ISSN 1444-8890

ECONOMIC THEORY, APPLICATIONS AND ISSUES

Working Paper No. 34

Changing Abundance of Elephants and Willingness to Pay for their Conservation

by

Ranjith Bandara and Clem Tisdell

December 2004

THE UNIVERSITY OF QUEENSLAND

ISSN 1444-8890
ECONOMIC THEORY, APPLICATIONS AND ISSUES
(Working Paper)

Working Paper No. 34

Changing Abundance of Elephants and Willingness to Pay for Their Conservation*

by

Ranjith Bandara[†] and Clem Tisdell[‡]

December 2004

---

* This is a substantially revised version of Working Paper No. 98 in the *Economics, Ecology and The Environment* series.

† Department of Economics, University of Colombo, P. O. Box 1490, Colombo 3, Sri Lanka; Telephone: + 94 011258266; Fax: + 94 0112502722; E-mail: rbandara@econ.cmb.ac.lk.

‡ School of Economics, The University of Queensland, Brisbane, 4072, Australia.
Email: c.tisdell@economics.uq.edu.au

WORKING PAPERS IN THE SERIES, *Economic Theory, Applications and Issues,* are published by the School of Economics, University of Queensland, 4072, Australia.

For more information write to Professor Clem Tisdell, School of Economics, University of Queensland, Brisbane 4072, Australia or email c.tisdell@economics.uq.edu.au

CHANGING ABUNDANCE OF ELEPHANTS AND WILLINGNESS TO PAY FOR THEIR CONSERVATION

Abstract

This paper explores the way in which the stated willingness to pay for the conservation of Asian elephants in Sri Lanka varies with hypothetical variations in their abundance. To do that, it relies on results from a sample of residents of Colombo. The willingness to pay function is found to be unusual. It increases at an increasing rate for hypothetical reductions in the elephant population compared to its current level (a level that makes the Asian elephant endangered) and also increases at a decreasing rate for increases in this population from its current level. Rational explanations are given for this relationship. The relationship is, however, at odds with relationships suggested in some of the literature for total economic value as a function of the abundance of a wildlife species. It is suggested that willingness to pay for conservation of a species rationally includes a strategic element and may not always measure the total economic value of a species. Nevertheless, willingness to pay is still policy relevant in such cases.

Keywords: Asian elephant, contingent valuation, Sri Lanka, total economic value, wildlife conservation, willingness to pay.

CHANGING ABUNDANCE OF ELEPHANTS AND WILLINGNESS TO PAY FOR THEIR CONSERVATION

1. Introduction

The Asian elephant (Elephas maximus) in Sri Lanka is the most prominent symbol of conservation, a 'true flagship species' (Desai, 1998). Ensuring its continued existence in the wild is supported by the majority of Sri Lankans who consider it to be a valued resource (Bandara and Tisdell, 2003). The economic value of the elephant, as for many other endangered species, resides in its varied economic, ecological and socio-cultural attributes. For example, substantial economic benefits, as estimated by Gunathilaka and Vieth (1998) and Tisdell and Bandara (2003), are obtained from the elephant-based tourism and recreational activities. Ecologically, elephants are dominant herbivores and exert a profound impact on the other wild species and plants in the areas where they dwell (Sukumar, 1989). From socio-cultural and religious perspective, De Silva (1998) describes the elephant as an important icon in many countries in Asia. Recently, Bandara and Tisdell (forthcoming) used the total economic valuation framework to assess the relative importance of the economic values of the elephant. They found that the majority of the surveyed respondents gave most weight to the non-use values of the elephant.

Similar results have been found by others for other species. For example, Langford et al. (2001) claim that people mostly choose to pay for conservation of endangered species to secure its existence primarily because it ensures a variety of subsidiary benefits for themselves and also for future generations. On the other hand, Kotchen and Reiling (2000) believe that desires to conserve some endangered species are mostly associated with the people's ethical motivation rather than their socio-economic interests. These authors also note that stronger pro-environmental attitudes by respondents usually yield significantly higher probabilities of responding 'yes' to contingent valuation questions supporting conservation of species.

Bulte and Van Kooten (2002) summarise the findings of the contingent valuation analyses of the African elephant (Loxodonta africana), and concluded that the bulk of these studies are directed at determining the willingness to pay (WTP) for conserving the current population of this species. Analyses undertaken on the Asian elephant are similarly focused (e.g., Bandara and Tisdell, 2004). However, none of these analyses of either the African or Asian elephant have examined how changes in the elephant population (their abundance) might influence the people's WTP for the conservation of this species.

The aim of this paper is to determine how the WTP for conservation of the Asian elephant varies with hypothetical alterations in the population of elephants. It also considers how well WTP reflects the total economic value (TEV) of this species in relation to variations in its abundance.

The analyses in this paper are based on data gathered from a contingent valuation survey of a sample of urban residents chosen form three housing schemes in Colombo, the capital of Sri Lanka. This survey was primarily undertaken to elicit their WTP for the conservation of current wild elephant population (CWEP) in Sri Lanka. However, it also assessed the possible impact on the initial WTP amounts that the respondents agreed to pay for the conservation of CWEP for six different hypothetical population scenarios namely (an increase/decrease in elephant populations compared to CWEP by 25%, 50% and 75%).
After reviewing relevant literature on non-market valuation of endangered species, this paper outlines the nature of the survey sample and the methods and materials used in the data collection process. The WTP elicitation procedure adopted in obtaining responses to the proposed hypothetical changes in CWEP in Sri Lanka are then reported together with results and followed by analysis and discussion of the results.

2. Changes in population density and economic value of conserving endangered species: a review of the literature

The economics of conserving endangered wildlife species has received significant attention over the last few decades (see Bulte and Kooten, 2002; Tisdell, 2002). During this period, several non-market valuation techniques have been developed and much experimentation has been completed on their capability of estimating the TEV of conserving species (e.g., Kotchen and Reiling, 2000; Langford et al. 2001). Carson et al. (2001) and Bateman et al. (2002) provide a useful discussion about stated-preference techniques and their application to the estimation of TEV. However, except for the work of authors such as Whitehead (1993); Loomis and Larson (1994); Fredman (1995); Fisher (1996); and Tisdell and Wilson (2002) there has been little systematic discussion of how changes in the population density of endangered species might influence people's WTP contribution for their conservation.

Whitehead (1993) explores the theoretical validity of the CVM in estimating TEV under conditions of uncertainty about the population density of loggerhead sea turtles in coastal North Carolina. He found that the results were consistent with those predicted by the basic principles of consumer demand theory. The analysis by Loomis and Larson (1994) consider two hypothetical increases (i.e. 50 and 100%) in the current gray whale population along the California coast to assess the consistency of respondents' WTP for conserving this species. They conclude that carefully performed contingent valuation studies yield results consistent with principles of demand theory for reasonably large changes in the quantity of a public good. After studying the responses from a survey of visitors to Mon Repos turtle rookery in Bundaberg, Australia, Tisdell and Wilson (2002) noted that demand to engage in turtle-watching could decline with a decreased population of turtles on the beach. Thus, unless the visiting turtle population is saved early enough from significant collapse, both tourist numbers and the public support for turtle conservation could diminish. None the less, they did not rule out the opposite possibility that in some cases, a reduced population of a species might result in increased social support for its conservation (p. 1535).
Fredman (1995) outlines a specific theory of the relationship between the total value that an individual or household might place on a species in relation to its abundance. He tests this for hypothetical population densities of the white-backed woodpecker (Dendrocopos leucotos) in Sweden.

According to Fredman, the TEV of a wildlife species is equal to:

$$TEV = EXV + ONUV + UV \qquad (1)$$

where the EXV is its the existence value, ONUV is the remainder of its non-use value (that is, for other than its existence value), and UV is its use value. Moreover, TEV is considered to be a function of the population density (Z) of the species and is assumed to have the following form where the terms in equations (2) and (3) correspond to those in equation (1):

$$TEV = F(Z) + g(Z) + h(Z) \quad (2)$$

$$= a + g(Z) + h(Z) \quad (3)$$

and ‘a’ is a positive constant for $Z \geq MVP$ and zero for $Z < MVP$. Equation (3) implies that the existence value of a wildlife species is independent of its population for all $Z \geq MVP$, where MVP represents the minimum viable population of the species. Whether or not existence value is always a constant of the type suggested by Fredman is contentious. For example, in their empirical study Rollins and Lyke (1998) found increasing valuation of remote wilderness parks in Canada as their area rose, and their existence valuation increased at a decreasing rate with their total area.

