ISSN 1327-8231

ECONOMICS, ECOLOGY AND THE ENVIRONMENT

Working Paper No. 98

Effects of a Change in Abundance of Elephants on Willingness to Pay for Their Conservation

by

Ranjith Bandara and Clem Tisdell

April 2004

THE UNIVERSITY OF QUEENSLAND

ISSN 1327-8231
WORKING PAPERS ON
ECONOMICS, ECOLOGY AND THE ENVIRONMENT

Working Paper No. 98

Effects of a Change in Abundance of Elephants on Willingness to Pay for Their Conservation[1]

by

Ranjith Bandara[2] and Clem Tisdell[3]

April 2004

---

1 Note that this is a revised version of Working Paper No. 85 in this series

2 Senior Lecturer, Department of Economics, University of Colombo, Sri Lanka
Email: s200516@student.uq.edu.au

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

WORKING PAPERS IN THE SERIES, *Economics, Ecology and the Environment* are published by the School of Economics, University of Queensland, 4072, Australia, as follow up to the Australian Centre for International Agricultural Research Project 40 of which Professor Clem Tisdell was the Project Leader. Views expressed in these working papers are those of their authors and not necessarily of any of the organisations associated with the Project. They should not be reproduced in whole or in part without the written permission of the Project Leader. It is planned to publish contributions to this series over the next few years.

Research for ACIAR project 40, *Economic impact and rural adjustments to nature conservation (biodiversity) programmes: A case study of Xishuangbanna Dai Autonomous Prefecture, Yunnan, China* was sponsored by the Australian Centre for International Agricultural Research (ACIAR), GPO Box 1571, Canberra, ACT, 2601, Australia.

The research for ACIAR project 40 has led in part, to the research being carried out in this current series.

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

Effects of Change in Abundance of Elephants on 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.

Effects of Change in Abundance of Elephants on 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 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).* Bateman et al. (2002) provide a useful discussion about stated-preference techniques and their application to the estimation of TEV. Moreover, among others, Nelson (2002) and Carson et al. (2001) discuss additional issues that arise in applying such techniques. However, except for the work of authors such as Whitehead (1993); Loomis and Larson (1994); Fredman (1995); 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 (*Dentropos levcotos)* 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, and UV is its use value. Moreover, TEV is considered to be a function of the population density (Z) of the species and to have the following form:

$$TEV = F(Z) + g(Z) + h(Z) \qquad \textit{(2)}$$

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

where 'a' is constant. This implies that the existence value of a wildlife species is independent of its population for all Z > MVP, where MVP represents the minimum viable population of the species.

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. It was assumed that the species would become extinct if Z < MVP, but will survive if Z ≥ MVP. Existence value disappears if Z < MVP. Extinction also implies no UV and ONUV is obtained. His diagram indicates $g'>0$ and $g''<0$. 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.

