focus on issues related to water quality improvements and sanitation (see for example, Aguilar & Sterner, 1995; Griffin *et al.*, 1995; Whittington *et al.*,

1990). In South Africa this method is being increasingly applied, even in the field of water pricing (see for example, Veck & Bill, 2000; Turpie & Joubert, 2000).

3.1   Population and sample

The first step taken in this contingent valuation of the Keurbooms Estuary was to determine the sampling frame and select a representative sample from it.

The first problem that was encountered in this connection was who to include in the sample frame as non-current-users, i.e. people who value the estuary for bequest, option or existence reasons. We were unable to identify this population and so omitted this category of demanders of the estuary services. For this reason the sample frame was deemed to consist only of users[3] of the Keurbooms Estuary in the Plettenberg Bay area during the year 2001. These people were determined through consultation with local authorities and the conducting of pilot studies on the users of the estuary. The following institutions were used to identify the sample frame: the angling club, the bird-watching club, town planning department, hotels, camp sites and owners of Bed and Breakfast establishments, and the Department of Nature Conservation. Following these consultations it was deduced that the total sample population was 13 250 people per annum (of residents and visitors). From these authorities it was further deduced that this sample could be roughly divided into the following sub-groups: anglers (1 800), baiters (600), swimmers (5 400), water frontage/access (490), birdwatchers (60), boaters (1 400) and scenic benefit (3 500). Most of these users were multiple users but they were allocated on the basis of what their main use was expected to be. For instance, most of the 600 baiters were also anglers, but because they spent more time collecting bait than fishing they were stratified as baiters. Assuming average size households of four people the total sample size translates into about 3 312 households.

The average number of anglers and bait collectors using the Keurbooms Estuary per annum was estimated from information supplied by the nature conservation authority on the number of licenses issued per annum. Angling and bait collecting is subject to strict control measures. The average number of swimmers and boaters making use of the estuary per annum was also obtained from the nature conservation authority who strictly control access to the estuary. Boaters require a license to use the estuary. The number of birdwatchers using the Keurbooms Estuary per annum was determined by reference to the birdwatchers registered with the bird-watching club in Plettenberg Bay. The number of people owning water frontage space with direct access to the estuary was determined in consultation with the town planning department of Plettenberg Bay. The number of people deriving a scenic benefit per annum from the estuary was determined by estimating

the proportion of the town's population which enjoyed direct view benefits. This analysis was also done in conjunction with the town planning department.

In order to select a sample of people to be interviewed from this sample frame a stratified sampling technique was used. Five strata of users were utilised, namely, fishermen, boaters, swimmers/bathers, water frontage owners and others (for example bird-watchers). Proportionate sampling was used whereby the size of the sample drawn for each stratum was proportionate to the relative size of that stratum in the total population. The proportional allocation formula was as follows:

$$n_h = \frac{nN_h}{N} \tag{1}$$

where: n_h =   sample size for stratum h
        n =   size of total sample drawn
        N_h =   size of stratum population
        N =   size of total sample population.

Proportional allocation assumes that the strata are independent.

In total 150 people out of the sample frame of 13 250 were interviewed (about 1 per cent). A cost efficient sampling design is a crucial step in applying the CVM. There are various aspects to consider in this connection. The sample should be randomly selected and administered at a time which reduces the potential for biases. Moreover, the size of the sample selected should be as great as the research budget allows (Choe *et al.*, 1999). The above objectives were pursued in the following ways. April 2001 was selected in order to obtain a mix of vacation and permanent resident users, respondents were randomly approached and the budget allowed 150 people to be surveyed (a 5 per cent sample size). Personal interviews are expensive and time-consuming, but they do allow for more complicated scenarios to be explained and this was indeed needed. Conveying information over the telephone is difficult due to time constraints, but it is relatively inexpensive. Mail surveys tend to suffer from a non-response bias and low response rates, but these surveys do have the advantage that they avoid interviewer bias (Mitchell and Carson, 1989).