Figure 1 presents the nature of the relationships that Fredman (1995) hypothesised between the value components of the TEV of a wildlife species and its population density. He assumed that the species would become extinct if $Z < MVP$, but will survive if $Z \geq MVP$. Existence value disappears if $Z < MVP$. Extinction also implies no UV and no ONUV is obtained. His diagram indicates that $g'>0$ and $g''<0$, that is, that ONUV rises at a decreasing rate. However, he does not say why that is so. Maybe it is a consequence of the altruistic motive. In relation to the use-value component, one might expect diminishing marginal utility as the population density of the species increases. This would imply that $h'>0$ and $h''<0$. Therefore the difference between the top line and the second line down in Figure 1 should increase with Z. The constant difference seems to involve an oversight in Fredman’s diagram.

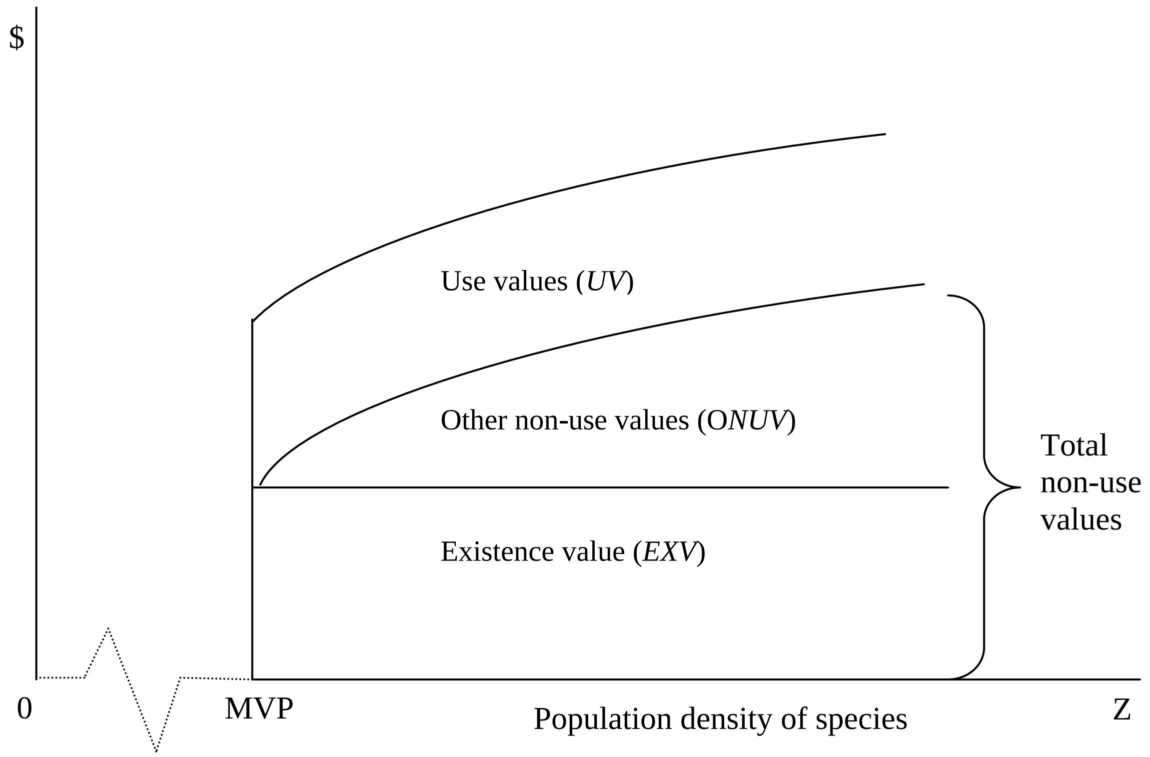

Figure 1: Value components of a wildlife species as a function of its population densi according to Fredman
(Source; Based on Fredman, 1995, p. 311)

Fredman conducted a survey in Sweden to test his theory that existence value of a species is independent of its population density. He asked respondents what they would be willing to pay as a one-off payment to support measures that will maintain the population of white-backed woodpeckers at the same level as today. That is at its current endangered population level. This is presumably in the neighbourhood of MVP. Secondly, respondents were asked what would they pay as a one-off contribution for measures that would increase the population of white-backed woodpeckers so that the species would be classified as common rather than endangered.

He concludes from his results that there is 'empirical evidence of a positive willingness to pay in order to save this particular species, and a non-positive willingness to pay for an increased population density above the minimum viable' (Fredman, 1995, p.324). For most individuals it seemed that WTP was constant but for some it declined as the population density of the species increased. Alternatively, for the latter group, it could be said that their WTP rose as hypothetical population density of the species declined. Consequently, overall

WTP for existence of this species seemed to increase as the hypothetical population density of it was reduced, and vice versa. This was certainly true for one category of respondents. As will be observed later, there are some parallels between this case and our empirical results for WTP for the conservation of the Asian elephant. Before turning to this study, let us note a few possible limitations of Fredman's Figure 1.

It indicates that use value is positive at MVP. It may, however, be zero and already have fallen to zero for a value greater than MVP. Again, there seems no logical reason why NUV would necessarily be equal to zero at MVP. It could be positive.

In reality, MVP may be a fiction – a biologically safe minimum population of a species may not exist (Hohl and Tisdell, 1993) although it is used by Ciriacy-Wantrup, (1968); Bishop, (1978); Ready and Bishop, (1991). Furthermore, if it does exist, it can differ from the socially safe minimum standard (Seidl and Tisdell, 2001). These matters should be given greater consideration.

In considering the WTP of Sri Lankans for different degrees of abundance of the Asian elephant in Sri Lanka, we do not use the MVP concept. However, it is an underlying assumption of the analysis that as the population of elephants in Sri Lanka is reduced the probability of their extinction increases. With this background in mind, let us consider the present study.

3. Sample, data source, and collection procedure

The data presented in this analysis were collected as part of a contingent valuation survey of a sample of 300 urban residents in three selected housing schemes (i.e. Jayanthipura, Jayawadanagam, and Anderson Flats) in Colombo, the capital of Sri Lanka. The Urban Development Authority of Sri Lanka (2001) classifies these schemes into three broad categories of income earners i.e. high, middle and low. This classification is based on the value of the property and other urban facilities in the area where these housing estates are located i.e. public schooling, shopping centres and recreational sites. A hundred residents from each of these housing schemes were randomly chosen as the sample. A stratified sampling procedure was adopted in selecting this sample. This procedure helps to identify the perception of different social segments in the urban population in Sri Lanka. Checks with the

Sri Lankan 2001 Census results showed that the sample was representative of the urban population of Sri Lanka in relation to the main socio-economic variables.

An interview schedule (IS) consisting of five separate sections was used in gathering information from the urban sample. Section one contained the personal profile of the respondent, and was designed not only to gain information about the respondent's social, economic and demographic characteristics but also to establish conversational rapport. Section two assessed the attitudes of the respondents on 'development' and 'environment'. Section three contained questions designed to assess respondents' awareness of the elephant-related issues in Sri Lanka and attitudes towards conserving elephants in their natural state. Section four presented the contingent market valuation questions used to elicit willingness to pay (WTP) for conservation of the elephant and preferred method of payment and the motivation for contribution by the respondents. This section also included a set of alternative willingness to pay questions to determine how the WTP for conservation of the elephant varies with hypothetical variations in the population of elephants. Section five presented alternative contingent market valuation questions to elicit respondents' willingness to pay for establishing an insurance/compensation scheme to compensate farmers for the economic damage caused by elephants.

In administrating the IS, face-to-face surveys were conducted in Sinhala, a major language in Sri Lanka. FAO (2000) states that most contingent valuation studies in developing countries have relied on this direct approach. Hadker et al. (1997) consider this method to be more effective than mailed questionnaire and telephone surveys in the developing countries.

Hadker et al. (1997) consider this method to be more effective than mailed questionnaire and telephone surveys for a developing country like Sri Lanka. This may be because telephone surveys would bias the sample towards the upper-middle and higher income brackets. Furthermore, face-to-face surveys have the advantage that trained interviewers can actually interact with respondents, and can clarify respondents' doubts, thereby minimising non-response rates. On the other hand, it must be noted they have the disadvantage that questions must be short and uncomplicated if the understanding and attention of the respondents are to be maintained. Some pre-testing was also done before the questionnaire was finalised. Virtually all of those approached agreed to participate and the response rate was 94 per cent.

4. Contingent valuation procedure and the nature of the questions asked

A hypothetical market was established to assess the respondents' WTP to conserve the CWEP in Sri Lanka and also to assess the impact of the hypothetical changes in the elephant population on the initial WTP amounts that respondents agreed to pay for the elephant conservation. In this process, the respondents were informed that the elephant population in Sri Lanka has been in decline since the mid-nineteenth century. As a result, IUCN (2000) has declared the Asian elephant in Sri Lanka to be an endangered species. At present, on average about 100 elephants die every year in Sri Lanka because of their interference with agriculture (Bandara and Tisdell, 2002). Today most estimates place the size of Sri Lanka's present elephant population at between 3,000-5,000 elephants (De Silva, 1998). The majority of this population consists of scattered small groups of less than 50 animals the survival of which are not genetically viable in the long run (Desai, 1998).