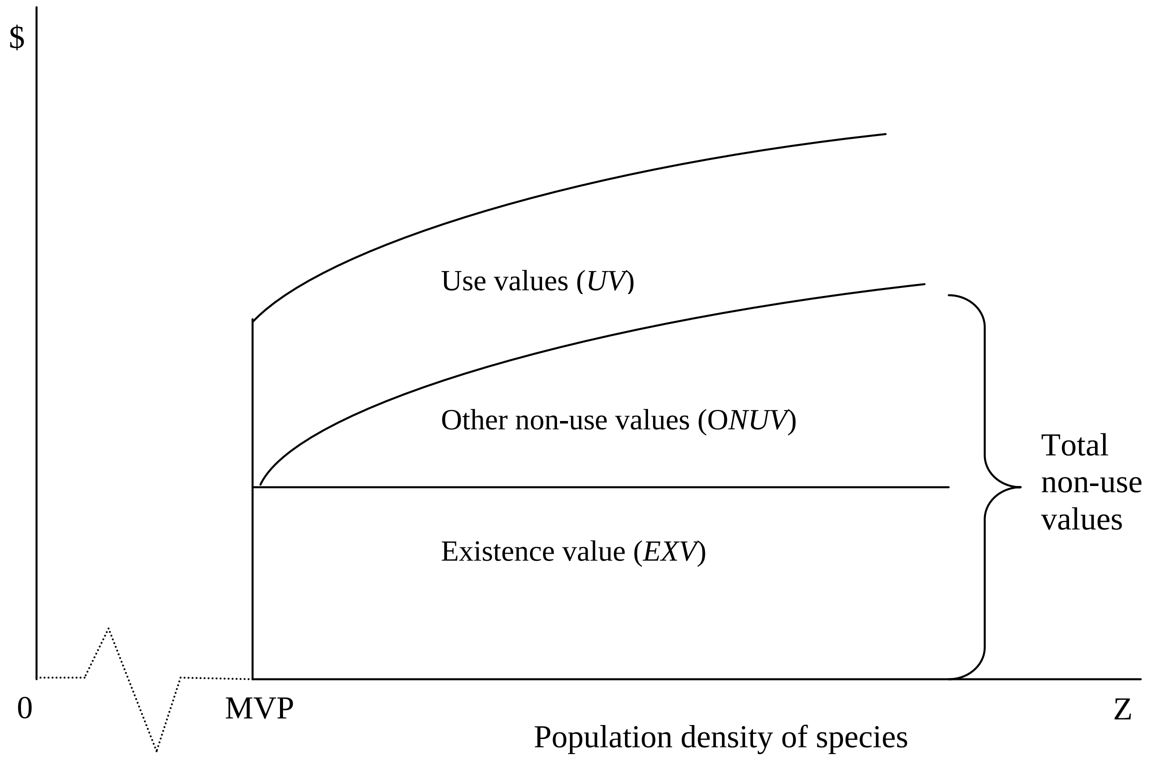

Figure 1: Value components of a wildlife species as a function of its population density according to Fredman
(Source: Fredman, 1995, p. 311)

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 the 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 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. 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 broader categories of income earners i.e. high, middle and low. A hundred residents were chosen from each of these housing schemes so as to provide a stratified sample.

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.

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. Then they were told that finance was required for the proposed programme and that the support of the general public would be needed to establish a 'trust fund' to undertake it. 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. 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).

In the present study, a bid vector with five different bid values (i.e. Rs. 500, 250, 100, 50, and 25) was offered to elicit the survey respondents' likely WTP contribution for the proposed scheme. The initial WTP elicitation question is presented with the highest bid value in the bid vector, which in the present study, was Rs. 500. 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 was 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.

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, the respondents should not have had difficulties in understanding the hypothetical changes proposed in the CWEP.

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 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). 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.

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

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; **c.** 95% level of confidence estimated for the mean monthly WTP.

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.

8. 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 WTP[b]
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	119.87 (8.65)	3.60	102.82:136.92
For 75% increase compared to the CWEP	121.69 (8.77)	1.89	104.42:138.96

Note: a: The respective standard error values are presented in brackets, b. The confidence intervals were estimated for 95% level of confidence.

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 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 $D_1 = WTP_{50} - WTP_{25}$ and then $D_2 = WTP_{75} - WTP_{50}$ and testing whether $D_i \leq 0$. 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 $\propto = 0.05$, df: n-1; **b.** for two sample test $\propto = 0.01$, 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. WTP_{50}) was of less value than the first increment (i.e. WTP_{25}) and also the test whether the WTP gain from the WTP_{75} (for 75% increase in the current elephant population) was of less value than the WTP_{50}. That is, by forming paired t-tests of: WTP gain for WTP_{50} < WTP gain for $WTP_{25} > 0$ and WTP gain for WTP_{75} < WTP gain for $WTP_{50} > 0$ where we reject the null hypothesis that the valuation for $WTP_{50} \geq WTP_{25}$ or $WTP_{75} \geq WTP_{50}$. 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.

9. 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 WTP[b]
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.** 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.

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. 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 of 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.

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. 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. More respondents were sufficiently concerned to increase their WTP amounts when the elephant population was reduced hypothetically than when it was increased.