3.2 The Questionnaire

(i) *The willingness-to-pay question*
The main purpose of the questionnaire was to ask users of the Keurbooms Estuary what they were willing to pay for a project that would maintain the freshwater inflows into the Keurbooms Estuary at their current levels. The maintenance of

freshwater inflows wouldprevent closure of the Keurbooms mouth. In turn this would prevent the negative ecological (see as described earlier) and recreation function impacts from occurring. This question corresponded to a potential future event (mouth closure) and not one that had already occurred. The willingness-to-pay amounts were elicited by means of a payment card approach whereby respondents were asked to circle the value that represents their maximum willingness-to-pay for the project in question, given a range of numbers listed on the survey form. The listed range of numbers were chosen in accordance with the typical expenditure by respondents on other publicly provided services as suggested by Hanley and Spash (1993). This elicitation mechanism is preferred because it is not subject to starting-point biases (Hanley & Spash, 1993).

An important part of the willingness-to-pay approach is the bid or payment vehicle (how the funds to make the payment were raised). The respondents were informed that this would take the form of a levy collected from all users who derive benefit directly or indirectly, e.g. by providing visitors access to the Keurbooms Estuary.

An important bias that can occur when applying the willingness-to-pay approach is the mental account bias, that is mental error in calculating what the person would be willing to pay (Hanley & Spash, 1993). In order to reduce it, respondents were reminded by the enumerator of their budget constraints – that spending for this good/service necessarily meant a reduction in other kinds of goods/services that could be purchased. They were asked what they would sacrifice in order to make this payment.

In a further attempt to reduce mental account bias, respondents were also made aware of possible substitutes for the good/service that they were valuing. The intention of the substitutes question was to sensitise the respondents to the fact that there were alternatives to the Keurbooms Estuary in the area and they should take this into account when deciding what they are willing to pay. The respondents were asked how they would go about satisfying their demand for the services provided by the Keurbooms Estuary if the Keurbooms mouth were to close and if they were to lose the availability of its services. The alternatives cited were the Wilderness, Knysna Lagoon, Jeffreys Bay and St Francis Bay.

An important component of a contingent valuation survey is the respondents' knowledge about the service they are valuing. The respondents' prior knowledge of the ecological function of the Keurbooms Estuary was tested by asking them what they thought would happen if no fresh water was allowed to flow into the Keurbooms Estuary and the mouth closed. To assist the enumerator the following list of impacts was provided:

- A significant shrinkage in the total area of estuary available for boating and other activities;
- A reduction/total loss of bait for fishermen, especially prawn;
- A reduction in fish available to be caught in the estuary and off shore, including estuary fish species (like spotted grunter and dusky cob) and migratory species (like garrick and shad);
- An increase in smelly decaying aquatic vegetation (exposed due to lower water levels);
- A total loss of foraging birds in the intertidal area around the estuary;
- A less attractive estuary and mouth shoreline (mud flats where water receded); and
- Increased potential for flooding of low lying properties near the Keurbooms when dams on this river overflow (because of sand bar build up at the mouth making a natural dam wall).

A respondent was judged to be well-informed if he/she was aware of three or more of the listed possible impacts, and poorly-informed if aware of less than three. The numerator explained those impacts of which the respondents were not aware. In addition to the above information the following was also conveyed to the respondents:

- The benefits of maintaining the freshwater inflow into the Keurbooms Estuary, either through the Working for Water Programme or dam water releases, would be available to all people who reside in Plettenberg Bay, or otherwise benefit from activities within the Keurbooms Estuary.
- Users of this water (residents and tourists) would be expected to make contributions towards catchment management or dam water releases. The managing authority would be the Plettenberg Bay Municipality.
- The respondents would be paying for water generated through the Working for Water Programme as natural runoff, to be released from dams in sufficient quantity to keep the mouth of the Keurbooms Estuary open.

(ii) *The factors expected to affect willingness to pay questions*
- Annual levies
  Those people paying more in levies are revealing a higher willingness-to-pay than those paying less. Accordingly it was expected that people who were paying more already would also respond that they were willing to pay more in the hypothetical case described than those who were currently paying less.
- Gender of the respondent
  We were not sure what role gender would play, if any, but were interested to see if it did.

- Location
  People living in close proximity to the Keurbooms Estuary were expected to be more disposed to making contributions than people living further away.
- Worth of owned fixed property
  People with greater wealth were expected to be more disposed to/capable of making contributions than people who own properties of lesser worth.
- Worth of vehicles and boats
  People with greater investment in access assets (to get to and use the estuary services) were expected to be more disposed to/capable of making contributions than people with lower investment in this type of asset.
- Education level of respondent
  People with more education were expected to be more aware of and sensitive to the ecological benefits for the estuary of freshwater inflows and therefore willing to pay more for them.
- Gross annual income of respondent
  People with higher gross annual incomes were expected to be capable of paying more than lower income earners simply because their budgets allowed for this.

