Conflicts in Wildlife Conservation: Aggregating Total Economic Values

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1. Introduction

Over at least the past 50 years economists have been arguing that identifying, assessing and then appropriating the maximum possible values for biodiversity is imperative for designing and implementing any biodiversity conserving wildlife strategy or policy (e.g. Krutilla 1967). It would be safe to say that the economist's position has been sold and is by now almost universally acknowledged (e.g. OECD 2002). A central concept in this reasoning is that of *Total Economic Value* (Pearce and Turner 1990). The concept was been developed to encompass the plurality of values that individuals may hold for environmental resources. In the case of wildlife, these span from consumptive uses values (e.g. wildlife products), non-consumptive use values (e.g. recreation) and non-use values. Use values (either consumptive or non consumptive) are associated with flows derived from wildlife stocks (e.g. food, ornaments, medicines, recreational experiences etc.) that directly enter the individual's utility function. Non-use values are best seen as monetary expressions of the utility gained from knowing that certain wildlife related flows accrue to different constituencies. These beneficiaries may include other people in the present or the future as well as the species themselves. The concept of TEV has been treated as an accounting identity in which the various types of values all add up. In other words, it has been assumed that all categories of value are compatible with one another. Yet, this aggregative property of the TEV concept may not be always plausible but instead it may in fact contain inherent trade-offs or conflicts. The source of conflict among values can be traced to the fact different constituencies are driven by often conflicting motivations for wildlife conservation. For example, the expression of wildlife non-use values by one constituency (say through donations) may be in conflict with certain consumptive uses of the species enjoyed by another (such as hunting). In other words, often the utilisation of wildlife from one constituent affects the production or utility functions of another leading in essence to forms of production and consumption externalities between these parties. That is, conflicting values may be seen as expressions of production and/or consumption externalities.

Acknowledging and understanding the nature of such conflicts or externalities has important policy significance for two reasons. First, we argue that examining these conflicts is instrumental in understanding many of the disagreements witnessed within

international wildlife conservation *fora*. For years different groups and constituencies have been at loggerheads over the direction that these institutions should take. The CITES and Biodiversity conventions are only but the most apparent manifestations of such tormented institutions. The disagreements mostly centre over the type and the extent of utilisation practises that a particular species ought be subjected to. For example, under the auspices of CITES African states have engaged over a battle on the future of the elephant. On the one hand the countries of the south wish to relax CITES trade restrictions on elephant products (such as ivory, hides, meat and trophies). They argue that values appropriated from trade would provide much needed income to local rural communities as well instate the incentives for the continued conservation of the species. On the other hand the countries of north and west of the continent, which rely heavily on ecotourism receipts, oppose lifting current trade restrictions. Their main fear is that the resumption of trade would restore black market prices for ivory and encourage poachers to destroy their elephant herds, one of the key attractions in their tourism industry (Brown, 2000).[1] This dispute is exemplary of the case where different types of consumptive use values that are flowing towards different constituencies are in conflict. Conceptually it is akin to a production externality. A different form of conflict surrounds wildlife species such as the minke whale or the African Black Rhinoceros. Here the main opposing constituencies are between those in favour of numerous forms of (sustainable) utilisation of the species (e.g. sport hunting, dehorning, sale of stockpiles etc.) and those groups who are only willing to support non-intrusive conservation practices (e.g. establishment of protected parks, ecotourism etc.). In essence, the consumptive uses sought out by one group are producing a type of public 'bad' and hence these forms of disputes resemble a typical consumption externality.

Secondly, understanding the nature of these conflicts is important for promoting one of the main conservation goals of developing countries: the appropriation of the maximum possible conservation value. Many of the problems faced by endangered species (poaching, habitat conversions) are driven fundamentally by the tight resource constraints faced by the peoples of developing countries and their governments. It is well documented that if range state governments do not perceive the benefits that might flow from the conservation of a particular species, then they will be unlikely to allocate large amounts of available funds to anti-poaching patrols and additional protected areas. Even if they do, these allocations will usually come to nothing if the local peoples do not perceive the benefits to be derived from sharing their lands and resources with the wildlife. (Swanson and Barbier 1992) Hence, the maximisation of the value of the endangered species, from the perspective of the local peoples and governments, is very likely a fundamentally important first step toward the conservation of the species. Does this mean that local policy makers should pursue all types of wildlife management policies in order to maximise the appropriated conservation value? We argue that this need not always be the case and that certain forms of wildlife utilisation are problematic policies to be pursued from the perspective of value maximisation. For example, it might be justified to deny consumptive uses of a species (hunting, commercial trade, etc.) provided that the values derived form these uses are less than those stemming from non-consumptive uses (tourism, conservation contributions, etc.). *and given that the two forms of values are in conflict with one another.* That is, the aggregate contributions to conservation may be maximised by concentrating on a single category of values (e.g. non-use) if