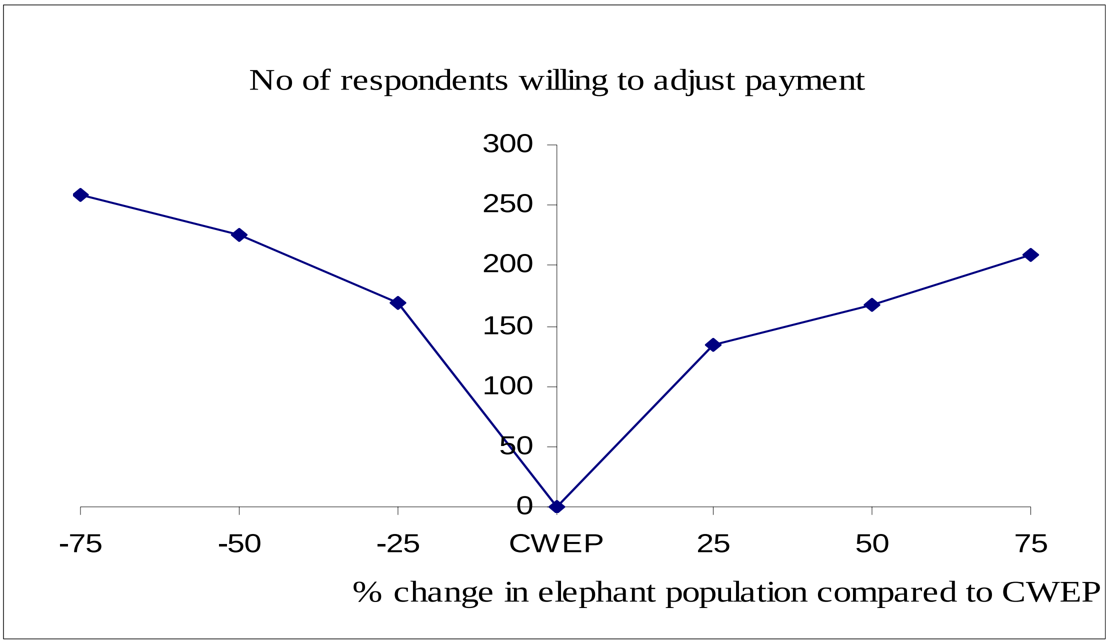

Figure 2: The number of respondents willing to adjust their initial WTP for elephant conservation amounts in relation to hypothetical changes in CWEP

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 as the hypothetical size of elephant population increases. It is found that the average bid per respondent increases at an increasing rate as the hypothetical elephant population is decreased in comparison to CWEP. It increases at decreasing rate as the elephant population is raised in relation to CWEP. Those relationships are evident from the Table 2 and 4 and are graphed in Figure 3.

