# Determining Visitor Preferences for Rhinoceros Conservation Management at Private Ecotourism Game Reserves in the Eastern Cape Province, South Africa: A Choice Modeling Experiment.

Deborah E. Lee*, Mario Du Preez†

February 19, 2015

**Abstract**

South Africa harbours 95 percent of the world's threatened white rhinoceros (18 000) population and 40 percent of the critically endangered black rhinoceros (1 950) population. Increased levels of rhinoceros poaching in South Africa, and the imminent threat of extinction, has emphasized the need for improved management and conservation policies. This pilot study employs a discrete choice experiment in order to value selected supply-side rhinoceros management and conservation strategies at private, ecotourism game reserves in the Eastern Cape Province, South Africa. The valuation setting is couched in real-world management and conservation strategies presently under consideration at state-owned and privately-owned nature reserves in South Africa. Results suggest that visitors to private, ecotourism reserves support the sale of stockpiled rhinoceros horn (as indicated by positive and significant derived values) but are strongly opposed to the introduction of trophy hunting or the continuation of rhinoceros darting experiences (as indicated by negative and significant derived values). Based on the findings of this study, it appears that the choice experiment technique is a promising instrument, which can inform the design of rhinoceros management and conservation policies for privately-owned, ecotourism game reserves in South Africa, with the possibility of extending its use to state-owned nature reserves.

Keywords: Discrete choice experiment, implicit price, ecotourism, game reserve, rhinoceros

*Corresponding author. E-mail address: Deborah.lee@nmmu.ac.za; Tel: +002741 5042206.

†Department of Economics, Nelson Mandela Metropolitan University, PO Box 77000, Port Elizabeth, South Africa

# 1 Introduction

South Africa currently harbours approximately 95 percent (or 18 000) of the world's threatened white rhinoceros (*Ceratotherium simum simum*) and 40 percent (or 1 950) of the world's critically endangered black rhinoceros (*Diceros bicornis*) (Crawford, 2011). Of the 18 000 white rhinoceros (rhino for short), about 4 600 are owned by private reserves, whereas about 486 of the 1 950 black rhino are owned by private reserves. As of 2012, this represented more rhino than could be found in the rest of the African continent. Recent data, however, suggests that the poaching of rhino on both public and privately-owned land has tripled in South Africa between 2010 and 2013 (Department of Environmental Affairs (DEA), 2013). More specifically, from the year 2000 up until the end of 2009, only 325 rhinos were poached (33 per annum on average), whereas in 2010, 2011, 2012 and 2013 the number of rhinos poached were 333, 448, 668, and 1004, respectively. In 2014, starting January 1 until December 10, 1 116 rhinos were killed for their horn in South Africa (DEA, 2013). This translates into roughly three a day or one rhino every eight hours. At the time of writing (December 2014), 52 rhinos had been poached over a two-week period in the Kruger National Park (the government's flagship nature reserve and one of the largest ones worldwide)[1]. This unprecedented amount of poaching of rhino horn in South Africa is steadily moving the black and white rhino towards extinction.

A number of reasons for the high incidence of rhino poaching have been offered. First, the inelastic demand for rhino horn, originating mainly from China and Vietnam, which is primarily driven by medicinal, wealth and status considerations (Conrad, 2012; Shaw, 2011). Second, the development of a burgeoning black market due to the banning of and/or restriction of rhino trade by CITES (Conrad, 2012). Third, the complete lack of or poorly defined property rights, which impede conservation efforts ('tragedy of the commons'). Fourth, the potential for rhino-human conflict, which impose further costs on their sustainability. Fifth, the poor conviction rate of offenders (such as poachers), which is mainly due to corruption in the legal system.

The protection of rhino is, however, prohibitively expensive, especially for private nature reserves in South Africa as the government has removed all financial and related support for the safeguarding of rhino on privately-owned land. It has thus become increasingly difficult for private landowners to keep rhino as, in many cases, it is no longer economically viable to do so (the costs of protection outweigh the monetary benefits of tourism). The exorbitant cost of anti-poaching efforts and the difficulty in patrolling a vast land surface area, has even forced the state-funded Kruger National Park to relocate many of its rhinos to secret, smaller locations around South Africa.

The accelerated rate of poaching incidents over the recent past, coupled with the very high cost of anti-poaching measures, reveals an urgent need to develop a more holistic conservation approach, consisting of complementary management plans in order to secure the future sustainability of the species. This

[1] For security reasons, the exact number of rhino poached on privately owned land is not made readily available to the general public.

sentiment was echoed in South Africa by, *inter alia*, the Endangered Wildlife Trust (EWT), the Wilderness Foundation (WF), the Private Rhino Owner's Association (PROA) and the Rhino Management Group (RMG) (Crawford, 2011). A more holistic approach necessitates the investigation of both demand-side and supply-side conservation policies. Demand-side policies attempt to decrease foreign demand for rhino horn through changing the 'mindset' of those individuals who believe in its medicinal value. While they are important, it is debatable whether these policies will garner sufficient support in time to stop the rhino population dropping below the minimum population threshold (Fischer, 2010). As a result, conservationists and other stakeholders have suggested that supply-side policies may be preferable for the recovery of endangered species populations (Damania & Bulte, 2007).

In the case of rhino management and conservation these policies include, but are not limited to, the sale of live rhino, the sale of stockpiled horn, dehorning, poisoning of the horn, trophy hunting and darting experiences (which includes tagging). It is with respect to these supply-side policies that this paper aims to make a contribution. More specifically, the objective of this study is to provide various nature reserve owners, wildlife agencies, policy-makers and other stakeholders with much needed information on visitor preferences for various supply-side management and conservation strategies by employing the choice experiment (CE) method. The latter is a stated preference technique, which is capable of gauging the public's support (willingness to pay) for various rhino management and conservation options. It is argued here that the money raised through the implementation of these options could aid in funding anti-poaching measures. The locus of the study constitutes privately-owned, ecotourism nature reserves in the Eastern Cape (EC) Province, South Africa. This study does not distinguish between white and black rhinos since both species are severely threatened and, as such, both require immediate intervention in terms of management and conservation – the same management and conservation strategies would apply to both species.

The contribution of this study to the literature is twofold. First, it adds to the limited work on the use of CEs to rhino management and conservation. To the authors' knowledge, no CEs exist which deal exclusively with rhino management and conservation. Second, this study is one of only a handful of CE applications that have been conducted in South Africa.

The paper is organised as follows: The next section discusses rhino conservation in South Africa and the case of private ecotourism game reserves in the EC. In Section 3, an overview of valuation and rhino-related studies is presented. Section 4 describes the research methodology employed. The estimation results of the econometric analyses are reported in Section 5. Section 6 provides a discussion and Section 7 conclusions.