[1] Cites lists fully protected species in which all international trade is banned in appendix I. Those in which a limited, highly regulated trade is allowed are in appendix II. The southern African states want their elephants listed in appendix II; Kenya wants them in I.

the two do not "add up" on account of fundamental objections of the greater one toward the other.

This paper examines the extent and nature of these conflicts in aggregating wildlife values within the context of a contingent valuation (CV) study on the Namibian Black Rhinoceros. This particular endangered species has been the subject of extraordinary control measures in many of its range states. Further, the trade in all Rhino products has been banned since the species was listed in CITES's Appendix 1 about twenty years ago. Yet, despite these measures the African Black Rhino populations continues to be under threat. In the midst of this dire circumstances the disagreements over the direction that Rhino conservation policies continue to persist as strong as ever. The main disputes are between those parties who are in favour of species conservation supported by a broad range of policies and those who are willing to support only non-intrusive means of conservation. Conceptually, these disputes resemble consumption externalities between different conservation parties in which the value or benefit received by one party derived from a specific wildlife flow subtracts from the utility of another.

The study examines the extent and nature of these conflicts. In particular we attempt to discern whether specific individuals and groups interested in the conservation of the rhinoceros (e.g. supporters of the CITES convention) will withdraw their support when other groups and individuals are contributing to conservation in a very different fashion. For example, will a group interested in contributing to the conservation of the rhinoceros for animal welfare motives withdraw their contribution in the face of conservation based on consumptive uses such as trophy Rhino? Or, is it possible to aggregate across both constituencies in order to maximise the amount of value available for conservation? In other words, to what extent do conflicting perspectives on conservation imply conflicting (or accumulating) values? The case study explores whether such conflicting values exist over the conservation of the Black Rhino and attempts to discern the optimal policy mix the would minimise such potential conflicts, thus maximising the total appropriable values.

Section 2 below discusses the conceptual nature of conflicting perspectives in wildlife conservation. Section 3 discusses how this framework applies to the case of the Black Rhinoceros. Section 4 describes the details of the contingent valuation study. Section 5, 6 and 7 discuss the main findings of the study. Section 8 presents the results from regression analysis that examined the motivational underpinnings of the elicited WTP values. Section 9 concludes the discussion.

2. Conflicts and trade-offs on Total Economic Value

The concept of total economic value has been viewed as an aggregative concept that combines values from both stocks of living rhinos (e.g. the value obtained from retaining the option to view rhinos in the future) and the flows of goods and services deriving from currently existing rhinos (e.g. the value of rhino horn sales). The former are usually refereed to as non-use values while the latter (consumptive and non consumptive) use values. We argue in this paper that the main conflicts or trade-offs between values concern categories of use and non-use values. This section discuses the nature of these values in an attempt to explain why and how these values can in principle conflict.

Use values are those derived form the actual or potential consumption of flows (goods and services) derived from a particular species. Defining and empirically assessing these values is relatively uncomplicated since it simply requires the use of standard micro-economic demand analysis. Whilst conceptualising and measuring forms of use values is considered to be straightforward, the same is not true for non-use values where numerous conceptual and empirical issues are still troubling academics and policy makers (see Swanson et al. 2002 for a detailed review). A central problem with the concept of non-use values is that it has been interpretd as the values held for the stock of a resource. This spawns various troubles since the idea that people have pre-existing preferences regarding living things of which they have little or no personal knowledge or experience and for which they have no intention to use in any way is to many problematic. Because of these conceptual difficulties we believe that non-use values are probably best thought of as attempts by individuals to channel flows of value to others about whom they care, rather than as a general willingness to provide stocks of the resource in the abstract. We believe that individuals are willing to pay to support policies that they believe will channel flows of value to other individuals and groups about which they care - even relatively remote groups, such as other people in this generation, future descendants or members of the endangered species itself. Willingness to pay values derived from donation data or CV studies will then be expression of altruism value (when conservation flows are channelled to other people in the current generation), bequest values (when conservation flows are channelled to other people in future generations) and animal welfare values (when conservation flows are channelled to the species itself). Such expressed stock-related values depend crucially on the expectations of the respondent about who will receive the benefits of the flows from those stocks.