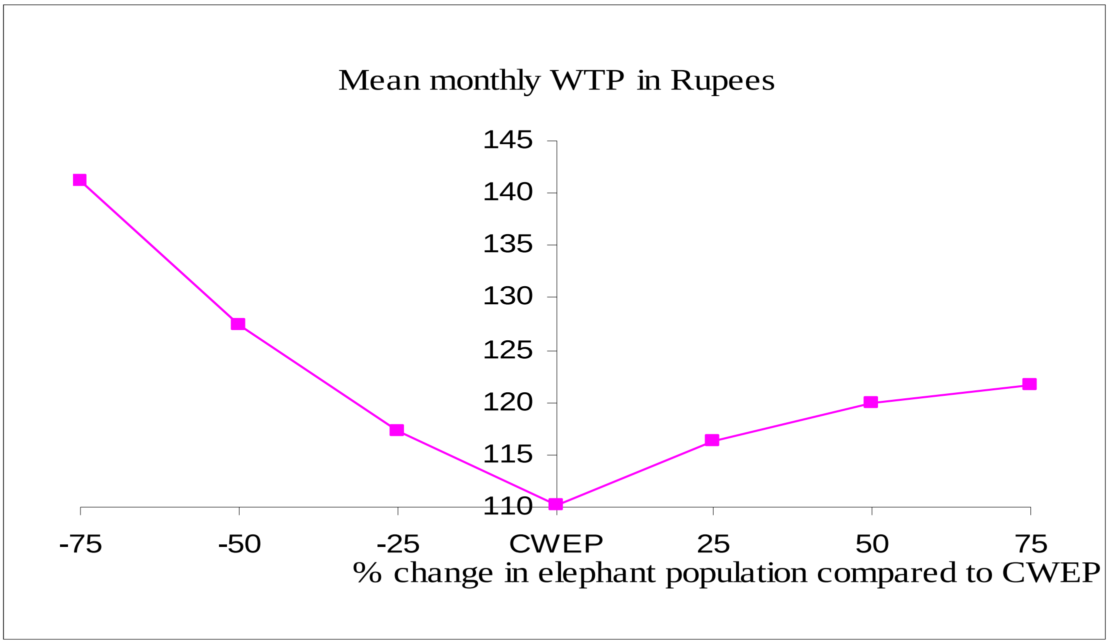

Figure 3: The mean monthly WTP of respondents for elephant conservation in relation to hypothetical changes in CWEP

From the graph in Figure 3, the mean willingness of respondents to contribute to the conservation of wild elephants can be seen to be asymmetrical about the CWEP.

10. 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), β_i represent vectors of unknown parameters, and x_1, x_2 ….x_k represent vectors of explanatory variable used (see Table 5) in the model. Y_i^* 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 = some what 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 = some what valued, 3 = moderately valued, 4 = highly valued.	3.687 (0.48)
NCUVE	Non-consumptive use values 1 = not valued, 2 = some what 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-R^2. 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.

11. 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 is more probable, the greater is 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.

This study also 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.

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. (Forthcoming), "Use and Non-use Values of Wild Asian Elephants: A Total Economic Valuation Approach", *Sri Lanka Journal of Economics Economics.*

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. 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.

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).

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 Lankan Elephants: The Case of Pinnawala 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.; 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.

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.

Nelson, R. H. (1997), "Does 'Existence' Value Exist? Environmental Economics Encroaches.

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.

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, 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).

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.

PREVIOUS WORKING PAPERS IN THE SERIES
ECONOMICS, ECOLOGY AND THE ENVIRONMENT

1. Governance, Property Rights and Sustainable Resource Use: Analysis with Indian Ocean Rim Examples by Clem Tisdell and Kartik Roy, November 1996.
2. Protection of the Environment in Transitional Economies: Strategies and Practices by Clem Tisdell, November 1996.
3. Good Governance in Sustainable Development: The Impact of Institutions by K.C.Roy and C.A.Tisdell, November 1996.
4. Sustainability Issues and Socio-Economic Change in the Jingpo Communities of China: Governance, Culture and Land Rights by Ren Zhuge and Clem Tisdell, November 1996.
5. Sustainable Development and Environmental Conservation: Major Regional Issues with Asian Illustrations by Clem Tisdell, November 1996.
6. Integrated Regional Environmental Studies: The Role of Environmental Economics by Clem Tisdell, December 1996.
7. Poverty and Its Alleviation in Yunnan Province China: Sources, Policies and Solutions by Ren Zhuge and Clem Tisdell, December 1996.
8. Deforestation and Capital Accumulation: Lessons from the Upper Kerinci Region, Indonesia by Dradjad H. Wibowo, Clement a. Tisdell and R. Neil Byron, January 1997.
9. Sectoral Change, Urbanisation and South Asia's Environment in Global Context by Clem Tisdell, April 1997.
10. China's Environmental Problems with Particular Attention to its Energy Supply and Air Quality by Clem Tisdell, April 1997.
11. Weak and Strong Conditions for Sustainable Development: Clarification of concepts and their Policy Application by Clem Tisdell, April 1997.
12. Economic Policy Instruments and Environmental Sustainability: A Second Look at Marketable or Tradeable Pollution or Environmental-Use Permits by Clem Tisdell, April 1997.
13. Agricultural Sustainability in Marginal Areas: Principles, Policies and Examples form Asia by Clem Tisdell, April 1997.
14. Impact on the Poor of Changing Rural Environments and Technologies: Evidence from India and Bangladesh by Clem Tisdell, May 1997.
15. Tourism Economics and its Application to Regional Development by Clem Tisdell, May 1997.
16. Brunei's Quest for Sustainable Development: Diversification and Other Strategies by Clem Tisdell, August 1997.
17. A Review of Reports on Optimal Australian Dugong Populations and Proposed Action/Conservation Plans: An Economic Perspective by Clem Tisdell, October 1997.
18. Compensation for the taking of Resources Interests: Practices in Relations to the Wet Tropics and Fraser Island, General Principles and their Relevance to the Extension of Dugong Protected Areas by Clem Tisdell, October 1997.
19. Deforestation Mechanisms: A Survey by D.H. Wibowo and R.N. Byron, November 1997.
20. Ecotourism: Aspects of its Sustainability and Compatibility by Clem Tisdell, November 1997.