# 2 The Case Study: Rhino Conservation and the Case of Private, Ecotourism Game Reserves in the EC Province, South Africa

## 2.1 *Rhino Conservation Strategies in South Africa*

Prior to the $20^{th}$ Century, black rhinos in Africa numbered in the 100 000s (Crawford, 2011) but the southern white rhino, however, was on the verge of extinction. During the mid-$20^{th}$ Century, the implementation of 'Operation Rhino' in South Africa allowed the population of white rhino to recover to almost 900, these being found largely in the Kwazulu-Natal Province (Milliken & Shaw, 2012), whilst the black rhino was being hunted to the brink of extinction. In an attempt to protect, *inter alia*, these species, a multilateral treaty, known as the Convention on International Trade in Endangered Species (CITES), was signed by 80 countries (CITES, 2013). The treaty came into force in 1975, and regulated plant and animal trade through placing species in different categories (Appendix I or II), based on their endangered status (Conrad, 2012). In 1975, the white and black rhino were allocated to Appendix I, implying they were both in danger of becoming extinct, and thus all commercial trade in their product was prohibited (Conrad, 2012). In 2005, the white rhino was down-listed from Appendix I to Appendix II, which meant that potential trade was not prohibited *per se*, but was now subject to strict regulation (Conrad, 2012). By 2012, the numbers of white rhino recovered to approximately 18 800. Despite the ratification of CITES and the African governments' best conservation efforts given limited resources, the numbers of black rhino have dropped from about 100 000 in 1960 to approximately 4 880 currently (Crawford, 2011).

In response to the rhino poaching crisis in South Africa, two strategy documents were developed, one for white rhino and one for black rhino. The white rhino strategy, published in 2003, is entitled 'A strategy for the conservation and sustainable use of wild populations of southern white rhino'. The black rhino strategy document is entitled 'The biodiversity management plan for South Africa's black rhino' (DEA, 2013). In addition to these two strategy documents, the DEA has also drafted a policy document entitled 'National strategy for the safety and security of rhino populations in South Africa' (DEA, 2013). According to the DEA policy, short-term interventions require supply-side policies which can aid in law-enforcement and provide financial and related support to private landowners and public structures (DEA, 2013). Longer-term strategies include firstly, securing the commitment of government, private landowners and international bodies in order to implement this policy, secondly, supporting the development of a national structure for co-ordinated information management, including enforcement, investigation and prosecution, if required, thirdly, developing an integrated management information system where all rhino information can be centrally and securely stored to aid security efforts, and lastly investigating other proactive measures for the possible implementation of regulated and controlled international trade into the future (DEA, 2013).

## 2.2 *The EC Province Scenario*

With an estimated size of 169 000 square kilometres, the EC is the second largest province in South Africa and plays host to some of the most well-known privately-owned nature reserves in South Africa, including the world-renowned Shamwari Game Reserve. The EC Private Nature Reserve Association (known as INDALO), formed in 2002, represents ecotourism-based, private game reserves in the EC. These reserves not only promote sustainability through their management practices, but also run local projects aimed specifically at uplifting previously disadvantaged communities in the area. The ten member reserves within INDALO all keep rhino, and have all suffered in some way from the scourge of rhino poaching. This province is also home to an established black rhino breeding population, which implies higher costs for those reserves tasked with their protection (Centre for African Conservation Ecology (CACE), 2011).

## 2.3 *Possible Supply-side Management Policies for Private, Ecotourism Game Reserves*

### 2.3.1 *The Sale of Live Rhino*

In South Africa, it is permissible to sell white and black rhino. The owner of the rhino, however, requires a permit before the sale can take place (DEA, 2013). The average price of a live rhino has fallen due to costly increases in anti-poaching security necessary to keep them alive (Collins, Fraser & Snowball, 2012). There is also the issue of illegal purchases of privately owned rhino, for the sole purpose of killing them for their horns (Rademeyer, 2012). The attractiveness of this option to the private ecotourism game reserve owner, however, is that the sale can still generate much needed revenue for funding existing or new anti-poaching security measures.

### 2.3.2 *The Potential Sale of Privately-held Stockpiled Rhino Horn*

This option involves selling existing, privately-owned, stockpiled horns in a controlled market setting. Although currently illegal, this process could be facilitated by applying to the CITES for a trial period during which a certain percentage of public and privately-owned stockpiled, dry horn is sold. A study by Brown and Layton (2001) showed that the sale of stockpiled rhino horn could potentially help address the issue of poaching with respect to the black rhino. Currently, the existence of a trade ban on stockpiled rhino horn is argued to be worsening the poaching crisis, having the opposite intended effect on the species it is supposed to protect (Conrad, 2012). Damania and Bulte (2007) argued that prices of horn could be lowered through flooding the market with stockpiled horn. There are those, however, who argue that the sale of stockpiled horn on the open market might simply increase demand for rhino horn, providing further incentives to increase their poaching efforts (Brown & Layton, 2001; Conrad, 2012).

### 2.3.3 *Dehorning Operations and the Potential Sale of New Privately-owned Rhino Horn*

Dehorning refers to a medical procedure where trained personnel (with a veterinarian present) shoot an adult rhino with a tranquiliser gun and then carefully saw off a portion of its horn. This horn would then be sold in a controlled environment where proper structures are already in place. The dehorning of rhino has found some support within the private game reserve community (Lindsey & Taylor, 2011). This process, however, is expensive with the dehorning of one rhino costing between ZAR6 000 and ZAR10 000 each time (Lindsey & Taylor, 2011). Rhino horn is estimated to grow about six centimetres (cm) each year. This implies dehorning would have to take place at least once every two years.

### 2.3.4 *The Introduction of Trophy Hunting on Ecotourism Game Reserves*

Private ecotourism game reserves do, for the most part, not promote or allow trophy hunting expeditions. In South Africa, trophy hunting is legal, however, only a limited number of permits are issued per annum (DEA, 2013). This number is based on current numbers of rhino as well as the population growth rate. Some studies have shown that trophy hunting can generate important incentives for rhino conservation (World Wildlife Fund South Africa (WWFSA), 2008). In Namibia, for example, a maximum of five hunting permits are sold per annum with the entire trophy fee of US$350 000 going to a trust fund that supports rhino conservation efforts in the country (Conniff, 2014). On such a low scale in South Africa, it is believed that carefully-managed and controlled hunting expeditions would not endanger the survival of the rhino, but could add value to owning and protecting them into the future.

### 2.3.5 *The Accompanying of Rhino-darting Experiences*

Darting safaris or 'green hunts' are no longer allowed by the South African conservation authorities (DEA, 2013). Accompanying a darting team, however, can be an attractive outdoor experience for private ecotourism game reserve visitors (Sholto-Douglas, 2013). This experience includes tracking of the rhino by helicopter, the darting of the animal by a qualified veterinarian, and an informative discussion on the processes that follows. The visitor is allowed to take photographs while the veterinarian notches the animal's ear, draws blood for DNA purposes and tags the animal for future monitoring. Not only is this a personal experience for the visitor, it can also assist with the creation of public awareness of current rhino management conservation efforts (Joubert, 2013; Visser, 2013).