Respondents were then asked to assume that an autonomous body, reputed for its efficient and honest work, would introduce an appropriate programme so that the current downward trend in the elephant population could be halted while addressing other elephant related issues. Respondents were then briefed on the details of the policies and strategies that this organisation intended to implement to encourage farmers in the unprotected areas to tolerate the presence of elephants on their private land. An appropriate programme would be undertaken to compensate farmers for the damage caused by elephants in order to encourage them to allow elephants some access to their crops for food and reduce the likelihood of farmers' killing these animals.

Simultaneously, suitable programs would also be undertaken for the provision of extra protection around existing national parks, translocation and domestication of troublesome elephants, the establishment of recreation centers and the promotion of the elephant based eco-tourism. Finally, the respondents were informed about the possible benefits that they would be able to obtain after the successful implementation of this programme.

In this process, we adopted non-obligatory, specific voluntary contribution mechanisms (VCM) to determine the survey respondents' likely contributions to the proposed trust fund. A number of recent contingent valuation studies, for example, Champ et al. (1997), Chilton and Hutchinson (1999) have used this mechanism to motivate respondents to tell the truth.

After a contingent valuation market was established, the survey respondents were presented the initial WTP elicitation question. They were asked: For the next five years, would you be willing to pay Rs X from the monthly income of your household that is Rs X per year, starting from January 1st 2002, towards the establishment of the proposed trust fund to implement the above mentioned programme to conserve the elephants in Sri Lanka?” The dichotomous choice format with a set of optional follow-up questions was used as a WTP elicitation technique. In this format, the initial WTP elicitation question is presented with the highest bid value in the bid vector. The follow-up question is conditional on the respondent’s response to the bid value offered in the initial question: the amount offered is lower if the response is ‘no’. This process is continued by reducing the bid value offered on each occasion, if the respondent’s response is ‘no’, until the lowest bid value in the bid list is reached. This format was initially proposed by Hanemann et al. (1991). FAO (2000) reports that, this method has become a widely used elicitation format, particularly in developing countries (see Bandara and Tisdell, 2004 for example). Whittington (1998), and Bateman and Wills (1999) discuss its significance in the context of developing countries and Bateman et al. (2001) provide a useful review of the recent studies based on this format.

It should be noted that although at first glance the approach used in the present study to elicit respondent’s WTP amounts may appear to be an ‘iterative bidding approach’ (cf. Whitehead, 2002), closer analysis shows that these two approaches differ. In the iterative bidding approach, the WTP elicitation starts by querying individuals using some initial randomly chosen dollar value, and then varying the value until the respondent accepts to pay an exact amount. This final dollar amount is interpreted as the respondents’ WTP. However, FAO (2000, p.5) claims that this approach has been virtually abandoned because it results in starting point bias. Another significant disadvantage of this approach is that repeated questioning may annoy or tire respondents, causing them to say ‘yes’ or no’ to a stated amount in the hope of terminating the interview (Welsh and Poe, 1998). In contrast, an upper bounded dichotomous format with follow-up questions is used in the present study. It does not determine WTP directly for most respondents; instead it forms broad intervals around the most respondents’ WTP amount.

Nonetheless, in the present study, a bid vector with five different bid values (i.e. Rupees 500, 250, 100, 50, and 25) was offered to elicit the survey respondents’ likely WTP contribution for the proposed scheme. Note. One US$ was equal to one hundred and two Sri Lankan

Rupees on 20 September 2004. The initial WTP elicitation question is presented with the highest bid value in the bid vector i.e. Rs. 500. As mentioned earlier, the follow-up question is conditional on the respondent's response to the bid value offered in the initial question. The questioning process was continued by reducing the bid value offered on each occasion when the respondent's response is 'no', until the lowest bid value in the bid list is reached.

The respondents who responded positively to the initial contingent valuation questions were presented with a follow-up question: If the number of elephants inside and outside the protected areas in the country was X percentage below/above the current level, would this change (i.e. increase, decrease or remain unchanged) your WTP amount? This question was repeated six times in relation to three different hypothetical population scenarios (i.e. 25%, 50% and 75%) below/above the CWEP. Respondents answers to this question were recoded as 'I would increase the initially agreed WTP amount' (coded as 2), 'I would decrease the initially agreed WTP amount' (coded as 1), or I would not change the initially agreed WTP amount' (coded as 0). On each of these occasions, the respondents who answered these questions either positively or negatively were also asked to indicate the change that they would wish to make as a percentage of their initially agreed WTP amount. Respondents' changes for five separate percentage variations: (i.e. 10%, 25%, 50%, 75%, or 100%) were recorded.

5. Dealing with possible biases

Given the presence of numerous biases associated with contingent valuation studies, it is necessary to either control for them in the survey procedure itself, or at the subsequent analytical stage. However, in many cases, the biases can be econometrically removed if they have been captured by a proxy variable (see Kanninen, 1995; Bateman et al. 2002). In the present study, the bid value, the rupee value obtained from the initial WTP questions used to elicit respondents' WTP contribution for the conservation of CWEP was highly significant. This implies that estimated mean WTP may be influenced in the elicitation process by the bid values offered in optional follow-up questions. Thus anchoring effects, also known as starting point bias, could be present. However, in this study, respondents were given seven separate opportunities to decide their WTP amount. In addition to this procedure, in order to remove this effect further, in the subsequent estimates of mean WTP, we removed the insignificant bids (bid values of less than Rs.25) and 'protest' responses by setting their WTP contribution equal to zero.

Furthermore, the hypothetical population levels presented with the alternative WTP questions to assess possible impact on the WTP of respondents could involve hypothetical bias. This is because respondents surveyed may have found it hard to imagine what large percentage changes in the population of the elephant would imply. However, in this study, prior to the contingent valuation questions being offered the respondents, they were presented with information about the current size of the elephant population in Sri Lanka. Moreover, the information gathered on level of education of the respondents reveals that 99.3% of the sampled respondents are literate, and 90% of the respondents had at least 10 years of formal schooling. Furthermore, about 17% of the sample had obtained a Bachelor's degree or higher and 31% had completed their education to the Diploma level. These findings are quite consistent with the national averages of the level of education of the urban population in Sri Lanka (see Department of Census and Statistics of Sri Lanka, 2002). Thus, many of the respondents may not have had great difficulties in understanding the hypothetical changes proposed in the CWEP. Furthermore, knowing the exact magnitudes is not very important in this context because only large percentage changes in the elephant population are considered.

Several other biases in valuation can also occur when using the contingent valuation method (Venkatachalam, 2004) has recently provided a comprehensive review of these. In the context of the current study, the embedding effect or lack of responsiveness of contingent values with scope requires particular mention because if has been raised in connection with variations in population levels of wildlife. Desvousges et al. (1993), see also Boyle et al. (1994), found from a sample of respondents in Georgia, USA, that their willingness to pay to save waterfowl from death, although positive, was relatively invariant to the numbers saved. Similarly, Diamond and Hausman (1994) found no significant changes in willingness to pay for an increased number of wilderness areas in the United States for the numbers they considered. This resulted in doubts about the validity of the contingent valuation method because utility theory suggests that the marginal utility of extra units of a desired good should be positive. However, beyond a point extra units of a good may not be desired – neoclassical theory recognises that beyond some level a good may change from being one for which extra units are desired to being one for which extra units are a nuisance. There could also be a transitory zone in which marginal utility of a good is zero or near zero as its quantity is increased.

In the case of public goods, such as the existence value of a wildlife species, increases in the population of the species above a threshold (for example, its MVP) may not alter total utility. That is the case in Fredman's model illustrated in Figure 1. Above a population threshold for some species (for which existence value is their main value) no change in bid values should be recorded if Fredman's theory holds. A similar point is made by Fisher (1996, p.31) but more generally. In such cases, no alteration in bid values is rational.

Rollins and Lyke (1998) claim that increasing utility but diminishing marginal utility may occur for an increase in a public good. However, when its supply is large, its marginal utility may be quite small. Thus, empirical studies that concentrate on the upper range may fail to detect differences in utility unless sample sizes are large (Rollins and Lyke, 1998, p.342). This problem is likely also to be more acute if only small changes in the supply of the goods are considered, because then the change in utility may be barely noticeable. In such circumstances, moreover, respondents may make little effort to detail their preferences because their effort does not justify their extra benefit (cf. Tisdell, 1996, Ch.3). In this study, we only consider relatively large changes in the quantity of the good, elephants.