21. A Report Prepared for the Queensland Commercial Fisherman's Organisation by Gavin Ramsay, Clem Tisdell and Steve Harrison (Dept of Economics); David Pullar and Samantha Sun (Dept of Geographical Sciences and Planning) in conjunction with Ian Tibbetts (The School of Marine Science), January 1998.
22. Co-Evolutions in Asia, Markets and Globalization by Clem Tisdell, January 1998.
23. Asia's Livestock Industries: Changes and Environmental Consequences by Clem Tisdell, January 1998.
24. Socio-Economics of Pearl Culture: Industry Changes and Comparisons Focussing on Australia and French Polynesia by Clem Tisdell and Bernard Poirine, August 1998.
25. Asia's (Especially China's) Livestock Industries: Changes and Environmental Consequences by Clem Tisdell, August 1998.
26. Ecotourism: Aspects of its Sustainability and Compatibility with Conservation, Social and Other Objectives, September 1998.
27. Wider Dimensions of Tourism Economics: A Review of Impact Analyses, International Aspects, Development Issues, Sustainability and Environmental Aspects of Tourism, October 1998.
28. Basic Economics of Tourism: An Overview, November 1998.
29. Protecting the Environment in Transitional Situations, November 1998.
30. Australian Environmental Issues: An Overview by Clem Tisdell, December 1998.
31. Trends and Developments in India's Livestock Industries by Clem Tisdell and Jyothi Gali, February 1999.
32. Sea Turtles as a Non-Consumptive Tourism Resource in Australia by Clevo Wilson and Clem Tisdell, August 1999.
33. Transitional Economics and Economics Globalization: Social and Environmental Consequences by Clem Tisdell, August 1999.
34. Co-evolution, Agricultural Practices and Sustainability: Some Major Social and Ecological Issues by Clem Tisdell, August, 1999.
35. Technology Transfer from Publicly Funded Research for improved Water Management: Analysis and Australian Examples by Clem Tisdell, August 1999.
36. Safety and Socio-Economic Issues Raised by Modern Biotechnology by Dayuan Xue and Clem Tisdell, August 1999.
37. Valuing Ecological Functions of Biodiversity in Changbaishan Mountain Biosphere Reserve in Northeast China by Dayuan Xue and Clem Tisdell, March 2000.
38. Neglected Features of the Safe Minimum Standard: Socio-economics and Institutional Dimension by Irmi Seidl and Clem Tisdell, March 2000.
39. Free Trade, Globalisation, the Environment and Sustainability: Major Issues and the Position of WTO by Clem Tisdell, March 2000.
40. Globalisation and the WTO: Attitudes Expressed by Pressure Groups and by Less Developed Countries by Clem Tisdell, May 2000.
41. Sustainability: The Economic Bottom Line by Clem Tisdell, May 2000.
42. Trade and Environment: Evidence from China's Manufacturing Sector by Joseph C. H. Chai, June 2000.
43. Trends and Development in India's Livestock Industry by Clem Tisdell and Jyothi Gali, August 2000.
44. Tourism and Conservation of Sea Turtles by Clem Tisdell and Clevo Wilson, August 2000.
45. Developing Ecotourism for the Survival of Sea Turtles by Clem Tisdell and Clevo Wilson, August 2000.
46. Globalisation, WTO and Sustainable Development by Clem Tisdell, August 2000.