### 2.3.6 *The Poisoning of Rhino Horn*

This option was initially suggested by Mr Ed Hern, owner of the Rhino and Lion Reserve, near Johannesburg, South Africa, who stated that the injection of

poison into a rhino's horns could be used as an effective tool to deter prospective rhino poachers. This concept was further developed into the Rhino Rescue Project, where the process of poisoning the horn became generally accepted across South Africa as a possible way of mitigating the poaching problem. The actual poisoning process involves drilling holes directly into the rhino's horns and then injecting in a highly toxic substance. This substance is considered safe for animals, however, ingestion by humans could lead to symptoms such as nausea, vomiting and convulsions. In addition to poisoning the horn, a bright coloured dye was also injected in an attempt to ward off potential poachers. A number of public and privately owned game reserves used this approach as one of their prevention measures, however, it was quickly found to be largely ineffective in mitigating the poaching problem (Ferreira, Hofmeyr, Pienaar & Cooper, 2014). The reasons were twofold: firstly, it was assumed that poachers would be deterred from killing rhino with poisoned horns but they were not, and secondly, it was assumed that consumers would not be willing to buy rhino horn that had been poisoned but they were. Given scarce resources, funds should ideally be focussed in management areas where they would have the most positive impact, and as such, the poisoning (and dyeing) of rhino horn was not included as a feasible management option in this study.

# 3 An Overview of Valuation and Rhino-related Studies

There are a number of international studies that have attempted to value endangered species through the application of a stated preference technique i.e. the contingent valuation method (CVM). These studies included the valuation of the possum in Australia (Jakobsson & Dragun, 2001), the Panda in China (Kontoleon & Swanson, 2003), the turtle in China, Philippines, Thailand and Vietnam (Jianjun, Indab, Nabangchang, Thuy, Harder & Subade, 2006; Tuan & Lindhjem, 2012), the elephant in Sri Lanka and India (Bandara & Tisdell, 2005; Ninan & Sathyapalan, 2005) and the shark in the Philippines (Indab, 2006). A review of international literature, however, revealed that only two CVM studies, in particular, have been conducted to value the endangered rhino.

A study conducted by Swanson, Mourato, Swierzbinski and Kontoleon (2002) valued management options for the preservation of the Namibian black rhino. Various conservation management options put forward by Swanson *et al.* (2002) for the conservation of black rhino (in Namibia) included firstly, an increase in entry fees, secondly, the sale of live rhinos, thirdly, the sale of stockpiled horns, fourth, dehorning operations, fifth, darting safaris, and sixth, trophy hunting. The increase in entry fees was aimed at photographic safaris and the general viewing of animals in the wild. The sale of a small number of live rhino could be carried out each year on a long-term basis. It was also suggested that any existing stockpiled horns be marketed in a controlled trade environment. This option was only feasible, however, if the legal trading of rhino horn was allowed.

The dehorning option allows for the safe removal of the rhino horn, however, was also only feasible if the harvested horns could be sold in a controlled trade environment. There was also a potential demand for darting safaris where tourist-hunters could shoot rhino with tranquiliser guns. The trophy hunting option allowed tourist-hunters to shoot and kill an adult black rhino, however this could only be done in small numbers and required stringent control measures in order not to endanger the survival of the species. Swanson *et al.* (2002) postulated that these management options would provide sources of funding for the conservation of rhino. It was, however, conceded that the money generated through these management options would not be enough to fund the entire conservation effort required to protect rhino in Namibia. The study argued that the shortfall should be made up by funding from government agencies.

The second study by Thuy (2007) measured the WTP for a conservation program for the Vietnamese rhino. This study formed part of a larger research project on the WTP for the conservation of endangered species in Southeast Asia. The study employed the dichotomous elicitation format where five bid levels were offered randomly to respondents. A sample of 800 households was targeted in two Vietnamese cities, namely Ho Chi Minh City and Hanoi City. The response was 690 households and the mean WTP for the conservation of the Vietnamese rhino was estimated at US$2.50 per household.

The studies mentioned above made use of the CVM in order to estimate WTP for conservation of the specific endangered species. The CE method, however, is more appropriate in this case as it forces the public to make trade-offs among various conservation management alternatives, and in so doing, reveal which of these is most preferred. This information is vital in the context of resource management decision making, where scarce resources need to be allocated between competing conservation management issues. To the authors' knowledge, this is the first application of a CE in the context of rhino conservation management.

# 4 Research Methodology: CEs

The CE method's main claim to superiority over the dichotomous elicitation format of the CVM, its close methodological relative, is that it is better suited to the analysis of changes that are multidimensional and less prone to protest bids and strategic bidding and yeah saying biases (Hanley, Mourato & Wright, 2001). For the purpose of rhino conservation management, the CE method is appropriate because the decision issues are typically multidimensional and interdependent. By including a cost attribute within the set of management options, marginal value for the specific management interventions can be deduced, and utilised to assist to help prioritise management effort.

## 4.1 *CE Design*

The first step in designing the survey was to identify which rhino management and conservation options were considered feasible for inclusion in the study. To this end, interviews were conducted with the managers/owners of private ecotourism game reserves in the EC, veterinarians, and anti-poaching personnel In addition, the choice of attributes was also informed by an extensive review of the literature on rhino management and conservation. The proposed rhino management and conservation options ranked most important by the interviewees were then translated into management and conservation attributes with their respective levels. The non-monetary attributes were allowed to vary in two levels: yes (1) and no (0). The attributes selected for this study and their corresponding levels are presented in Table 1 below. The five rhino management options (attributes) selected included 'The sale of live rhino', 'The potential sale of existing privately owned stockpiled horn', 'Dehorning operations and the potential sale of new stockpiled horn', 'The introduction of trophy hunting expeditions' and 'The accompanying of a rhino darting experience' (These were discussed in Section 2.3 above.). The sixth attribute represented the payment vehicle and was defined as a voluntary, once-off donation made by visitors to private ecotourism game reserves in the EC.

Collection of this proposed donation would occur on entry to private ecotourism game reserves in the EC – visitors who engage in multiple visits or visit multiple reserves in a year would only be asked to make a donation once-off Visitors would be asked at the gate if they are willing to make a donation to support a publicly preferred set of management and conservation programmes. The donations would be directed back to these private ecotourism game reserves to help finance rhino anti-poaching measures. The funds would be forwarded to, and managed by the PROA and allocated according to a set of qualifying PROA anti-poaching criteria. The donation values are based on extensive discussions with reserve owners and anti-poaching personnel regarding the cost of funding an additional entry level ranger for a maximum period of one week. These values include ZAR60, ZAR120, ZAR360 and ZAR720. In addition, a *status quo* value of ZAR0 was also included. Note that the ZAR0 donation value only made an appearance in the status quo option due to the fact that all other management and conservation options required some form of payment. A pilot study revealed that the selected values are appropriate – respondents felt that these values were realistic and non-controversial.