While nearly all respondents as a whole in our study reacted actively to changes in scope, some respondents were much less responsive than others. Some only responded to very large changes in scope. Such mixed possibilities have been noted by (Fisher, 1996). Such differences do not necessarily imply that the less responsive individuals are irrational. Utility functions, and their thresholds can vary between individuals. We will provide information about the numbers of respondents altering their bids with hypothetical changes in the population of elephants. However, embedding does not appear to be a significant problem in this study.

6. WTP for the conservation of the CWEP: preliminary findings

Of 300 respondents in the sample, 266 (88.7%) answered positively to WTP elicitation questions and only 34 (11%) protested against all the bid values offered in the bid vector. Of these 34 respondents, 14 offered a positive amount of less than Rs. 25 (US$ 0.24) and the remainder gave 'protest' bids or zero bids. Both these zero and insignificant bids were excluded from the calculation of WTP based estimates undertaken in this study. This approach is similar to that of Hanemann (1984) and accords with WTP estimates by Miller and Lindsay (1993), and Hadker (1997).

In Hanemann's approach, Hicksian compensating and equivalent welfare measures are employed to measure the consumer surplus for the contingent good. Thus the area under the cumulative logistic distribution curve can be used to obtain the expected or mean WTP estimates for any experimental sample of respondents. The actual values of these estimates can be obtained geometrically or by mathematical integration (Miller and Lindsay, 1993). When equivalent welfare measure is sought, the integral of the inverse cumulative distribution function can be obtained from the following equation:

$$WTP = \int_0^{\infty} [1 - F_e(\$X)]\, d(\$X) \qquad (4)$$

where Fe ($X) is the cumulative distribution function for e, and e is defined by Hanemann to be e1 – e0 representing the error term in the utility differences among the survey responses. Estimation of mean WTP by this approach is usually accomplished by Statistical Packages and this study, the Social Sciences (SPSS) Version 10.0 was applied. Table 1 presents the descriptive statistics of the respondents' answers to the WTP elicitation questions.

As indicated in Table 1, non-protest respondents on average are willing to pay Rs. 110.17 per month for the proposed scheme to conserve the elephant in Sri Lanka. This amounts to an annual value of Rs. 1322. As the payment will be made over a period of five years, the total present discounted value of these annual amounts at a 5% real rate of discount equals Rs. 6,009.

Table 1:
Descriptive statistics of the respondents' responses to the initial WTP elicitation questions (n =300)

Variable description	Statistic
Protest and insignificant bids[a]	34 (11.3)[b]
Number of non-protest bids	266 (88.67)
Mean monthly WTP (in Rupees)	110.17
Standard deviation	41.91
Conf. inter. estimate for the mean monthly WTP[c]	94.24:126.10

Note: a. Insignificant bids refer to the WTP amounts less than Rs. 25; b. Bracketed values refer to the percentage of total respondents in each sample; One US$ was equal to one hundred and two Sri Lankan Rupees on 20 September 2004. 95% level of confidence estimated for the mean monthly WTP.

Respondents' responses to changes in the abundance of elephants: preliminary findings

Participants' responses to changes in the CWEP were assessed by presenting six alternative WTP elicitation questions for six hypothetical population levels. Analysis of responses received for the WTP elicitation questions it reveals that about 82% of the respondents were willing to adjust the WTP amounts that they initially agreed to pay for the conservation of CWEP for population levels below the CWEP. However, only 64% were prepared to do this for hypothetical population levels above the CWEP. Overall about 73% of the respondents on average in the sample were prepared to adjust their agreed WTP amounts in relation to population scenarios proposed, but the rest of the respondents showed no interest in such an adjustment.

Increases in the elephant population compared to CWEP and its impact on the respondents' WTP for conservation of elephants

Three hypothetical elephant population levels above the CWEP (i.e. 25%, 50% and 75%) were used to assess the specific impact on the respondents' initial WTP contribution compared to what they had agreed to pay for conservation of the elephant at the current population level. Table 2 presents the summary of the calculated WTP estimates in relation to these hypothetical population levels.

Table 2:
Summary of WTP estimates for hypothetical increase in the elephant population above the CWEP (n = 266)

Population levels	Mean monthly WTP (in Rs)	Marginal WTP change	Conf. inter. estimate for mean monthly WTPb
WTP for the CWEP	110.17 (8.09)[a]	----	94.24:126.10
For 25% increase compared to the CWEP	116.27 (8.43)	6.10	99.66:132.88
For 50% increase compared to the CWEP			
For 75% increase compared to the CWEP	119.87 (8.65)	3.60	102.82:136.92
	121.69 (8.77)	1.89	104.42:138.96

Note: a. One US$ was equal to one hundred two Sri Lankan Rupees on 20 September 2004; b. The confidence intervals were estimated for 95% level of confidence, c: The respective standard error values are presented in brackets.

As shown in Table 2, there is some increase in the estimated monthly WTP values corresponding to these hypothetical increases in the population of wild elephant compared to the current level. However, the marginal change in the respondents' WTP amounts is diminishing. This is consistent with diminishing marginal utility from a rise in elephant numbers. This result may also indicate that some respondents who responded positively to the initial WTP elicitation questions in the sample are not prepared to pay for the conservation of the elephant if this species' long-term survival is no longer threatened or endangered.

Three different hypothesis tests were performed (the results of which are summarised in Table 3) at three different levels in order to examine whether the initial WTP amount that respondents agreed to pay for the conservation of the elephant are statistically different from zero with the hypothetical increase in the elephant population. The first test was carried out for each proposed percentage increase in the current elephant population in order to see whether the incremental valuations are statistically different from zero. The results of this analysis indicate that the incremental change in WTP in relation to the proposed hypothetical change in the elephant population is significant at the 5% level.

In the second hypothesis test, two separate paired t-tests were performed to determine whether the respondents' expressed WTP amounts for the increase in the elephant population of between 25% - 50%, and then 50% -75% are different from zero. That is, by taking the

WTP difference D1 = WTP50 – WTP25 and then D2 = WTP75 – WTP50 and testing whether Di ≤ 0. The results of these tests reported in Table 3, are significant at the 5% level, indicating that the incremental valuations from 25% to 50% and then from 50% to 75% are statistically different from zero.

Table 3:
Hypothesis tests concerning WTP for the increases in the elephant population compared to the CWEP

Null hypothesis (H_0)	*t*-value	Decision
WTP_{25} = 0 (for 25% increase in the CWEP)	13.90	Reject H_0
WTP_{50} = 0 (for 50% increase in the CWEP)	14.11	Reject H_0
WTP_{75} = 0 (for 75% increase in the CWEP)	14.14	Reject H_0
$WTP_{25} = WTP_{50}$	15.86	Reject H_0
$WTP_{50} = WTP_{75}$	14.96	Reject H_0
WTP gain for 1st 25% increase in CWEP = WTP gain for 2nd 25% increase	16.74	Reject H_0
WTP gain for 2nd 25% increase in CWEP = WTP gain for 3rd 25% increase	17.86	Reject H_0

Note: a. For one sample test ∝ = 0.05, df: n-1; **b.** for two sample test ∝ = 0.01, df: $n_1 + n_2 - 2$

The third test was undertaken to examine whether the rise in WTP from the second proposed increase in the elephant population (i.e. WTP50) was of less value than the first increment (i.e. WTP25) and also the test whether the WTP gain from the WTP75 (for 75% increase in the current elephant population) was of less value than the WTP50. That is, by forming paired t-tests of: WTP gain for WTP50 < WTP gain for WTP25 > 0 and WTP gain for WTP75 < WTP gain for WTP50 > 0 where we reject the null hypothesis that the valuation for WTP50 ≥ WTP25 or WTP75 ≥ WTP50. Our results indicate that the WTP gain for the initial 25% increase in the current elephant population is greater than the WTP gain for the second 25% increase in the population as well as the third incremental change.

In summary, the result indicates that the overall marginal valuation of increases in Sri Lanka's elephant population (above its current level) are positive but decrease with increases in the projected level of elephant population. Thus the total utility of a larger population of elephants increases but at a diminishing rate.

7. Decreases in the CWEP and its impact on the respondents' initial WTP contribution

Randall (1998) believes that people dislike disturbance of environmental amenity mostly because of their altruism. This might result in individuals being willing to pay increasing amounts to return to the status quo if there is a diminution in the environmental amenity. Tisdell and Wilson (2002) suggested that in some cases, a reduced population of a species might result in increased public support for their conservation when their population falls below some threshold. To consider this theoretical possibility, we undertook a WTP study of decreases in the current population of Sri Lankan elephants. The possible impact of a decrease in the elephant population on initial WTP contributions by the survey respondents was assessed in relation to three hypothetical population scenarios, namely reductions of 25%, 50% and 75%) in the CWEP in Sri Lanka. Table 4 summarises the results.