We argue that this motivational assumption regarding expressions of positive stock related values is much more fruitful than other interpretations of the concept since it avoids various of the key criticism levied against its use in environmental decision making. First of all, this motivational assumption can be expressed formally through well-grounded economic theory. This addresses the misconception held by many critics that the concept of non-use values has no coherent behavioural basis. More specifically, the motivational assumption evoked in this paper can be readily modelled through a model of choice that incorporates the flows received by one party in the utility function of another 'non-user'. The non-user of a resource is thus seen as maximising utility by optimally allocating stock related flows across time and constituencies. This form of interdependence between non-use and ‘beneficiary’ has

been loosely termed 'altruism' and has been formally modelled in various different guises (e.g. see Johansson 1992 and McConnell 1997 for reviews).

Secondly, the type of altruism that most closely explains non-use values is that of paternalistic altruism. Under this form of altruism the source of non-use value is the knowledge that particular flows accrue to specific constituencies while the impact of these flows on the welfare of these 'beneficiaries' is irrelevant to the 'benefactor'. This framework, thus, has the benefit of not requiring the conceptually difficult talk of positing a welfare function for other people or species.[2] This kind of altruism resembles a consumption externality where one person's consumption of a particular flow enters another person's utility function. For the altruist or the 'non-user' of the resource there is no trade off between service flow to the beneficiary and (overall) utility to the beneficiary. The altruist that positively values a particular flow accruing to a certain beneficiary is better off even if the beneficiary consumes recourses services (flows) but suffers a loss in real income or a reduction in overall utility (McConnell 1997).

Thirdly, the interpretation of non-use values discussed in this paper is operationally more useful since it allows for the testing of empirical hypotheses. For the purposes of this paper, the conception of non-use value described here allows for the examination of the conflicts that may be inherent in the TEV concept. This is so since it allows for these conflicts to be assessed in terms of a negative consumption externality: the disutility experienced by one group (non-users) from the consumption of particular flows by other groups.

3. The many values of the Black Rhino

It is clear that any species of wildlife, such as the rhinoceros, exhibits values under both the use and non-use value categories. Sport hunters and tourists spend vast sums of money each year in order to engage in the direct use of the wildlife of African countries; for example, Kenya earned approximately US $349 million in 1988 from primarily wildlife-based tourism activities while the financial contribution of trophy hunting to Namibia in 1991 was approximately N$25 million (Cumming *et al* 1990; Barnes 1995). Equally clearly, the observed non-use values of the black rhinoceros are also quite substantial. Appeals for conservation funds for these species by organisations such as the World Wide Fund for Nature provide funding for vast conservation programmes across these same countries. These programmes are usually being funded by means of donations from persons living on the other side of the globe from the wildlife, with little or no prospect of ever actually seeing one of the animals in its native country. In 1990, donations to wildlife conservation organisations in the US alone amounted to at least US $273 million, with $42 million flowing to the WWF (WCMC 1992). In addition, to the evidence from observed market data, use and non-use values for wildlife conservation have been exhibited in numerous stated preference studies (see Table 1).