It has been argued that the use of a voluntary donation as the payment vehicle in CVM studies of environmental projects have led to some form of hypothetical bias – the tendency for respondents to overstate their hypothetical willingness to pay (WTP) due to a so-called 'warm glow' effect (Carlsson & Martinsson, 1999). The empirical results of certain studies have confirmed this (see for example, Seip & Strand, 1992; Brown, Champ, Bishop & McCollum, 1996). A meta-analysis study by Carson, Flores, Martin and Wright (1996) has, however, found that CVM estimates of welfare measures are somewhat lower than those generated by their revealed preference method counterparts – an

indication of external validity As far as the CE technique is concerned, Carlsson and Martinsson (1999) maintain that it constitutes a viable way of assessing preferences, especially due to the absence of the overstatement of WTP in a hypothetical setting.

A large number of distinctive rhino management and conservation scenarios can be constructed taking into account the number of attributes and levels in this study – a total of 64 different choice alternatives were possible (2x2x2x2x4), known as a full-factorial design. Since the number of possible alternatives was too large and cumbersome for practical implementation, the 'Statistical Package for the Social Sciences (SPSS) software and experimental design methods (Louviere, Hensher & Swait, 2000; Hensher, Rose & Greene, 2005) were employed to obtain an orthogonal fractional factorial design which yielded a minimum of 16 different treatment combinations or alternatives. This design is deemed a 'main effects' one where a main effect refers to an isolated attribute effect on the probability of choice. Louviere et al. (2000) has found that 'main effects' account for 70 to 90 percent of explained variances.

For the purposes of this study, each questionnaire was assigned four choice sets. These were randomly allocated to the questionnaires. The alternatives presented in the choice sets were unlabelled. The respondent was requested to choose their favourite alternative from among three rhino conservation management alternatives, one of which represented the *status quo* (current situation) The respondent was then requested to repeat the choice exercise three more times for different choice sets. The inclusion of the *status quo* alternative is essential for the estimation of welfare measures that accord with standard demand theory (Louviere et al. 2000; Bennett & Adamowicz, 2001). An example of a choice set is provided in Figure 1.

The questionnaire was made-up of five sections: (1) attitudes of the respondent to rhino management and conservation; (2) visitation data; (3) CE exercise; (4) follow-up questions to choice exercise; (5) socio-economic information. The pilot study revealed that respondents were generally satisfied with the structure and wording, the level of complexity (especially the choice task), and the length of the questionnaire

## 4.2 *CE Data Collection*

The CE questionnaire survey was administered face-to-face during December 2013 and January 2014 by 5 trained enumerators. Respondents were given a small gift as compensation for their time and effort if they completed the survey. The non-probability quota sampling technique was used to construct a sample of 219 respondents who were visitors to INDALO-affiliated reserves. The enumerators followed the intercept sample method – this method was deemed appropriate since the users of these reserves do not reveal themselves until they actually visit the reserves. In order to be representative of the target population of visitors to INDALO-affiliated reserves, the sample was stratified according to visitor origin. This information was obtained from a report commissioned by INDALO and developed by the CACE at Nelson Mandela Metropolitan

University (NMMU) (CACE, 2011). This information is presented in Table 2.

Before commencement of the choice exercise, the enumerators explained each attribute and their respective levels to the respondent. In order to prevent the occurrence of part-whole bias, respondents were reminded of their budget constraints, that this study deals exclusively with rhino management and conservation in privately-owned, ecotourism nature reserves in the EC Province, South Africa, and that this particular rhino management and conservation option constitutes one of many possible conservation initiatives (around the world, including South Africa) to which they may wish to donate money.

### 4.3 *Statistical methods*

Random utility theory (RUT) forms the theoretical basis for CE:

$$U_{iq} = V_{iq} + \varepsilon_{iq} \tag{1}$$

where:

$U_{iq}$represents utility derived for consumer $q$ from option $i$,

$V_{iq}$is an attribute vector representing the observable component of utility from option $i$ for consumer $q$, and

$\varepsilon_{iq}$is the unobservable component of latent utility derived for consumer $q$ from option $i$

As mentioned above, the CE was designed so that each respondent (visitor to a private, ecotourism nature reserve) would be offered four choice sets, each consisting of three rhino management and conservation alternatives (two new alternatives and the current situation) where each alternative is defined by specific attributes and their respective levels. Analysing choices among three alternatives as a function of the attributes of the alternatives requires the use of a conditional logit (CL) model. The CL model has the following form:

$$P(i|A) = \frac{1}{\sum_{j=1}^{j} \exp -(V_i - V_j)} \tag{2}$$

where:

$P_i$ is the probability of an individual choosing the $i$th alternative over the j$^{th}$ in the set of choices A,

$V_i$ is the representative utility from the $i$th alternative, and

$V_j$ is the representative utility from the $j$th alternative (Louviere *et al.*, 2000).

An important assumption regarding the CL model is property of independence of irrelevant alternatives (IIA), which requires that the relative probabilities of choosing between any two alternatives be unaffected by the introduction or removal of other options (Louviere et al., 2000; Haab & McConnell, 2002; Hensher et al., 2005). The CL model may produce biased estimates if the IIA assumption is violated due to the fact that the observed and unobserved components of utility can be dependent on one another and the error term exhibit

serial correlation. The CL model also assumes that there is homogeneity in preferences across respondents, which implies that consumers that exhibit the same socioeconomic characteristics, for example level of income, will value the good in question in an equal manner. In reality, preferences are often heterogeneous in nature (MacDonald et al., 2005; Ben-Akiva & Lerman, 1985; Louviere et al., 2000).

It may be more appropriate to estimate a random parameters logit (RPL) model if any of these assumptions are violated (Hensher et al., 2005). A generalised version of the RPL model can be shown as follows:

$$P(j|\mu_i) = \frac{\exp(\alpha_{ji} + \theta_j \mathbf{z}_i + \delta_j \mathbf{f}_{ji} + \beta_{ji} \mathbf{x}_{ji})}{\sum_{j=1}^{J} \exp(\alpha_{ji} + \theta_j \mathbf{z}_i + \delta_j \mathbf{f}_{ji} + \beta_{ji} \mathbf{x}_{ji})} \tag{3}$$

where:

$\alpha_{iq}$ is a fixed or random alternative specific constant (ASC) with $i = 1, 2....,n$ alternatives and $q = 1,....,n$ individuals; and $\alpha_i = 0$,

$\delta_i$ is a vector of non-random parameters,

$\beta_{iq}$ is a parameter vector that is randomly distributed across individuals,

$\mu_q$ is a component of the $\beta_{iq}$ vector,

$\boldsymbol{z}_q$is a vector of individual-specific characteristics, for example, income,

$\boldsymbol{f}_{iq}$is a vector of individual-specific and alternative-specific attributes,

$\boldsymbol{x}_{iq}$is a vector of individual-specific and alternative-specific attributes, and

$\mu_q$ is the individual-specific random disturbance of unobserved heterogeneity (Louviere et al., 2000).