Table 4:
Summary of WTP estimates for hypothetical reductions in the elephant population relative to the CWEP (n = 266)

Population levels	Mean monthly WTP (in Rs)	Marginal WTP change	Conf. inter. estimate for mean monthly WTPb
WTP for the CWEP	110.17 (8.09)[a]	--	94.24:126.10
For 25% reduction compared to the CWEP	117.19 (8.57)	7.02	100.31:134.07
For 50% reduction compared to the CWEP	127.39 (9.04)	10.20	109.58:145.20
For 75% reduction compared to the CWEP	141.17 (9.74)	13.78	122.01:160.34

Note: a. The respective standard error values are presented in brackets, **b.** One US$ was equal to one hundred and two Sri Lankan Rupees on
20 September 2004, **c.** The confidence intervals were estimated for 95% level of confidence.

As shown in Table 4, with a decline in abundance of elephants in Sri Lanka of 25%, 50% and 75%, the corresponding mean WTP of respondents for the conservation of wild elephants by the respondents increased at an increasing rate.

WTP values for wild elephant conservation both with hypothetical increases and decreases in their population size

Let us now consider the overall WTP values for wild elephant conservation taking into account hypothetically larger and smaller populations compared to the CWEP. Variations in this aggregate WTP value depends on how many respondents vary their WTP compared to this value for CWEP and by how much they do so on average. Consider first the number of respondents willing to adjust their payments. This provides some indication of the extent of their reaction to scope, that is whether or not an embedding problem may exist.

Figure 2 presents the distribution of number of respondents who willing to adjust their initial WTP amounts in relation to hypothetical population changes proposed both below and above the CWEP. At the aggregate level, 73% of the respondents who responded positively to the initial payment questions (i.e. 266) were willing to adjust their WTP amounts in relation to hypothetical changes presented in the elephant population of Sri Lanka. This was 82% of respondents for an elephant population below the CWEP and 64% for an elephant population above the CWEP. More respondents were sufficiently concerned to increase their WTP amounts when the elephant population was reduced hypothetically than when it was increased. This is so for all equal increases and decreases in the elephant population compared to CWEP.

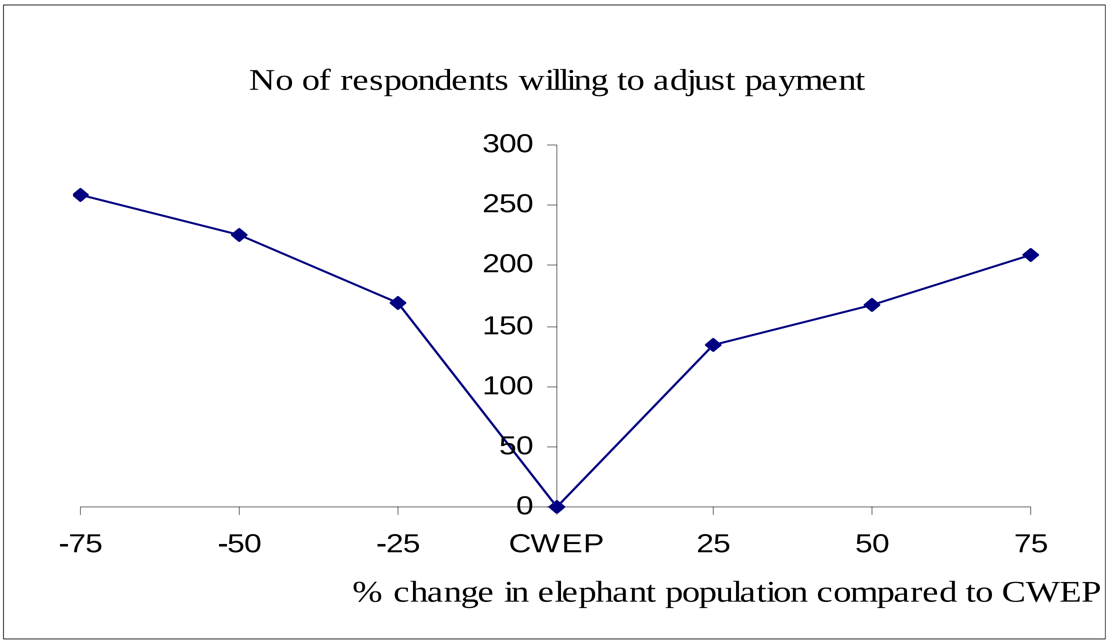

Figure 2: The number of respondents willing to adjust their initial WTP for elephant conservation amounts in relation to hypothetical changes in CWEP.

It can be observed that the greater the reduction in the elephant population the larger is number of respondents willing to increase their contribution to the conservation of elephants but the number rises at a decreasing rate. Similarly the numbers willing to increase their contribution to elephant conservation rises at a decreasing rate as the hypothetical size of elephant population increases.

It might be noted that not all respondents varied their bids with alteration in elephant abundance but most did. The proportion not varying the bid is highest for the smallest variation in elephant abundance. Although most respondents were consistently responsive to changes in scope, some were not. However, as argued earlier, this does not necessarily mean that those who were not responsive to scope, or showed limited response to scope, were irrational (cf. Fischer, 1996). For example, many did not respond to increase in elephant abundance compared to CWEP presumably because their main interest in elephants was in their existence or non-use values but did so for declines in abundance. Some evidence in support of this reason is provided in the next section.

On the basis of Tables 2 and 4, the average willingness of those in the sample to contribute to wild elephant conservation has the form shown in Figure 3. Willingness to contribute is much higher if the abundance of elephants falls than if it increases. Furthermore, the amount offered for this conservation increases at an increasing rate with declines in elephant abundance but only at a decreasing rate with rises in elephant abundance. When this is considered in conjunction with the data portrayed in Figure 2, it can be inferred that the convexity of the left hand branch of the WTP curve is primarily due to a sharp acceleration in the WTP amounts of those who are prepared to adjust their bids when elephants are less abundant. With less abundance of elephants, more individuals are willing to adjust their bids (but their numbers are decelerating) whereas their payments on average are accelerating. To the right of CWEP, however, deceleration occurs both in numbers adjusting and adjustments in their bid amounts.

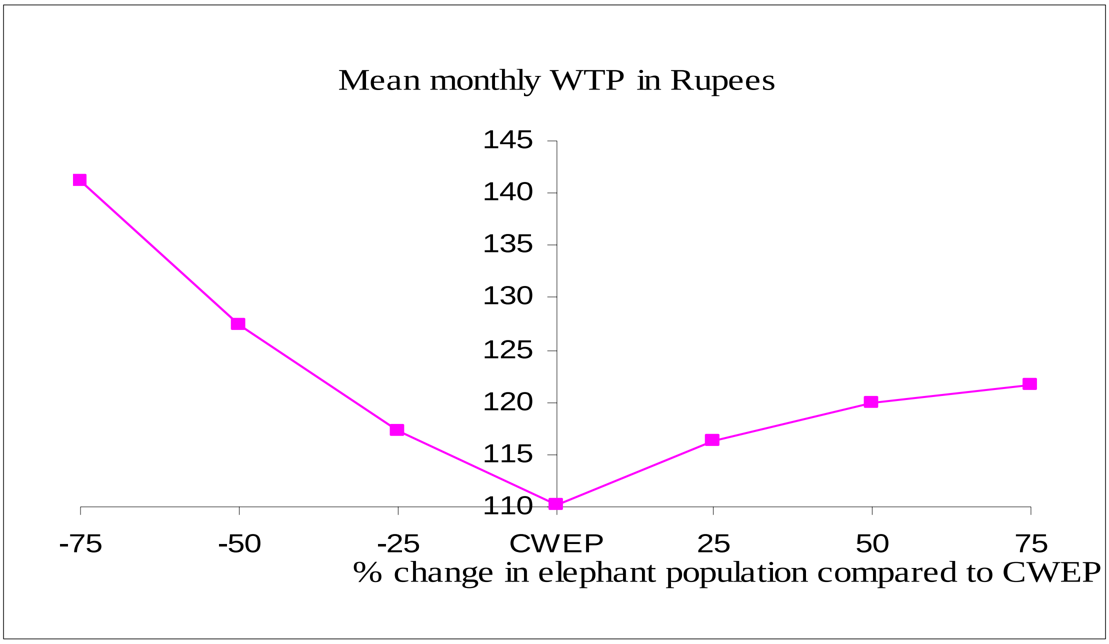

Figure 3: The mean monthly WTP of respondents for elephant conservation in relation to hypothetical changes in CWEP

Given the above findings, the total willingness to pay of these respondents for alternative density of wild elephants has a cusp at the current level of this population. It does not display the form illustrated in Figure 1. Moreover, it is possible that it does not measure the TEV of elephants. This is because the WTP in this case for the conservation of elephants seems to be subject to 'strategic' influence. The respondents seem to believe that it is more important to contribute to a scheme to save elephants as their abundance is reduced and in many cases, contribute larger sums. This is probably because they perceive that the extinction of elephants becomes more imminent as their abundance is reduced and thus it becomes more urgent for humans to act. On average, respondents were willing to pay more to ensure the continuing existence of elephants as hypothetical number of elephants declined.