Therefore, it is apparent that this form of accounting (under a wide range of values) makes sense for many wildlife species. People around the world are willing to pay for the conservation of wildlife on account of a wide range of individual motivations. Some do so for the particular function that the wildlife species is able to perform for

[2] This feature of the model also avoids issues of double counting pure altruistic preferences (Johannson, 1992)

themselves, e.g., providing enjoyment in the course of recreation or providing products (leather, medicines) for their personal use in everyday life. Others do so for a wider and more complex range of reasons corresponding to the non-use values. These are best viewed as values stemming from the belief that enhanced stocks correlate with an enhanced flow of goods and services to some other beneficiary (other individuals or groups, future generations, the animals themselves).[3]

The central question we are addressing in this paper is the extent to which the concept of TEV is not a simple accounting identity but is imbued with inherent trade-offs and conflicts between values. The source of these conflicts can be traced to conflicting motivations for conservation across constituencies. For example expressed values for conservation that are motivated primarily by animal welfare concerns may be in conflict with certain forms of wildlife utilisation that compromise the well-being of species. It was argued in the previous section that the nature of these conflicts would resemble a consumption externality. We now proceed to examine these conflicts in a contingent valuation case study on the Black Rhinoceros. The study explored the extent and nature of the possible conflicts described in the previous sections. Further, the findings from this study provide insights as to the choice of optimal set of wildlife conservation policies that minimise these conflicts and maximises total appropriable value for conservation.

4. A contingent valuation study for the preservation of the Black Rhino.

The rhino survey was undertaken in the UK in a collaborative exercise between the Namibian Ministry of Parks and the Centre for Social and Economic Research for the Global Environment. The final study was conducted in 12 PTA meetings at elementary schools in Cambridgeshire during July 1996. [4] On the whole 381 people were interviewed in group meetings ranging between 18-72 people and lasting between 1-1.5 hours.[5]

Respondents were initially presented information about the reasons for the decline in the black rhino population as primarily having to do with the poaching for rhino horn rather than habitat conversion. The consumptive uses for rhino horn were presented in a pragmatic way: as mainly an ingredient for producing traditional medicine with fever reducing properties which is widely used in Asia (and not an aphrodisiac as is widely believed in Western societies). This first part of the group presentation ended with a reference to the institutional framework, focusing on the existing ban on

[3] If the benefactor was able to separate out and to provide for these flows to these groups directly, then the stock related value would not exist. Positive statements of stock related values, in this framework, act as surrogates for flows that are unable to be thought out and arranged otherwise. Expressed preferences over enhanced stocks then act as very crude instruments for the channelling of flows of goods and services in the desired direction.

[4] Given the complexity of the proposed task, the survey development stage lasted several months in between 1995-1996. Survey design and development included consultation of experts (valuation, biologists and rhino policy experts), a focus group session and three pre-tests which including debriefing sessions with randomly selected participants.

[5] In many CV experiments, group surveys have been found to exhibit the advantages of in person interviews while also allowing for greater consistency in the presentation of material (e.g. Morey *et al* 1999). In fact since no interaction was allowed between respondents the entire procedure is almost identical to in person interviews. In addition, group interviews may reduce the interviewer bias and decrease non-response rates to 'sensitive questions' (e.g. income level) since group settings offer more privacy to respondents (Weinberg, 1983).

international trade on rhino products. Respondents were then informed about the current anti-poaching measures existing in Namibia, highlighting the fact that they are insufficient due to lack of financial support. A proposed conservation programme for rhinos was then introduced: the Black Rhino Conservation Programme (BRCP), aiming to protect the existing Namibian black rhino population of 670 animals and to promote its increase to a population of 2000, within the next 25 years. This would be achieved through the creation of heavily guarded rhino sanctuaries.

The survey provides a unique opportunity to study the breadth and depth of the motivations driving the existence of non-use values for exotic wildlife. None of the individuals surveyed were residents of the country with which the study was concerned, none had visited this particular place, none had consumed or bought any products from Rhino horn nor had any immediate intentions to do so. The surveyed group was instead being asked to assess how much they would be willing to contribute for the conservation of *another country's* wildlife for benefit of *other* people of this or future generations and for the benefit of the Rhino itself. The setting of the survey within the context of various management options then allowed for the examination of possible conflicts between the motives generating the stated values for conserving black rhino stocks.

Respondents were made aware of the fact that a current *shortfall* exists for the financing of the BRCP that would prevent its adoption. Two possible ways of covering this shortfall were described. Firstly, by establishing an environmental tax surcharge (called the *International Direct Contribution - IDC*) levied on all UK taxpayers and secondly, by establishing a set of management programmes developing various uses of the Namibian black rhinos in order to generate amounts of money to sustain in part their conservation efforts.