The RPL allows the researcher the freedom to determine which variables to distribute and which distributions to choose. In most cases, all non-price variables are randomised and the cost variable is retained as a non-random variable (Anderson, 2003). Some applications only randomise the cost variable (Layton, 2000). The former choice is favoured for two reasons. Firstly, the distribution of the marginal WTP for an attribute is simply the distribution of that attribute's parameter estimate, and secondly, it allows the cost variable to be restricted to be non-positive for all individuals (Carlsson, Frykblom & Liljenstople, 2003). The most popular distribution assumptions are normal, triangular, uniform and log-normal distributions (Bhat, 2000; Bhat, 2001).

# 5 Results

## 5.1 *Socio-economic Characteristics and Respondent Attitudes*

Socio-economic characteristics of respondents are presented in Table 3. These results are representative of visitor origin i.e. approximately 32 percent of respondents were local whilst 68 percent of respondents were international visitors.

Approximately half of the sample was female. In terms of educational attainment, 64 percent had obtained a higher education qualification. The average age

of those sampled was 41 years, with a minimum of 18 years and a maximum of 86 years – there were no respondents younger than 18 years since they were deliberately excluded from the sample.At least 55 percent of respondents sampled earned a gross annual income of more than ZAR400 000 (US$40 000). In terms of attitudes, 45 percent of respondents felt that the level of rhino conservation and protection in South Africa is inadequate. This is compared to 16 percent of respondents who thought it was sufficient. Another finding was that 57 percent of respondents did not want CITES to lift the trade ban on rhino horn – it is important to note that these statements were made before respondents engaged in the task of making choices amongst different alternatives. Approximately 53 percent of respondents did not believe that dehorning a rhino would devalue their ecotourism experience. When choosing which private ecotourism game reserve to visit, respondent choice was largely driven by recommendations by friends, as well as the presence of the 'Big Five'.

## 5.2 *Econometric Results*

Using LIMDEP NLOGIT Version 4.0, a CL model and an RPL model were estimated. The models show the importance of choice set attributes in explaining respondents' choices across the three options: option A, option B and the *status quo* The models provide an estimate of the effect of a change in any of these rhino management attributes on the probability that one of these options will be chosen.

### 5.2.1 *CL Model*

Table 4 shows the estimated results for the CL model. Despite the fact that the results for the CL model show a relatively low overall fit (see McFadden's $R^2$), all the signs of the coefficients are as expected *a priori*, and four of the six coefficients are statistically significant – one is significant at the 10 percent level and three are significant at the 1 percent level.

The coefficients for 'Live rhino' and 'Dehorning operations' are not statistically significant, implying there is some disagreement amongst respondents regarding the use of these management options to raise funds for private rhino conservation.

The 'Sale of stockpiled horn' coefficient is, however, significant at the 10 percent level and has a positive sign suggesting moderate support for the sale of stockpiled horn – in other words, *ceteris paribus* the inclusion of the sale of stockpiled horn increased the probability that a management and conservation scenario is selected. This finding accords with that of the Swanson et al. (2002) study namely that "...selling stockpiled horns seem to generate widespread support."

The coefficients for 'Trophy hunting' and 'Rhino darting' are negative, and highly statistically significant, implying that respondents oppose the use of these management and conservation options – in other words, the respondents are willing to donate money to prevent the nature reserves having to resort to using

these options to raise funds for rhino conservation. The proposed introduction of trophy hunting and rhino darting in an alternative decreased the probability of that alternative being chosen. The donation coefficient is statistically significant and its sign is indicative of the fact that utility is negatively affected if an option with a higher donation level is chosen – this result is encouraging since the donation coefficient is vital to the calculation of welfare measures.

#### 5.2.2 *RPL Model*

Table 4 above shows the estimation results for the RPL model in the second column. All the parameters except the donation attribute were specified to be uniformly distributed. The RPL model shows a better overall fit compared to the CL model but not unlike the CL model, all the signs of the coefficients are as expected *a priori*, and the same four coefficients are statistically significant – one at the 10 percent level and three at the 1 percent level.

The RPL model estimates show insignificant and small derived standard deviations for four attributes, namely Sale of live rhino, Sale of stockpiled horn, Trophy hunting and Rhino darting, which reveals that the data does not support choice specific unconditional unobserved heterogeneity for these attributes. The derived standard deviation for Dehorning operations is large and significant indicating some preference heterogeneity although its estimated parameter was insignificant. Since none of the significant parameter estimates indicated unobserved heterogeneity, further investigation of the sources of heterogeneity in this case was unnecessary.

#### 5.2.3 *WTP Estimates*

Once the CL and RPL models have been estimated, their respective parameter estimates can be used to calculate marginal WTP values for each attribute, also known as their implicit prices. These are calculated by determining the marginal rates of substitution between the individual management attributes and the marginal utility of income (the coefficient for cost or donation in this case) (Hanemann, 1984). Table 5 reports the implicit prices for each of the significant rhino management and conservation attributes estimated using the Delta method (Wald procedure) in LIMDEP NLOGIT Version 4.0 (Greene, 2007).

These values indicate that the maximum amount, on average, that a person is willing to donate for the adoption of the sale of stockpiled horn as a management and conservation strategy is ZAR185 per visitor (2014 prices). Unfortunately, there are no values from other studies to which this value may be compared.

Individual visitors are also willing, on average, to donate ZAR1 043 in order to ensure that trophy hunting is not allowed in private, ecotourism game reserves (2014 price level). In comparison, respondents in a study conducted by Swanson et al. (2002) were willing to pay £2.51 (approximately ZAR43 at 2014 price levels) once-off to avoid trophy hunting of black rhinos in Namibia. A possible reason for the large discrepancy between these two values could be the

phenomenon known as 'distance decay' – those who are physically closer to the problem may value it more highly than those who are physically removed from it. Another reason may be that the Swanson et al. (2002) study was conducted at a time when the poaching of rhino was less pronounced.

The rhino darting experience is also not favoured by the public as a possible management and conservation intervention. A visitor is willing, on average, to donate ZAR400 to the PROA conservation fund in order for these expeditions to be discontinued (2014 prices). Once again, there are no values from other studies to which this value may be compared.

#### 5.2.4 *An analysis of follow-up questions: issues of reliability and validity*

Four follow-up questions on the respondents' experience of the CE exercise were asked after completion of the choice exercise. The inclusion of these questions aimed to allow an assessment to be made of the extent to which the respondents' decision strategies conformed to the assumptions underlying the CE approach. In the first follow-up question, respondents were asked whether they found it difficult or easy to complete the CE. The majority of respondents (55%) found it easy to make the necessary choices, did not need to adopt a simplified decision rule to make their choice selections easier, felt the CE was not overly complicated and was not too time-consuming.