The questionnaire was pre-tested by a team of four interviewers in a pilot study. Following this survey the questionnaire was simplified and some technical terms were replaced by those used in everyday language.

One enumerator administered the questionnaire to all 150 users selected to be interviewed during April 2001.

4   EMPIRICAL ANALYSIS AND DISCUSSION

4.1   Invalid responses

An important starting step in *analysing* responses to CVM questionnaires is to check them for validity. The two main types of responses sometimes deemed invalid and excluded are protest zeros and outliers. Protest zero bids are bids provided by respondents for reasons other than a zero value being placed on the environmental good or service which is being valued. Outliers, on the other hand, are simply very large bids.

The approach used most often to deal with invalid responses is to discard these observations (protest zeros and outliers), but this is incorrect from a statistical point of view (Carson, 1991). Protest zeros are usually determined by reference to the question why individuals were not willing to pay, where they said they were not

prepared to pay anything. Outliers are determined by the researcher on the number of standard deviations the response is away from the mean WTP.

Out of 150 responses, 25 (or 17 per cent) gave what we deemed to be invalid responses to the valuation question. As is usually the case for in-person interviews, the item non-response was zero. Responses stating that the Plettenberg Bay Municipality should pay for everything were deemed by us to be protest responses. They made up about 92 per cent of the invalid responses (23 responses). Outliers made up 8 per cent of invalid responses (2 responses). These were defined to be those willing to pay (WTP) responses that were more than 3 standard deviations above the mean willingness-to-pay.

A comparison of means of variables for respondents with invalid and valid responses to the valuation question was carried out to test for differences between the two groups. The results are shown in Table 1.

Table 1   Comparison of means of variables for respondents with invalid and valid responses to the valuation question

Variable	Mean for valid responses	Mean for invalid responses	t-statistic
Annual levies	205.67	174.50	-0.73
Distance	5.70	3.95	-1.58
Worth – fixed property	798 330	673 330	-1.24
Worth – boats/vehicles	134 380	113 330	-0.64
Income	168 210	147 000	-1.20
Number of observations	120	30	

Table 2   The Pearson Chi-Square test for independence

Variable	Independence hypothesis
Information	Rejected at 95% C.L.
Annual levies	Not rejected
Freshwater worth	Rejected at 99% C.L.
Gender	Not rejected
Distance	Not rejected
Education	Rejected at 95% C.L.
Worth – fixed property	Rejected at 95% C.L.
Worth – boats/vehicles	Not rejected
Income	Not rejected

The fact that the null hypothesis holds in the comparison of means tests suggests that there were no significant differences in terms of characteristics between those who gave valid and invalid responses. However, the Pearson Chi-Square test for independence yielded different results. This test's results are shown in Table 2.

Four of the nine variables listed in Table 2 (stating independence) were rejected in terms of the null hypotheses. In view of the results of this test it was deduced that the valid and invalid responses represented different types of respondent, and that in order to avoid the occurrence of sample selection bias, all responses should be included in calculating the mean willingness-to-pay. Sample selection bias, due to the exclusion of invalid responses, may cause one or both of the following consequences. The empirical analysis of the valuation function used to test for theoretical validity may give inconsistent parameter estimates, and the estimated benefit measures and hence the aggregated values may also be biased.

4.2   How informed the respondents were and what their attitude was toward the freshwater allocation issue

The majority of respondents were well-informed about the ecological functioning of the Keurbooms Estuary and were disposed to favour allocations of freshwater to the estuary over allocations to the residents of Plettenberg Bay for consumption. More specifically, 48 per cent of the respondents were well-informed, 44 per cent were not clear and 8 per cent were poorly informed. Only 5,3 per cent of the respondents preferred allocations of freshwater to the residents of Plettenberg Bay, whereas 79,5 per cent preferred allocations to the estuary. Approximately 15,2 per cent of the respondents preferred the current allocation levels.

4.3   Willingness-to-pay

The statistics relating to the willingness to pay are shown in Table 3 below.

Table 3   Analysis of the willingness-to-pay statistics

Variable	Popu-lation	Mean Rand	Standard deviation Rand	Min Rand	Median Rand	Max Rand	95% Lo Rand	95% Hi Rand
Willing-ness-to-pay	150	273,67	262,26	0,00	150,00	1500,00	231,35	315,98

Analysis of the willingness-to-pay statistic shows that on average the respondents in this survey were willing to pay R273,67 each for sufficient freshwater inflows to keep the mouth of the Keurbooms open.