There was then a presentation on the proposed black rhino *management option*s along with the percentage of revenues that would be generated by each management option.[6] These options are denoted as A to F in Figure 1.

The Option A, involved "increasing entry fees" to ecotourists entering the existing Rhino nature reserves, was described as being able to generate 6% of the funds required for conservation. Option B, "sale of live rhinos", involved the sale of six Rhinos per year to zoos across the world. This management option could raise 10% of the funds required for the BRCP. Option C, "sale of stockpiled horns", involved selling the existing stockpiled horns in a controlled market setting. The Rhino horn would be sold for the purposes of being used as an ingredient in the production of medicinal products that are in high demand in various Asian countries. This option could contribute 17% of the entire BRCP budget. Option D, "dehorning operations", consisted of carefully executed procedures where trained personnel would tranquilize an adult Rhino and then saw off its horn. The horn would then be sold in the same manner as the stockpiled horns. It was explained that Rhino horn would re-grow in about 10 years time. The revenues from harvesting the horns from about 80 rhinos per year would contribute towards the BRCP budget by 14%. Option E, "darting safaris",

[6] The Namibian government provided detailed information on the various management options available for the conservation of the black rhinoceros, and the funding that each would generate. We would like to acknowledge the co-operation of the Namibian Ministry of Parks in providing the data that supported this research exercise. Nigel Patchings was the member of the Ministry who supplied the necessary effort. Malan Lindeque was the director of research who developed the collaborative link.

consisted of organizing sport-hunting safaris where tourist-hunters would shoot Rhinos with tranquilliser guns. Ten such expeditions per year could contribute 4% of the BRCP budget. The last management option (Option E), "trophy hunting", involved tourist-hunters shooting and killing an adult black rhino. The hunts would be closely supervised by the park authorities so as to ensure that only one rhino per hunting expedition was killed. It was made clear that allowing for such low scale, carefully managed hunting would not endanger the survival of the Rhino population. It is estimated that three hunting exhibitions per year could cover 9% of the BRCP budget. Attention was called to the fact that some of these options would only be available if legal trade of rhino products was to be allowed. These options are the sale of stockpiled horns, dehorning, darting and hunting (those marked with * in Figure 1).

Since we used an open-ended elicitation format it would have been inappropriate to provide exact figures for the revenues that could be raised by each management option. Instead we only provided the *percentage* of the BRCP budget that could be raised by each management option. It has been shown that providing information on the actual distribution of cost induces respondents to offer WTP amounts that reflect their 'fair share' towards the cost of the of the project rather than their total consumer surplus (Carson *et al*, 1999). By providing figures on the percentage of revenues that could be raised by each management option we avoid this problem. Also this strategy was more in line with the aims of this study which were to investigate whether different conservation policies would be associated with conflicting values and not as such to examine if stated non-use values would be sufficient to cover the entire cost of the BRCP. It is this qualitative information that is most relevant in addressing the questions regarding the interaction/conflicts between values.

Before the respondents were presented with WTP questions on the BRCP they were asked to vote on the adoption of the different set of options outlined in the presentation. They were reminded that the more options approved the less rhino conservation would have to rely on foreign aid. This question aimed at uncovering people's attitudes towards different levels of intervention on the species.

Immediately after voting on these management options, respondents were faced with the valuation questions. The elicitation format was open-ended and the payment vehicle was a one-time-only tax surcharge. Three WTP questions were posed to each respondent in a step-wise order. Each respondent gave a WTP to all three questions, irrespective of the answer given to previous WTP questions. That is, the WTP questions were *not nested*. The questions sought to elicit respondents' WTP for the BRCP *given* that the programme would be financed via combinations of management options and direct taxation. Three such alternative combinations of financing schemes where presented.