The next question was only answered by those respondents who indicated that the choice task was difficult. Table 6 below shows the percentage breakdown of these answers.

The responses to this question shed light on how different parts of the CE are understood. One of the assumptions underlying the use of the CE method is that individuals apply compensatory decision making strategies, that "individuals are assumed to consider all attributes, and make trade-offs between all attributes within the choice sets provided in the design" (Watson, Phimister & Ryan, 2004). Encouragingly, of the 'problem' respondents, 50 percent chose the "Several factors important" answer-option, indicating that they were aware of the need to adopt a compensatory decision-making strategy.

The next follow-up question was a policy-orientated question, which asked the respondents whether they would visit a private game reserve more often or whether their visitation would remain the same if the rhino conservation efforts were improved? The majority of visitors (63%) indicated that they would visit more often if the rhino conservation efforts were improved.

The final follow-up question asked whether voluntary contributions (donations) represent a credible way of funding rhino conservation on private ecotourism game reserves. The majority of respondents (82%) indicated that voluntary contributions (donations) represent a credible way of funding rhino conservation on private ecotourism game reserves.

# 6 Discussion

The aim of this pilot study was to provide various conservation bodies and reserve owners with supply-side strategies that visitors preferred for managing and conserving rhino on privately-owned land. With no government funding support for rhino protection on private land, it was envisaged that the results from this study could assist private reserves in gauging the amount of public support (expressed by voluntary donations) for several rhino management and conservation measures. Voluntary donations are, and will become even more important in the future to fund anti-poaching measures, especially if the current rate of poaching does not abate.

The results indicate moderate support by private ecotourism game reserve visitors for the sale of stockpiled rhino horn (a donation of ZAR185) but significant opposition to both trophy hunting and the introduction of rhino darting experiences on private, ecotourism game reserves. More specifically, a visitor is willing to donate approximately ZAR1 043 to avoid reserves having to resort to trophy hunting to finance their anti-poaching operations, and ZAR400 to avoid reserves having to resort to darting experiences. The latter result is somewhat surprising as these darting experiences could potentially assist with the creation of public awareness surrounding the difficulties and complexities of current rhino anti-poaching efforts.

These results would allow private ecotourism game reserves, through the control of the PROA, to develop an integrated rhino management and conservation policy. The latter would take into account the dissenting voices of the majority of visitors with respect to trophy hunting and darting experiences as well as the supportive ones with respect to the sale of stockpiled horn. With this management and conservation policy in place, the reserves could potentially earn a voluntary donation of ZAR1 627 per visitor. These funds would be collected and administered across the EC by the PROA.

In terms of affordability, this amount is relatively high for local visitors. Foreign visitors, however, were found to be more willing to donate such a high amount for the conservation of rhino in these game reserves. Foreign visitors make up approximately 70 percent of all visitors to private ecotourism game reserves in the EC (CACE, 2011) An average of 8 850 bed nights was sold over the 2009/2010 period (CACE, 2011). Assuming that each visitor stays an average of 2 nights, this implies that approximately 4 425 visitors are recorded as visiting INDALO game reserves over that period (CACE, 2011). With a conservative estimate of 65 percent and 40 percent of foreign and local visitors, respectively, donating ZAR1 628, a total amount of ZAR386 million could be raised for funding private rhino anti-poaching initiatives in the EC (2014 prices) It is important to note that this amount excludes possible donations from private game reserves that are not members of INDALO. It also excludes all day visitors. With approximately 780 day visitors to INDALO reserves during the 2009/2010 period, and a donation payment by 40 percent of visitors, this could add a further ZAR50 000 to the PROA anti-poaching fund.

# 7 Conclusions

The application of CEs to natural resource valuation and, specifically, to valuing rhino management and conservation options in South Africa is a recent development. This paper adds to the limited literature on the determination of economic values of various rhino management and conservation strategies using discrete choice experiments. This study is also the only one of its kind that has been undertaken in South Africa. The locus of the study was the management and conservation of the black and southern white rhino at private ecotourism game reserves in the EC Province, South Africa. Overall, the study finds CE to be a useful policy tool for generating valuable and useful insights into visitors' preferences for various rhino management and conservation strategies at private, ecotourism nature reserves. A compelling argument in favour of using this method to value rhino management and conservation attributes is its ability to "generate multiple value estimates from a single application" (Bennett & Blamey, 2001).

The CE method, by its very nature, forces nature reserve visitors surveyed to make trade-offs among rhino management and conservation attributes, and reveal which of these are most important. This information is vital in the context of resource management decision making, where trade-offs need to be made and scarce resources allocated between competing management and conservation pressures. These estimates provide nature reserve owners and managers as well as other stakeholders with specific measures by which to assess various resource allocations in order to determine rhino management and conservation packages that will maximise overall benefits to the reserve and society at large.

When applying the CE method, it is important to understand that, although some private, ecotourism nature reserves fall into the same management and conservation class, they may face different challenges and be used by different populations. The results of a CE valuing visitor preferences for rhino management and conservation attributes at private, ecotourism nature reserves in the EC Province cannot completely be extrapolated to other privately-owned nature reserves in the rest of South Africa, nor can they be entirely extrapolated to publicly-owned nature reserves. Given this restriction, it is suggested that more research be carried out to determine visitors' preferences for rhino management and conservation alternatives at other privately-owned nature reserves around South Africa and at state-owned nature reserves.

# References

[1] ANDERSON, C.M. (2003) *Policy Implication of Alternative Economic Approaches to Population Heterogeneity in Stated Preference Surveys.* Paper presented at the American Agricultural Economics Association Meetings: United States of America.

[2] BANDARA, R. & TISDELL, C. (2005) Changing abundance of elephants and willingness to pay for their conservation. *Journal of Environmental Management,* 76: 47 – 59.

[3] BEN-AKIVA, M. & LERMAN, S. (1985) *Discrete Choice Analysis: Theory and Application to Travel Demand*. Cambridge: MIT Press.

[4] BENNETT, J. & ADAMOWICZ, W. (2001) Some fundamentals of environmental choice modelling. (*In* Bennett, J. & Blamey, R.K. (Eds). *The Choice Modelling Approach to Environmental Valuation.* Cheltenham: Edward Elgar Publishing).

[5] BENNETT, J. & BLAMEY, R. (2001) *The Choice Modelling Approach to Environmental Valuation*. Cheltenham: Edward Elgar Publishing.

[6] BHAT, C.R. (2000) Flexible model structures for discrete choice analysis. (*In* Hensher, D.A. & Button, K. J. (Eds). *Handbook of Transport Modelling, Vol. 1: Handbooks in Transport*. Oxford: Pergamon Press. pp. 71 - 90.)

[7] BHAT, C. R. (2001) Quasi-random maximum simulated likelihood estimation of the mixed multinomial logit model. *Transportation Research B,* 35(7): 677 - 695.