4.4   The willingness-to-pay function

In order to better understand the determinants of the willingness-to-pay responses and test these against what would be expected, a willingness-to-pay function was estimated using Ordinary Least Squares.[4]
The function estimated took the following form:

$$Y = \sum_{i=1}^{n} \beta_i X_i + \varepsilon \qquad (2)$$

where: Y = WTP (dependent variable)
         X = vector of n explanatory variables (independent variables)
         β = vector of n parameters
         ε = disturbance term

The explanatory variables selected for this purpose have already been identified above: annual levies, gender, distance from estuary, education level, worth-fixed property, worth-boats and vehicles and income. A statistical analysis of these variables is shown in Tables 4 and 5 below.

Table 4   An analysis of the explanatory variables in the WTP function

Explanatory variables	**Classes**	**% of sample in class**
Annual levies	R	037.1%
	R 1 – 20	0.7%
	R 21 – 50	2.0%
	R 51 – 100	4.0%
	R 101 – 200	13.2%
	R 201 – 500	37.1%
	R 501 – 1 000	6.0%
	> R1 001	0%
Gender	Males	73.5%
	Females	26.5%
Distance from estuary	0 – 1 km	16.6%
	1 – 3 km	27.2%
	3 – 5 k	27.8%
	5 – 10 km	11.9%
	11 – 15 km	3.3%
	< 15 km	13.2%

Table 4 continued

Explanatory variables	Classes	% of sample in class
Education of respondents	Matric	44.7%
	Post matric	3.3%
	Diploma	18.7%
	Degree	26.7%
	Postgraduate degree	6.7%
Worth – fixed property	R 0	0%
	R1 000 – R50 000	2.0%
	R50 001 – R100 000	2.0%
	R100 001 – R200 000	3.3%
	R200 001 – R500 000	34.4%
	R500 001 – R1 000 000	30.5%
	> R1 000 000	27.8%
Worth – boats vehicles	R 0	0%
	R1 000 – R 50 000	18.5%
	R50 001 – R100 000	45.0%
	R100 001 – R200 000	24.5%
	R200 001 – R500 000	9.9%
	R500 001 – R1 000 000	1.3%
	> R1 000 000	0.7%
Income	R 0 – R 60 000	4.6%
	R60 001 – R120 000	37.1%
	R120 001 – R250 000	47.7%
	> R250 001	10.6%

Table 5   Descriptive statistics

Variable	Mean	Std Dev.	Min	Max	Median
Annual Levies	198,11	207,90	0,00	750,0	150,00
Gender	-	-	-	-	-
Distance	5,36	5,43	0,50	17,50	4,00
Education	-	-	-	-	-
Worth – fixed property	773 180	494 020	25 000	1 500 000	750 000
Worth – boats/vehicles	129 800	161 260	25 000	1 500 000	750 000
Income	164 110	86 660	60 000	375 000	185 000

The majority of respondents (i.e. 63 per cent) paid annual levies, with most paying between R101 and R500, suggesting that most of the respondents interviewed made direct use of the recreational services provided by the estuary (for boating, fishing etc.). Only 13 per cent of the respondents interviewed had residences

located more than fifteen kilometers from the estuary. About 55 per cent of the respondents had tertiary education – all of the respondents had obtained a matric certificate. The majority of the respondents (93 per cent) owned fixed property worth in excess of R200 000. About 45 per cent of the respondents owned boats and vehicles worth between R50 001 and R100 000. Only 4.6 per cent of the respondents interviewed earned less than R60 000 per annum. Almost half of the respondents (47.7 per cent) earned between R120 001 and R250 000 per annum.

The results of the estimation of the WTP function (Equation 2) are shown in Table 6.

Table 6   Estimation results of the WTP function (n = 150)

Explanatory variable	Dependent Variable Money Contribution (Rand) R^2 = 0,3441 f-stat = 8,043			
	Estimated coefficient	Std error	t-statistic	P-value
Annual levies	43,5517	25,6030	1,70	0,09
Gender	25,1839	46,3417	0,54	0,59
Distance	-13,2906	23,1979	-0,57	0,57
Education	-7,8196	39,5858	-0,20	0,84
Worth – fixed property	7,1027	38,3607	0,19	0,85
Worth – boats/vehicles	74,9987	27,2785	2,75	0,01
Income	53,2494	41,6542	1,28	0,20

The parameter estimates of several variables in the regression analysis were insignificant at 90 per cent (Table 6): gender, distance, education, worth – fixed property and income. When these insignificant predictors are eliminated and the function is re-estimated the results change to those shown in Table 7.