The first WTP question asked for individual WTP for the full BRCP, when all the management options previously described were being used to help finance it (WTP_{FP}) This entailed that 60% of the project would be covered by the revenues from the uses and the remaining 40% from taxation (i.e. *via* the IDC). In the second WTP question, hunting was deleted as an option to finance the BRCP (WTP_H). This entailed that that UK tax payers would have to provide for an extra 9% of the BRCP budget via direct taxation to make up for the loss in revenue from not allowing the hunting option. The remaining 51% of the budget would be financed by the other management options. In essence respondents were asked for their new WTP amount to avoid trophy hunting as a management option. The third elicitation question asked for WTP when all the

options that implied legal trade were deleted (sales of stockpiled horns, dehorning operations, darting safaris and trophy hunting) (WTP_{LT}). This implied that only 16% of the budget could be covered by revenues generated by uses while the remaining 84% would have to be covered by UK taxpayers. This is basically the *status quo* option where the only possible way to endogenously generate funds for wildlife conservation is by increasing entry fees in national parks and selling animals to zoos and other parks. The question was designed to assess the benefits that may accrue from re-opening the legal trade of rhino horn products.

By using the information from these estimated welfare measures we were able to assess which types of use values conflict with non-use values. Our main hypothesis concerned the potential conflict between welfare and conservation interests. These conflicts could be identified in various ways. If welfare concerns predominated over a general interest in conservation, the full BRCP would be the set of management options that would receive the lowest WTP, because it entailed the most intrusive set of management programs (all six) while generating the most conservation funding. In addition, given the general public's dislike for sport hunting, it was anticipated that the elimination of rhino hunting would generate a significantly higher WTP than the full BRCP. Moreover, if welfare effects are strong, the elimination of further intrusive regimes (de-horning operations and darting safaris), and the denial of the commercial trade as well as sport hunting, might increase the WTP over that registered for the full BRCP minus sport hunting. Hence, it is interesting to investigate how the subtraction of further intrusive programs affects the non-use value.

More formally, the specific hypotheses that were tested in the context of the current experiment were:

1. Use and Non-use values for conservation associated with *hunting* are in conflict. The null and alternative hypotheses would be:

H_0: $WTP_H = WTP_{FP}$
$H_{1:}$ $WTP_H \neq WTP_{FP}$

If H_0 is rejected in favour of H_1 then individuals would be willing to pay a statistically significant additional amount for conservation in order to eliminate hunting as a management option. In this case non-use and use values for conservation associated with hunting would be in conflict.

2. Use and non-use values for conservation associated with *all* trade options are in conflict. The null and alternative hypotheses would be:

H_0: $WTP_{LT}=WTP_{FP}$
$H_{1:}$ $WTP_{LT}\neq WTP_{FP}$

If H_0 is rejected in favour of H_1 then individuals would be willing to pay a statistically significant additional amount for conservation in order to eliminate all forms of Rhino utilisation that involve trade in Rhino products. In this case non-use and use values for conservation associated with all available trade options would be in conflict.

3. Use and non-use values for conservation associated with trade options *apart from hunting* are in conflict. The null hypothesis would be:

H_0: $[WTP_{LT} - WTP_{FP}] = [WTP_H - WTP_{FP}]$
H_1: $[WTP_{LT} - WTP_{FP}] \neq [WTP_H - WTP_{FP}]$

If H_0 is rejected in favour of H_1 then individuals would be willing to pay a statistically significant additional amount for conservation in order to eliminate all forms of Rhino utilisation *beyond* hunting. In this case non-use and use values for conservation associated with all available trade options except hunting would be in conflict.

5. Attitudes towards wildlife management policies.

Table 2 presents the attitudes of respondents towards various forms of wildlife management. As can bee seen the great majority of the sample is strongly opposed to trophy hunting (91%) and darting safaris (61%). Table 3 also reveals a strong correlation between the two policies ($\rho = 0.41$): those who oppose hunting tend to also vote against darting. This finding is not unexpected and, more than a general interest in animal welfare, confirms the UK public's distaste for blood sports and for enjoyment in harvesting wildlife.

On the contrary, non-intrusive policies like increasing entry fees in safari parks and selling stockpiled horns seem to generate widespread support. The endorsement of the latter option is indicative of some support for a controlled legal trade in rhino products - the survey also explicitly elicited respondents views on this issue with only 25% voting against legal trade (see Table 2).