47. Environmental Impact of China's Accession to WTO in the Manufacturing Sector by Joseph Chai, August 2000.
48. Effects of Cartagena Biosafety Protocol on Trade in GMOs, WTO Implications, and Consequences for China (English version) by Dayuan Xue and Clem Tisdell, August 2000.
49. Effects of Cartagena Biosafety Protocol on Trade in GMOs, WTO Implications, and Consequences for China (Chinese version) by Dayuan Xue and Clem Tisdell, August 2000.
50. The Winnipeg Principles, WTO and Sustainable Development: Proposed Policies for Reconciling Trade and the Environment by Clem Tisdell, September 2000.
51. Resources Management within Nature Reserves in China by Dayuan Xue, October 2000.
52. Economics, Educational and Conservation Benefits of Sea Turtle Based Ecotourism: A Study Focused on Mon Repos by Clem Tisdell and Clevo Wilson, October 2000.
53. Why Farmers Continue to use Pesticides despite Environmental, Health and Sustainability Costs by Clevo Wilson and Clem Tisdell, November 2000.
54. Wildlife-based Tourism and Increased Tourist Support for Nature Conservation Financially and Otherwise: Evidence from Sea Turtle Ecotourism at Mon Repos by Clem Tisdell and Clevo Wilson, November 2000.
55. A Study of the Impact of Ecotourism on Environmental Education and Conservation: The Case of Turtle Watching at an Australian Site by Clem Tisdell and Clevo Wilson, December 2000.
56. Environmental Regulations of Land-use and Public Compensation: Principles with Swiss and Australian Examples by Irmi Seidl, Clem Tisdell and Steve Harrison.
57. Analysis of Property Values, Local Government Finances and Reservation of Land for National Parks and Similar Purposes by Clem Tisdell and Leonie Pearson, March 2001.
58. Alternative Specifications and Extensions of the Economic Threshold Concept and the Control of Livestock Pests by Rex Davis and Clem Tisdell, May 2001.
59. Conserving Asian Elephants: Economic Issues Illustrated by Sri Lankan Concerns by Ranjith Bandara and Clem Tisdell, June 2001.
60. World Heritage Listing of Australian Natural Sites: Tourism Stimulus and its Economic Value by Clem Tisdell and Clevo Wilson, September 2001.
61. Aquaculture, Environmental Spillovers and Sustainable Development: Links and Policy Choices by Clem Tisdell, October 2001.
62. Competition, Evolution and Optimisation: Comparisons of Models in Economics and Ecology by Clem Tisdell, October 2001.
63. Aquaculture Economics and Marketing: An Overview by Clem Tisdell, October 2001.
64. Conservation and Economic Benefits of Wildlife-Based Marine tourism: Sea Turtles and Whales as Case Studies by Clevo Wilson and Clem Tisdell, February 2002.
65. Asian Elephants as Agricultural Pests: Damages, Economics of Control and Compensation in Sri Lanka by Ranjith Bandara and Clem Tisdell, February 2002.
66. Rural and Urban Attitudes to the Conservation of Asian Elephants in Sri Lanka: Empirical Evidence by Ranjith Bandara and Clem Tisdell, May 2002.
67. Willingness to Pay for Conservation of the Asian Elephant in Sri Lanka: A Contingent Valuation Study by Ranjith Bandara and Clem Tisdell, May 2002.
68. Bioeconomic Analysis of Aquaculture's Impact on Wild Stocks and Biodiversity by Clem Tisdell, May 2002.
69. Will Bangladesh's Economic Growth Solve its Environmental Problems? by Clem Tisdell, May 2002.