Table 7   Estimation of a revised willingness-to-pay function – including significant variables only (n = 150)

Explanatory variable	Dependent variable Money contribution (Rand) R^2 = 0,3213 f-stat = 23,043			
	Estimated coefficient	Std error	t-statistic	P-value
Annual levies	82.2038	20,9667	2,97	0,00
Worth – boats/vehicles	107 020	20,7103	5,17	0,00

The results shown in Table 7 indicates that those respondents who pay higher annual levies and those respondents who own boats and vehicles of higher worth are more willing to pay money to conserve the Keurbooms Estuary. These parameter signs accord with *a priori* expectations.

4.5   Two estimates of the value of freshwater inflows into the Keurbooms Estuary

In order to calculate the value (per cubic metre) of freshwater flowing into the Keurbooms Estuary the total WTP amount was divided by the minimum amount of freshwater inflows needed to keep the estuary mouth open. The latter amount of water was estimated at 78 540 000 m^3/a using expert opinion (Hosking *et al.*, 2002). The total WTP was calculated in two ways: as the product of the mean WTP per user and the total number of users and as a product of the mean WTP and the estimated number of households. These products are shown in Table 8 below.

Table 8   Average and aggregated benefit measures

Mean user WTP	Total number of users of estuary	Total WTP
R273.67	13 250	R3 626 128
Estimated number of households*		
R273.67	3 312	R906 395

* Note: Assuming four-person households.

The recreational environment value of water per m^3 was calculated as the total willingness-to-pay divided by the minimum required fresh water. Where the population is taken to be the users:

$$P_w = \frac{R3\ 626\ 128}{78\ 540\ 000\,m^3} = R0{,}046/m^3$$

Where the population is restricted to household heads:

$$P_w = \frac{R906395}{78\ 540\ 000\,m^3} = R0{,}012/m^3$$

These estimates exclude demand from non-current-users, e.g. people who we could not identify that had bequest, option and existence demand.

5   CONCLUSION

This paper applies the contingent valuation method to value the freshwater inflow into the Keurbooms in terms of the services yielded to recreation users of the estuary. The value (excluding non-current-users) of this water was estimated by reference to both the total user population and the household heads. For the former case the estimate was R0,046/m^3 and for the latter R0,012/m^3. Estimation of a willingness-to-pay function show annual levies paid and investment in access to recreation services as the major factors determining the willingness-to-pay response. Unfortunately, the potential for error exists due to the smallness in sample size (5 per cent of the sample population). Given the small sample size and the hypothetical circumstances in which contingent valuation studies are made comparisons with other values of water should be made with caution.

The values of water estimated here are lower than the value of the water for farming in this area as calculated using the income *capitalisation* method, which is 12,5c/m^3 (Hosking *et al.*, 2002). However, the values of freshwater inflow into estuaries can be expected to increase as estuary services are undermined at more and more locations in South Africa and demand for them increases.

We would encourage policy makers to endeavour to create an awareness and educate people, especially those who live in close proximity to estuaries, regarding the importance of estuaries as ecological and tourism hotspots. Furthermore, policy makers should be made aware that upstream water impacts, such as too high abstraction or insufficient dam water releases, constitute the source of a loss of value in the recreational services yielded by estuaries.

ENDNOTES

2   Other well-known resource valuation techniques, such as the travel cost method (TCM) and the hedonic pricing method (HPM), are much more difficult to target at specific negative ecological impacts such as discussed

above. Travel cost method uses total expenditure to get to an area as its value basis and hedonic pricing method uses proximity as its value basis.

3   This is a biased estimate in that non-use values were not captured in this study. Envisaged non-use benefactors would include all those people who would be prepared to pay something to preserve the Keurbooms Estuary even though they do not intend to extract any direct benefit. This group would include conservation-minded people all over the world. Amongst those groups who were not captured in our CVM were option value users, people who would wish to pay to maintain the estuary for succeeding generations and those people who attach a high value to conservation.

4   It is important to note that if R^2 values for valuation functions are less than 15 per cent the credibility of the values should be called into question (Mitchell & Carson, 1989).

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