As the population of wild elephants in Sri Lanka is reduced below its current level, extinction of the species becomes more imminent and probable. Therefore, the left hand side of the relationship in Figure 3 accords to some extent with an observation by Fredman (1995) for a group of his respondents. These respondents reduced their WTP for the conservation of the white-backed woodpecker when its numbers were hypothetically increased to make it common. He suggests that this negative relationship may occur because "people primarily 'holding' on existence value may be more inclined to distribute their total willingness to pay amount among additional species, or public amenities, when the proposed population density is large and the species is not considered as threatened any longer" (Fredman, 1995, p.324).

The WTP for existence of a species does not, therefore, seem to be independent of the population density of the species and the nature of the relationship empirically obtained does not always appear to measure the total economic value of the species for the population density at which it occurs. Nevertheless, the WTP figures can be the correct ones despite the fact they do not accurately indicate TEV. The discrepancy seems to be particularly marked once the population level of a species falls to a level where the species is believed by the respondents to be endangered. Action and funding to save the species is then considered to be a priority and moral sentiments may also come to the fore. Thus, the type of relationship suggested by Tisdell and Wilson (2002) as possible seems to have empirical validity for some species.

It can be seen that this WTP curve differs from the type of TEV relationship in Figure 1 suggested by Fredman assuming that CWEP approximates the MVP for elephants in Sri Lanka. While the right hand branch of the WTP curve is consistent with this curve in Fredman's curve above MVP, the value of this curve in Fredman's case is zero to the left of MVP. Furthermore, it is quite different to the WTP curve suggested by Fisher (1996, p.3, Figure 2.5) which may indeed be plausible as an indicator of the total economic value of a bird population, even though benefit from a bird population below MVP would presumably by transitory in this case. Fisher's curve shows WTP increasing at a decreasing rate as a bird population increases, then jumping to a higher level once MVP is achieved and then continuing to increase at a decreasing rate.

Possibly the differences arise because our analysis has some affinity with prospect analysis (Kahneman and Tversky, 1979). If their approach is adopted then CWEP could be considered a reference point, and WTP when the elephant populations are reduced could be interpreted as WTP to avoid such reductions. The fact that our WTP curve is steeper to the left of CWEP than to the right, is consistent with the theory of Kahneman and Tversky (1979, pp.279-280). However, the fact that the WTP rises at an increasing rate as the extent of losses in the elephant population rise is not because individuals would be prepared to pay more in our case to avoid risks of fluctuations in levels of elephant populations below CWEP. In fact, the relationship shown in Figure 3 is compatible with the neoclassical theory that utility obtained from a good increases but at a decreasing rate as its quantity is increased. This implies risk avoidance. But it is doubtful if this explains the observed relationship in Figure 3.

This main reason for the nature of the left hand branch of WTP in Figure 3 may increasing urgency and greater need for action to avoid extinction of the species as its population declines. With population declines, the probability of losing all future economic values including existence values, appears to rise at an increasing rate. If say the species has only a fixed existence value, the expected loss in this expected value rises at an increasing rate as the population declines. This together with the increasing probability of loss of all other values may help explain the observed phenomenon. Certainly the prospect of losing non-use values seems to be a major influence on WTP when the population of elephants is hypothetically reduced as the next section indicates.

8. Probit analysis of factors influencing WTP for conservation of elephants as their population density alters

To isolate significant factors influencing the respondents' answers to the alternative WTP elicitation questions, an ordered probit model was applied separately to increases and decreases in the elephant population compared to the CWEP

The approach adopted in specifying this model is similar to that of Aldrich and Nelson (2000). Seonghoon and Adams (1999) describe the advantages of ordered probit models in relation to their ability to capture the multiple response choices. Jekanowski et al. (2000) also claim that ordered probit models are statistically more efficient than the binary logit or probit models. Furthermore, (see Adams and Cho, (1998); Wang et al. (2000) argue that this model offers a better fit for the analysis of multiple responses. Therefore, the ordered probit model is employed here. The following equation summarises the general model we used.

$$Y_i^* = \beta_o + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots\ldots\ldots\ldots\beta_k x_{ki} + \varepsilon \qquad (3)$$

where ε is the error term which is assumed to be normally distributed with zero mean (μ = 0), βi represent vectors of unknown parameters, and x1, x2 ….xk represent vectors of explanatory variable used (see Table 5) in the model. Yi* is the dependent variable which is an ordered choice with three categories. Responses to the alternative WTP elicitation questions in relation to hypothetical population levels of elephants below and above the CWEP are classified as 'I would increase the initially agreed WTP amount' (coded as 0), ' I would decrease the initially agreed WTP amount' (coded as 1), or I would not change the initially agreed WTP amount' (coded as 2).

Table 5:
Variables included in the preliminary ordered probit models

Variable	Definition	Mean
AGERE	Age of the respondent in years	44.02 (10.8)[a]
CONSE	Awareness about the current elephant conservation issues; 1=not aware, 2 = aware 3 = very aware	2.37 (0.68)
BQVOE	The bequest value of the elephant; 1 = not valued, 2 = somewhat valued, 3 = moderately valued, 4 = highly valued.	3.91 (0.43)
GREEN	Pro-conservation perception; 4 = supportive, 3 = neutral, 2 = not supportive, 1 = strongly not supportive	3.42 (1.12)
PERIN	Personal income in Rupees	12986.6 (8692.0)
EXVOE	The existence value of the elephant; 1 = not valued, 2 = somewhat valued, 3 = moderately valued, 4 = highly valued.	3.687 (0.48)
NCUVE	Non-consumptive use values 1 = not valued, 2 = somewhat valued, 3 = moderately valued, 4 = highly valued.	2.16 (0.298)
USER	1 if the respondent had visited national park(s) to see the elephants or wildlife in general; 0 otherwise	0.39 (0.49)
YRSCH	Years of schooling	12.54 (3.12)

Note: Respective standard deviation values are presented in the brackets.

Table 6 presents the results of the estimated models. In addition, this table also reports the results of three goodness-of-fit measures, which were estimated for each of these hypothetical changes introduced. One measure is the log-likelihood ratio. A second measure used is the pseudo-R2. A third measure examines how well the model classified the respondents based on estimated probabilities. These measures indicate that the estimated model has satisfactory explanatory power and fits the data reasonably well.

Table 6:
Estimates of the ordered probit models: factors influencing the respondents' responses for the alternative WTP questions (n = 266)

Variable	Model estimated for populations above the CWEP		Model estimated for populations below the CWEP	
	Coefficient	***t*-value**	**Coefficient**	***t*-value**
Constant	-2.014	-3.098	-2.971	-3.103
AGERE	- 0.872	-1.971	-1.591	0.154
CONSE	0.983	0.861	2.639	3.682
BQVOE	1.618	1.410	2.981	3.961
GREEN	1.792	0.657	2.902	2.817
PERIN	3.678	4.351	1.691	4.811
EXVOE	1.931	0.987	2.982	3.879
NCUVE	1.750	2.161	0.104	0.767
USRER	2.101	3.591	0.871	0.014
YRSCH	1.981	2.761	1.561	2.981
Log-likelihood ratio	42.19		44.11	
Pseudo-R^2	71.01		69.24	

Note: Dependent variable: Probability of saying 'I would increase the initially agreed WTP amount', 'I would decrease' or I would not change' to the alternative WTP questions were presented in relation to each hypothetical change below and above the CWEP.

As indicated in Table 6, the overall ability of these models to the yield correct predictions of responses for alternative WTP questions presented to the respondents for elephant populations below and above the CWEP were 69% and 71% respectively. Furthermore, except for variables such as AGERE (age of the respondents), USER (respondent who visit national park(s) to see the elephants or wildlife), NCUVE (non-consumptive use value of elephant), all the other explanatory variables are significant in the model estimated for elephant populations below the CWEP either at the 0.01 or 0.05 level of significance. The probability of respondents increasing their WTP when the elephant population is hypothetically reduced was significantly higher in the case of respondents who were more aware of conservation issues involving the elephant, placed importance on its bequest value and on its existence value (non-use values), held pre-conservation values, had higher incomes and a greater amount of education. The variables significant in the model estimated for population above the CWEP include USER, NCUVE, PERIN (personal monthly income) and YRSCH (years of schooling).