[8] BROWN, T., CHAMP, P., BISHOP, R. & MCCOLLUM, D. (1996) Which response format reveals the truth about donations to a public good? *Land Economics*, 72: 152 – 166.

[9] BROWN, G. & LAYTON, D.F. (2001) A market solution for preserving biodiversity: the black rhino. (*In* Shogren, J. & Tschirhart, T. (Eds). *Protecting Endangered Species in the United States: Biological Needs, Political Realities, Economic Choices*. Cambridge: Cambridge University Press).

[10] CARLSSON, F. & MARTINSSON, P. (1999) *Do hypothetical and actual willingness to pay differ in choice experiments? – Application to the valuation of the environment*. Working Papers in Economics no. 13, Department of Economics, Goteborg University: Goteborg.

[11] CARLSSON, F., FRYKBLOM, P. & LILJENSTOLPE, C-J. (2003) Valuing wetland attributes: an application of choice experiments. *Ecological Economics,* 47(1): 95 – 103.

[12] CARSON, R., FLORES, N., MARTIN, K. & WRIGHT, J. (1996) Contingent valuation and revealed preference methodologies: Comparing the estimates for quasi-public goods. *Land Economics*, 72: 80 – 99.

[13] CENTRE FOR AFRICAN CONSERVATION ECOLOGY (CACE). (2011) *Combining conservation and socio-economic development: an assessment of ecotourism-based private game reserves in the Eastern Cape.* Centre for African Conservation Ecology Report No. 60. Port Elizabeth: Nelson Mandela Metropolitan University.

[14] CITES. (2013) *Convention on International Trade in Endangered Species.* [Online]. Available: www.cites.org/eng/disc/how.php. [Accessed: October 2013].

[15] COLLINS, A., FRASER, G. & SNOWBALL, J. (2012) Could a regulated market approach for rhinoceros horns in South Africa? Some practical issues and concerns. *Unpublished working paper.*

[16] CONNIFF, R. (2014) *A Rhino Trophy Hunt that's Good for Rhino.* Published: New York Edition, January, 21, 2014.

[17] CONRAD, K. (2012) Trade bans: a perfect storm for poaching? *Tropical Conservation Science,* 5(3): 245 – 254. [Online]. Available from: www.tropicalconservationscience.org. [Accessed: $15^{th}$ February 2014].

[18] CRAWFORD, J. (2011). *Wildside Magazine.* Summer 2011: 13 – 22.

[19] DAMANIA, R. & BULTE, E.H. (2007) The economics of wildlife farming and endangered species conservation. *Ecological Economics,* 62 (2007): 461 – 472.

[20] DEPARTMENT OF ENVIRONMENTAL AFFAIRS (DEA). (2013) *Update on rhino poaching statistics.* [Online]. Available: www.environment.gov.za/?q=content/rhinopoaching_stats. [Accessed: November 2013].

[21] FERREIRA, S., HOFMEYR, M., PIENAAR, D. & COOPER, D. (2014) Chemical horn infusions: a poaching deterrent or an unnecessary deception? *Pachyderm,* 55: 54 – 61.

[22] FISCHER, C. (2004) The complex interactions of markets for endangered species products. *Journal of Environmental Economics and Management,* 48 (2004): 926 – 953.

[23] FISCHER, C. (2010) Does trade help or hinder the conservation of natural resources? *Review of Environmental Economics and Policy,* 4(1): 103 – 121.

[24] GREENE, W.H. (2007) *NLOGIT: Version 4.0, User manual.* New York: Econometric Software, Inc.

[25] HAAB, T.C. & MCCONNELL, K.E. (2002) *Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation.* Cheltenham: Edward Elgar Publishing.

[26] HANEMANN, W.M. (1984) Discrete/continuous models of consumer demand. *Econometrica,* 52(3): 541 – 561.

[27] HANLEY, N.D., MOURATO, S. & WRIGHT, R.E. (2001) Choice modelling approaches: A superior alternative for environmental valuation? *Journal of Economic Surveys*, 15(3): 435 - 462.

[28] HENSHER, D., ROSE, J.M. & GREENE, W.H. (2005) *Applied Choice Analysis: A Primer*. Cambridge: Cambridge University Press.

[29] INDAB, A.L. (2006) Rationalising WTP for whale shark conservation in Sorsogon province. (*In* Economy and Environment Program for Southeast Asia. (Ed.). *Willingness to pay for the Conservation of Endangered Species in four Asian Countries,* EEPSEA).

[30] JAKOBSSON, K.M. & DRAGUN, A. K. (2001) The worth of a possum: valuing species with the contingent valuation method. *Environmental and Resource Economics,* 21: 287 – 302.

[31] JIANJUN, J., INDAB, A., NABANGCHANG, O., THUY, T.D., HARDER, D. & SUBADE, R. (2006) *Willingness to Pay for Marine Turtle Conservation: A Cross-country Comparison in Asia.* Paper presented at the $3^{rd}$ World congress of environmental and natural resource economists, Japan.

[32] JOUBERT, J. (2013) Chief Veterinarian and Wildlife Manager: Shamwari Private Game Reserve. *Personal Interview:* July 2013.

[33] KONTOLEON, A. & SWANSON, T. (2003) The willingness to pay for property rights for the giant panda: can a charismatic species be an instrument for nature conservation? *Land Economics,* 79: 483 – 499.

[34] LAYTON, D. (2000) Random coefficient models for stated preference surveys. *Journal of Environmental Economics and Management,* 40(1): 21 - 36.

[35] LINDSEY, P.A. & TAYLOR, A. (2011) *A Study on the Dehorning of African Rhinoceroses as a Tool to Reduce the Risk of Poaching.* Pretoria: South African Department of Environmental Affairs.

[36] LOUVIERE, J.J., HENSHER, D.A. & SWAIT, J.D. (2000). *Stated Choice Methods: Analysis and Application.* Cambridge: Cambridge University Press.

[37] MACDONALD, D.H., BARNES, M., BENNETT, J., MORRISON, M. & YOUNG, M.D. (2005). Using a choice modelling approach for customer services standards in urban water. *Journal of the American Water Resources Association,* 41(3): 719 – 728.

[38] MILLIKEN, T. & SHAW, J. (2012) *The South Africa – Viet Nam Rhino Horn Trade Nexus: A deadly combination of institutional lapses, corrupt wildlife industry professionals and Asian crime syndicates.* TRAFFIC, Johannesburg, SA.

[39] NINAN, K.N. & SATHYAPALAN, J. (2005). The economics of biodiversity conservation: a study of a coffee growing region in the Western Ghats of India. *Ecological Economics,* 55: 61 – 72.

[40] RADEMEYER, J. (2012) *Killing for Profit: Exposing the Illegal Rhino Horn Trade.* Cape Town: Zebra Press.

[41] SEIP, K. & STRAND, J. (1992) Willingness to pay for environmental goods in Norway: A contingent valuation study with real payments. *Environmental and Resource Economics*, 2: 91 – 106.