70. Socioeconomic Causes of loss of Genetic Diversity: Analysis and Assessment by Clem Tisdell, June 2002.
71. Empirical Evidence Showing The Relationships Between Three Approaches For Pollution Control by Clevo Wilson, August 2002.
72. Energy-Use, the Environment and Development: Observations with Reference to China and India by Clem Tisdell and Kartik Roy, September 2002.
73. Willingness of Sri Lankan Farmers to Pay for a Scheme to Conserve Elephants: An Empirical Analysis by Ranjith Bandara and Clem Tisdell, January 2003.
74. The Public's Knowledge of and Support for Conservation of Australia's Tree-kangaroos by Clem Tisdell and Clevo Wilson, February 2003.
75. Ecotourism/Wildlife-based Tourism as Contributor to Nature Conservation with Reference to Vanni, Sri Lanka by Clem Tisdell, March 2003.
76. Visitor Profiles and Environmental Attributes, especially of Birds, Attracting Visitors to Lamington National Park: Tourist Attitudes and Economic Issues by Clem Tisdell and Clevo Wilson, March 2003.
77. Wildlife Damage, Insurance/Compensation for Farmers and Conservation: Sri Lankan Elephants as a Case by Ranjith Bandara and Clem Tisdell, May 2003.
78. Open-Cycle Hatcheris, Tourism and Conservation of Sea Turtles: Economic and Ecological Analysis by Clem Tisdell and Clevo Wilson, May 2003.
79. Attitudes to Entry Fees to National Parks: Results and Policy Implications from a Queensland Case Study by Clevo Wilson and Clem Tisdell, June 2003.
80. Use and Non-use Values of Wild Asian Elephants: A Total Economic Valuation Approach byRanjith Bandara and Clem Tisdell June 2003
81. Valuation of Tourism's Natural Resources by Clem Tisdell, August 2003.
82. Visitors' Reaction to Pinnawala Elephant Orphanage in Sri Lanka: A Survey by Clem Tisdell and Ranjith Bandara, August 2003.
83. Property Rights of Landholders in Non-Captive Wildlife and Prospects for Conservation by Clem Tisdell, August 2003.
84. Wildlive-Based Recreation and Local Economic Development: The Case of the Pinnawala Elephant Orphanage in Sri Lanka by Clem Tisdell and Ranjith Bandara, August, 2003.
85. Willingness to Pay for Different Degrees of Abundance of Elephants by Ranjith Bandara and Clem Tisdell, September 2003.
86. Conflicts over Natural Resources and the Environment: Economics and Security by Clevo Wilson and Clem Tisdell, September 2003.
87. The Net Benefit of Saving the Asian Elephant: A Policy and Contingent Valuation Study by Ranjith Bandara and Clem Tisdell, October 2003.
88. Economics of Wildlife Tourism by Clem Tisdell and Clevo Wilson, October 2003.
89. Notes on Market Failure and the Paretian (Kaldor-Hicks) Relevance and Irrelevance of Unfavourable Externalities by Clem Tisdell, December 2003.
90. Does Ecotourism Contribute to Sea Turtle Conservation? Is the Flagship Status of Turtles Advantageous? By Clem Tisdell and Clevo Wilson, December 2003.
91. Influences of Knowledge of Wildlife Species on Patterns of Willingness to Pay for their Conservation by Clem Tisdell, December 2003.
92. Economic Incentives to Conserve Wildlife on Private Lands: Analysis and Policy by Clem Tisdell, December 2003.
93. Recreational Fishing: Its Expansion, its Economic Value and Aquaculture's Role in Sustaining it by Clem Tisdell, December 2003.
94. Tourism as a Contributor to Development in Sri Lanka: An Overview and a Case Study by Clem Tisdell and Ranjith Bandara, January 2004.

95. Birds – Their importance to Visitors to an Australian Rainforest by Clem Tisdell and Clevo Wilson, January 2004.
96. Knowledge of Birds and Willingness to Pay for their Conservation: An Australian Case Study by Clevo Wilson and Clem Tisdell, January 2004.
97. Recreational Fishing and Fishing Policies in the Netherlands and Australia: A Comparative Review.