This suggests that in this case, use-values have the predominant influence on WTP in relation to hypothetical increases in elephant populations but that non-use values predominate in relation to hypothetical decreases in this population. Levels of income and years of schooling are positive and significant influences on WTP both in relation to increased and decreased population of elephants compared to the CWEP.

9. Concluding remarks

The results from this study have some parallels with those of Fredman (1995) in relation to WTP for the conservation of the white-backed woodpecker but he did not test for a possible reduction in its population. Also in his analysis of TEV, he assumes a definite minimum viable population of a species which we do not.

Our results in this case indicate the presence of asymmetry in the WTP for the conservation of the Asian elephant in Sri Lanka. This WTP tends to be greater for comparable hypothetical reductions in the elephant population than for increases in it. Probit analysis suggests that non-use values are predominant influences on WTP when the elephant population is hypothetically decreased and that use values predominate when the species becomes more common.

The right hand branch of the WTP curve (Figure 3) may reflect diminishing marginal utility from use of the species as it becomes more common, and reflect the fact that non-use values are satisfied once the population of the species exceeds a ‘safe’ threshold and then show little or no marginal change.

On the other hand, the left-hand branch of the WTP curve (Figure 3) does not indicate diminishing marginal utility as the population of the species in this range is increased. This portion appears to reflect the willingness of respondents to pay for action to ensure the continuing survival of the species. The willingness of respondents to pay for this action increases with the weight they give to non-use economic values of the species. However, as suggested by Kotchen and Reiling (2000), non-use economic values are closely associated with ethical attitudes towards the conservation of species.

If WTP for (or contribute to schemes) to conserve a species is used to measure its TEV, the TEV of the species is liable to be underestimated if respondents (or many of them) believe the population of the species to be relatively secure. In such cases, those who value the existence or non-use values of the species will see little point in contributing to a scheme to conserve the species because it will survive anyway. For example, the TEV of the elephant to Sri Lankan respondents must exceed the value of 110.17 Rs which they are prepared to contribute to its conservation given the CWEP. Their TEV of the elephant must be at least 141.17Rs monthly on average, the amount they would be willing to pay on average should the elephant population be reduced by 75 per cent below its current level. Presumably, all or nearly all respondents, would then believe the elephant to be critically endangered. In the above circumstances, although WTP may be a useful guide to policy, eg. whether or not there is strong demand for conservation, action to be taken to preserve a species, it may be a poor guide to the TEV of the species or a particular population level of the species.

This study suggests that the relationship between WTP of respondents for the conservation of a species and their TEV is not straightforward, even if the WTP amounts are accurate or correct. This is because WTP of respondents may incorporate their legitimate attitudes about the strategic need for conservation actions. Furthermore, the type of relationship for WTP discovered in this Asian elephant study may also apply to some other wildlife species. There is considerable scope for further exploration of the issues raised by this case.

10. Acknowledgements

We would like to thank the reviewers for their useful comments. A portion of the research for this article benefited from an Australian Research Council Discovery Grant for investigation of the economics of conserving wildlife.

11. References

Adams, R. M. and Cho, S. H. (1998) "Agriculture and Endangered Species: An Analysis of Trade-offs in the Klamath Basin, Oregon", *Water Resources Research*, **34**: 2741-2749.

Aldrich, J. H. and Nelson, F. D. (1984) Linear Probability, Logit and Probit Models (Sage University Papers Series 07-045, Sage Publications, Newbury Park, London).

Alexander, R. R. (2000) “Modelling Species Extinction: The Case for Non-Consumptive Values”, *Ecological Economics*, **35**: 259-69.

Bandara, R. and Tisdell, C. (2002) “Conserving Asian Elephants: Economic Issues Illustrated by Sri Lankan Concerns” in The Economics of Conserving of Wildlife and Natural Areas C. A. Tisdell (Edward Elgar, Cheltenham, UK) pp 193-211.

Bandara, R. and Tisdell, C. (2003) “Comparison of Rural and Urban Attitudes to the Conservation of Asian Elephants in Sri Lanka”, *Biological Conservation*, **110**: 327-342.

Bandara, R. and Tisdell, C. (2004) “The Net Benefit of Saving the Asian Elephant: A Policy and Contingent Valuation Study”, Ecological Economics, **48**: 93-107.

Bandara, R. and Tisdell, C. (2003) “Use and Non-use Values of Wild Asian Elephants: A Total Economic Valuation Approach”, *Sri Lanka Journal of Economics*, **4**(2): 3-30.

Bateman, I. J. and Willis, K. G. (eds) (1999) Valuing Environmental Preferences:Theory and Practice of the Contingent Valuation Method in US, EU and Developing Countries (Oxford University Press, Oxford, UK)

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. and Swanson, J. (2002) Economic Valuation with Stated Preference Techniques: A Manual (Edward Elgar, Cheltenham, UK).

Bishop, R. C. (1978) “Endangered Species and Uncertainty: The Economics of a Safe Minimum Standard”, *American Journal of Agricultural Economics*, **57**: 10-18.

Boyle, K. J.; Desvousges, W. H.; Johnson, F. R.; Dunford, R. W. and Hudson, S. P. (1994) “An Investigation of Part-whole Biases in Contingent Valuation Studies”, *Journal of Environmental Economics and Management*, **27**: 64-83.

Boyle, K. J. and Bishop, R. C. (1987) “Valuing Wildlife in Benefit-Cost Analyses: A Case Study Involving Endangered Species”, *Water Resources Research*, **23**: 943-950.

Bulte, E. and Kooten, G. C. (2002) “Downward Sloping Demand for Environmental Amenities and International Compensation: Elephant Conservation and Strategic Culling”, *Agricultural Economics*, **27**: 15-22.

Carson, T. R.; Flores, N. E. and Meade, N. R. (2001), “Contingent Valuation: Controversies and Evidence”, *Environmental and Resource Economics*, **19**: 173-210

Champ, R.; Bishop, R.; Brown, T. and McCollum, D. (1997) “Using Donation Mechanism to Value Non-Use Benefits from Public Goods”, *Journal of Environmental Economics and Management*, **33**: 151-163.

Chilton S. and Hutchinson, W. (1999) “Some Further Implications of Incorporating Warm Glow of Giving Into Welfare Measures: A Comment on the Use of Donation Mechanisms by Champ et al.”, *Journal of Environmental Economics and Management*, **37**: 202-209.

Ciriacy-Wantrup, S. V. (1968) Resource Conservation: Economics and Policies (Berkeley:University of California Press).

Department of Census and Statistics of Sri Lanka, (2002) Census of Population and Housing-2001 (Department of Census and Statistics, Colombo, Sri Lanka).

De Silva, M. (1998) “Status and Conservation of the Elephant and the Alleviation of Man-Elephant Conflict in Sri Lanka”, *Gajah*, **19**: 1-24.

Desai, A. A. (1998) Conservation of Elephants and Human-Elephant Conflict, Unpublished Technical Report, Department of Wildlife Conservation, Colombo, Sri Lanka.

Desvousges, W. H.; Johnson, F. R,; Dunford, R. W.; Boyle, K. J.; Hudson, S. P. and Wilson, N. (1993) "Measuring Natural Resource Damages with Contingent Valuation Tests of Validity and Reliability". In J. A. Hausman (ed.) Contingent Valuation: A Critical Assessment, (North Holland, Amsterdam), 91-159.

Diamond, P. P. and Hensman, J. A. (1994) "Contingent Valuation: Is Some Number better than No Number?", *Journal of Economic Perspectives*, **8**: 45-64.

FAO, (2000) Application of the Contingent Valuation Method in Developing Countries: A Survey (Information Division, Food and Agricultural Organization of the United Nation, Viale delle Terme di Caracalla, Rome, Italy).

Fisher, A. C. (1996) "The Conceptual Underpinnings of the Contingent Valuation Method", in D. J. Bjornstad and J. R. Kahn (eds), The Contingent Valuation of Environmental Resources (Edward Elgar, Cheltenham, UK), 19-37.

Fredman, P. (1995) "The Existence of Existence Value: A Study of the Economic Benefits of an Endangered Species", *Journal of Forest Economics*, **1**: 307-327.

Gunathilaka, H. M. and Vieth, G. R. (1998) "An Assessment of Scenic Value of Sri Lanakan Elephants: The Case of Pinnawela Orphanage", *Sri Lanka Journal of Social Science*, **21**: 37-51.

Hadker, N.; Sharma, S.; David, A. and Muraleedharan, T. R. (1997) "Willingness to Pay for Borivli National Park: Evidence from a Contingent Valuation", *Ecological Economics*, **21**: 105 -122.

Hanemann, M. (1984) "Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses", *American Journal of Agricultural Economics*, **66**: 332-41.

Hanemann, W. M. and Loomis, J. and Kanninen B. J. (1991) "Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation", *American Journal of Agricultural Economics*, **73**: 1255-1263.