[42] SHAW, J. (2011) *Black Rhino: An Endangered Species.* Published: The Horn. TRAFFIC, East/Southern Africa.

[43] SHOLTO-DOUGLAS, A. (2013) Manager: Kwandwe Private Game Reserve. *Personal Interview:* September 2013.

[44] SWANSON, T., MOURATO, S., SWIERZBINSKI, J. & KONTOLEON, A. (2002) Conflicts in conservation: the many values of the black rhinoceros. (*In* Pearce, D., Pearce, C. & Palmer, C. (Eds.). *Valuing the Environment in Developing Countries: Case Studies.* Edward Elgar Publishing: Cheltenham. Pp 169 – 205).

[45] THUY, T.D. (2007) Willingness-to-pay for conservation of the Vietnamese rhino (*In* Economy and Environment program for Southeast Asia. (Ed.). *Willingness-to-pay for the Conservation of Endangered Species in four Asian Countries,* EEPSEA).

[46] TUAN, T.H. & LINDHJEM, H. (2012) Valuation of species and nature conservation in Asia and Oceania: a meta-analysis. *Environmental Economics and Policy Studies,* 14(1): 1 – 22.

[47] VISSER, R. (2013) Security Manager: Shamwari Private Game Reserve. *Personal Interview:* July 2013.

[48] WATSON, V., PHIMISTER, E. & RYAN, M. (2004) *Testing the Assumption of Compensatory Decision-making in Discrete Choice Experiments: An Application to the Decommissioning of Off-shore Oil Installations.* Paper prepared for the $13^{th}$ Annual European Association of Environmental and Resource Economists Conference: Budapest, Hungary.

[49] WORLD WILDLIFE FUND SOUTH AFRICA (WWFSA). (2008) Position on trophy hunting in South Africa. *Best Practices in Sustainable Hunting,* pp 25 – 26. [Online]. Available: http://ftp.fao.org/docrep/fao/010/aj114e/aj114e06.pdf. [Accessed: June 2012].

**Table 1:** The attributes and their levels used in choice sets

| Attributes | Levels | Coding | Description of levels |
|---|---|---|---|
| The sale of live rhino | Yes (current) | 1 | Allow the sale of live rhino |
| | No | 0 | Do not allow the sale of live rhino |
| The potential sale of existing privately owned stockpiled horn | Yes | 1 | Allow a once-off sale of stockpiled, privately owned rhino horn |
| | No (current) | 0 | Do not allow a once-off sale of stockpiled, privately owned rhino horn |
| Dehorning operations and the potential sale of new stockpiled horn | Yes | 1 | Carry out dehorning operations and sell off the new stock |
| | No (current) | 0 | Do not carry out dehorning operations |
| The introduction of trophy hunting expeditions | Yes | 1 | Introduce trophy hunting expeditions at privately owned ecotourism reserves |
| | No(current) | 0 | Do not allow trophy hunting at privately owned ecotourism reserves |
| The accompanying of a rhino darting experience' | Yes (current) | 1 | Introduce and promote the rhino darting experience |
| | No | 0 | Do not promote the rhino darting experience |
| Voluntary donation (ZAR) | R0 (current) | | Voluntary, once-off donation managed by the Private Rhino Owners Association, and directed back to qualifying private ecotourism game reserves |
| | R60 | | |
| | R120 | | |
| | R360 | | |
| | R720 | | |

**Table 2:** Sample stratum percentages for population representation

| Visitor origin | Sample Percentage |
|---|---|
| Foreign | 70 |
| Local | 30 |

***Source:*** *CACE (2011)*

**Table 3:** Selected socio-economic characteristics of respondents

| Gender | % | Education | % |
|---|---|---|---|
| Male | 51 | No schooling | 0 |
| Female | 49 | Primary only | 0 |
| | **100** | Matriculation | 23 |
| | | Vocational training | 13 |
| | | University qualification | 64 |
| | | | **100** |

**Table 4:** Estimation results of the CE

| Attributes | CL model | RPL model |
|---|---|---|
| | **Coefficient (s.e.)** | **Coefficient (s.e.)** |
| Sale of live rhino | -0.0022 (0.0999) | -0.0139 (0.1209) |
| Sale of stockpiled horn | 0.2046* (0.1098) | 0.2284* (0.1340) |
| Dehorning operations | 0.1020 (0.1027) | -0.0163 (0.1665) |
| Trophy hunting | -1.1784*** (0.1166) | -1.2878*** (0.2939) |
| Rhino darting | -0.4493*** (0.1024) | -0.4944*** (0.1325) |
| Donation[1] | -0.0011*** (0.0002) | -0.0012*** (0.0002) |
| **Derived standard deviations of parameter distributions[2]** | | |
| Sale of live rhino | | 0.6578 (1.2317) |
| Sale of stockpiled horn | | 0.6179 (1.6619) |
| Dehorning operations | | 1.8784* (0.8827) |
| Trophy hunting | | 0.7532 (1.9046) |
| Rhino darting | | 0.0823 (0.9739) |
| Log likelihood | -947.4853 | -962.3844 |
| Sample size | 876 | 876 |
| Pseudo $R^2$ | 0.08 | 0.097 |

**Indicates significance at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level.*
*1. The Donation parameter was specified as a non-random parameter.*
*2. A uniform distribution was employed in all cases since all the parameters (except cost) were captured as dummy variables.*

**Table 5:** Marginal WTP (MWTP) for attributes and 95% confidence intervals (CI)*

| Attributes | Marginal WTP (ZAR) | | Swanson *et al.* (2002) – CVM values (UK£) |
|---|---|---|---|
| | CL | RPL | |
| Sale of stockpiled horn | 179; (31; 327) | 185; (21; 350) | - |
| Trophy hunting | -1030; (-1400; -659) | -1043; (-1517; -569) | -2.51 |
| Rhino darting | -393; (-553; -231) | -400; (-574; - 227) | - |

** Confidence intervals in parentheses.*

**Table 6:** Reasons why the choice task was difficult

| Reason | % |
|---|---|
| Could not relate to questions | 6 |
| Too much information conveyed | 31 |
| Did not understand questions | 5 |
| Alternatives too expensive | 2 |
| Several factors considered important | 50 |
| Visitors should not have to make donations | 2 |
| Other | 3 |
| Don't know | 1 |

**Figure 1:** Sample choice set

| **Attribute** | **Option A** | **Option B** | **Status Quo** |
|---|---|---|---|
| The sale of live rhino | Yes | No | Yes |
| The potential sale of existing privately owned stockpiled horn | No | Yes | No |
| Dehorning operations and the potential sale of new privately owned stock | No | Yes | No |
| The accompanying of a rhino darting experience | Yes | No | Yes |
| The introduction of trophy hunting expeditions | No | Yes | No |
| Voluntary donation amount (R) | R60 | R720 | R0 |
| **I would choose (TICK ONE BOX ONLY):** | √ | □ | □ |