Hohl, A. and Tisdell, C. (1993) "How Useful are Environmental Safety Standard in Economics? – The Example of Safe Minimum Standards for Protection of Species", *Biodiversity and Conservation*, **2**: 168-181.

IUCN (2000) Red List of Threatened Species (IUCN Gland, Switzerland).

Jekanowski, M. D.; Williams, D. R. and Schiek, W. A. (2000) "Consumers' Willingness to Purchase Locally Produced Agricultural Products: An Analysis of an Indiana Survey", *Agricultural and Resource Economics Review*, **29**: 43-53.

Kahneman, D. and Tversky, A. (1979), "Prospect Theory: An Analysis of Decision under Risk", *Econometrica*, **47**: 263-292.

Kanninen, B. J. (1995) "Bias in Discrete Response Contingent Valuation", *Journal of Environmental Economics and Management*, **28**: 114-125.

Kotchen, M. J. and Reiling, S. D. (2000) "Environmental Attitudes, Motivation, and Contingent valuation of Non-use Values: A Case Study Involving Endangered Species", *Ecological Economics*, **32**: 93-107.

Langford, I. H.; Skourtos, M. S.; Kontogianni, A.; Day, R. J.; Georgiou, S. and Batemen, I. J. (2001) "Use and Non-use Values for Conserving Endangered Species: The Case of the Mediterranean Monk Seal", *Environment and Planning A*, **33**: 2219-33.

Loomis, J. B. and Larson, D. M. (1994) "Total Economic Value of Whale Populations: Results from a Contingent Valuation Survey of Visitors and Households", *Marine Resource Economics*, **9**: 275-286.

Metrick, A. and Weitzman, M. L. (1998), "Conflict and Choices in Biodiversity Preservation", *Journal of Economic Perspective*, **12**: 21-34.

Randall, A. (1998) Making the Environment Count: Selected Essays of Alan Randall (Edward Elgar, Cheltenham, UK).

Ready, R. C. and Bishop, R. C. (1991), "Endangered Species and Safe Minimum Standard", *American Journal of Agricultural Economics*, **73**: 309-12.

Rollins, K. and Lyke, A. (1998) "The Case for Diminishing Marginal Existence Value", *Journal of Environmental Economics and Management*, **36**: 324-344.

Seonghoon, H. and Adams, R. M. (1999), "Household Responses to Price Incentives for Recycling: Some Further Evidence", *Land Economics*, **75**: 505-514.

Seidl, I. and Tisdell, C. A. (2001) "Neglected Feature of the Safe Minimum Standard: Socio-Economic and Institutional Dimensions", *Review of Social Economy*, **59**: 417-442.

Sukumar, R. (1989) The Asian Elephant: Ecology and Management (Cambridge University Press, Cambridge).

Tisdell, C. A. (2002) The Economics of Conserving Wildlife and Natural Areas (Edward Elgar, Cheltenham, UK).

Tisdell, C. (1996) Bounded Rationality and Economic Evolution, (Edward Elgar, Cheltenham, UK).

Tisdell, C. and Bandara, R. (2003) Wildlife-Based Recreation and Local Economic Development: The Case of the Pinnawala Elephant Orphanage in Sri Lanka. Economics, Ecology and the Environment, Working Paper No. 83, School of Economics, The University of Queensland, Qld 4072, Australia.

Tisdell, C. and Wilson, C. (2002) "Ecotourism for the Survival of Sea Turtles and other Wildlife", *Biodiversity and Conservation*, **11**: 1521-1538.

Urban Development Authority of Sri Lanka (2001) Land Use Planning In Sri Lanka, Volume 1 (Urban Development Authority, Sethsiripaya, Colombo, Sri Lanka).

Venkatachalam, L. (2004) "The Contingent Valuation Method: A Review", *Environmental Impact Assessment Review*, **24**: 89-124.

Wang, H. H.; Young, D. L. and Camara, O. M. (2000), "The Role in Environmental Education in Predicting Adoption of Wind Erosion Control Practices", *Journal of Agricultural and Resource Economics*, **25**: 547-58

Whitehead, J. C. (1993) "Total Economic Value for Coastal and Marine Wildlife: Specification, Validity, and Valuation Issues", *Marine Resource Economics*, **8**: 119-132.

Zhang, J. and Wang, X. (1997) "Selecting the Best Regression Equation via the P-Value of F-Test", *Metrika* **46**: 33-40.

ISSN 1444-8890

PREVIOUS WORKING PAPERS IN THE SERIES

ECONOMIC THEORY, APPLICATIONS AND ISSUES

1. Externalities, Thresholds and the Marketing of New Aquacultural Products: Theory and Examples by Clem Tisdell, January 2001.
2. Concepts of Competition in Theory and Practice by Serge Svizzero and Clem Tisdell, February 2001.
3. Diversity, Globalisation and Market Stability by Laurence Laselle, Serge Svizzero and Clem Tisdell, February 2001.
4. Globalisation, the Environment and Sustainability: EKC, Neo-Malthusian Concerns and the WTO by Clem Tisdell, March 2001.
5. Globalization, Social Welfare, Labor Markets and Fiscal Competition by Clem Tisdell and Serge Svizzero, May 2001.
6. Competition and Evolution in Economics and Ecology Compared by Clem Tisdell, May 2001.
7. The Political Economy of Globalisation: Processes involving the Role of Markets, Institutions and Governance by Clem Tisdell, May 2001.
8. Niches and Economic Competition: Implications for Economic Efficiency, Growth and Diversity by Clem Tisdell and Irmi Seidl, August 2001.
9. Socioeconomic Determinants of the Intra-Family Status of Wives in Rural India: An Extension of Earlier Analysis by Clem Tisdell, Kartik Roy and Gopal Regmi, August 2001.
10. Reconciling Globalisation and Technological Change: Growing Income Inequalities and Remedial Policies by Serge Svizzero and Clem Tisdell, October 2001.
11. Sustainability: Can it be Achieved? Is Economics the Bottom Line? by Clem Tisdell, October 2001.
12. Tourism as a Contributor to the Economic Diversification and Development of Small States: Its Strengths, Weaknesses and Potential for Brunei by Clem Tisdell, March 2002.
13. Unequal Gains of Nations from Globalisation by Clem Tisdell, Serge Svizzero and Laurence Laselle, May 2002.
14. The WTO and Labour Standards: Globalisation with Reference to India by Clem Tisdell, May 2002.
15. OLS and Tobit Analysis: When is Substitution Defensible Operationally? by Clevo Wilson and Clem Tisdell, May 2002.
16. Market-Oriented Reforms in Bangladesh and their Impact on Poverty by Clem Tisdell and Mohammad Alauddin, May 2002.
17. Economics and Tourism Development: Structural Features of Tourism and Economic Influences on its Vulnerability by Clem Tisdell, June 2002.
18. A Western Perspective of Kautilya’s Arthasastra: Does it Provide a Basis for Economic Science? by Clem Tisdell, January 2003.
19. The Efficient Public Provision of Commodities: Transaction Cost, Bounded Rationality and Other Considerations.
20. Globalization, Social Welfare, and Labor Market Inequalities by Clem Tisdell and Serge Svizzero, June 2003.
21. A Western Perspective on Kautilya’s ‘Arthasastra’ Does it Provide a Basis for Economic Science?, by Clem Tisdell, June 2003.
22. Economic Competition and Evolution: Are There Lessons from Ecology? by Clem Tisdell, June 2003.
23. Outbound Business Travel Depends on Business Returns: Australian Evidence by Darrian Collins and Clem Tisdell, August 2003.
24. China’s Reformed Science and Technology System: An Overview and Assessment by Zhicun Gao and Clem Tisdell, August 2003.

25. Efficient Public Provision of Commodities: Transaction Costs, Bounded Rationality and Other Considerations by Clem Tisdell, August 2003.
26. Television Production: Its Changing Global Location, the Product Cycle and China by Zhicun Gao and Clem Tisdell, January 2004.
27. Transaction Costs and Bounded Rationality – Implications for Public Administration and Economic Policy by Clem Tisdell, January 2004.
28. Economics of Business Learning: The Need for Broader Perspectives in Managerial Economics by Clem Tisdell, April 2004.
29. Linear Break-Even Analysis: When is it Applicable to a Business? By Clem Tisdell, April 2004.
30. Australia's Economic Policies in an Era of Globalisation by Clem Tisdell, April 2004.
31. Tourism Development as a Dimension of Globalisation: Experiences and Policies of China and Australia by Clem Tisdell, May 2004.
32. Can Globalisation Result in Less Efficient and More Vulnerable Industries? by Clem Tisdell, October 2004.
33. An Overview of Globalisation and Economic Policy Responses by Clem Tisdell, November 2004.