Perhaps the most interesting part of the analysis relates to respondents' attitudes towards the sale of live rhinos and dehorning operations. Of the six proposed management options these two are arguably the most clear indicators of concern for animal welfare. Increasing entry fees and selling stockpiled horns are non-intrusive regimes that do not reflect welfare concerns while darting and trophy hunting may generate a disutility from either a concern for the welfare of the rhinos themselves or from the hunters enjoyment derived from molesting the animals. Hence, a more 'refined' indicator for animal welfare concerns can be obtained from people's attitudes towards dehorning and live sales options. Selling rhinos will remove the animals from their natural original habitat and may have disruptive effects on the animal life while shooting rhinos with tranquilliser guns and sawing off their horns is an obviously distressing operation.

The survey shows that only 56% of the sample supported the sale of live rhinos while a much larger 77% voted for dehorning operations. Given that the latter is presumably more disturbing for the animals this result is somewhat surprising - the fact that dehorning operations, apart from potentially generating money from the sale of rhino horns, make the animals less attractive to poachers may have influenced the results. In any case, altruistic values (i.e. the value non-users placed on the flows from Rhino conservation consumed by other people) seem to dominate, on average, over animal welfare concerns. This finding is endorsed by the low and insignificant correlation coefficient between hunting and dehorning and other legal trade options, suggesting that different factors may be behind respondents attitudes towards these different options.

6. WTP for the Full Black Rhino Conservation Programme

On average, respondents were willing to pay between £5 and £12.67 (depending on whether the median or the mean is used to summarize the data) for the full management Black Rhino Conservation Program, as a one-time-only contribution (see Table 4). We have thus identified a positive and nontrivial WTP for the conservation of the Namibian black rhinoceros; however, that value was derived by reference to a conservation programme that includes various types of management options, some of which are perceived as being detrimental to the animal's welfare (e.g. trophy hunting with a 91% disapproval rating). As Table 4 shows the public clearly does hold preferences over the sorts of intrusions it would prefer to apply in conservation. Hence, individuals may have withdrawn some of their support for conserving the Rhino in lieu of certain uses under the first policy regime. This suggests that the WTP attributed by UK citizens to the specified full management BRCP might not be result in the greatest aggregate return (when combining BRCP and the WTP). That is, this aggregate amount might still be maximised if some of the "less preferred" options were omitted from the BRCP. The next section will further explore this possibility.

7. Conflicts between use and non-use values

We now turn to investigate whether various use and non-use values for the Balck Rhino are in conflict. This was achieved by assessing the impact of varying management regimes on the values offered in support of the Full BRCP and then by testing the hypotheses laid out in Section 4. More formally we will be testing the hypotheses laid out in Section 4.

The WTP for a management regime that is devoid of sport hunting has a mean value of £15.18 (see Table 4), which indicates that, on average, respondents are willing to pay an extra £2.51 to avoid trophy hunting of black rhinos (see Table 5). This difference is statistically significant both according to the Student's *t*-test of paired comparisons and the paired-rank Wilcoxon nonparametric test (see Table 6). The preferred measure of average WTP also indicates this difference in stark fashion: the median WTP doubles from £5 to £10 with the elimination of the use of the rhino for sport hunting. We can thus reject the first hypothesis and conclude that non-use values are in conflict with the presence of this particular use.

Next, the potential conflict between non-use values and the use of the products that the black rhinoceros can generate was evaluated. Specifically, the survey groups were queried on the sensitivity of their WTP to the commercial usage of the horn of the black rhinoceros; that is, the regimes that implied the existence of a legal trade for rhino horn-sales of stockpiled horns, de-horning operations, darting safaris, and trophy hunting. Returning to Table 4 the mean WTP for the BRCP without these options - the *status quo* scenario - is £13.68, an increase of about one pound over the full BRCP. However, this slightly higher amount is not substantial enough to be statistically different from the WTP for the full programme with all management options included, as both the t-test of paired comparisons and the paired-rank Wilcoxon test shows (Table 6). That is, on the basis of this sample size, it is not possible to reject the second hypothesis that the WTP within the UK is identical for both management programmes (i.e. those with and without trade in rhino horn). This leads to the conclusion that respondents are not against having this set of options included in the program; that is, there is no perceived conflict between the non-use

value that the respondents are expressing and the use values derived from rhino horn trade. These two forms of value appear to be aggregative.

Further insights into the nature of respondents' preferences are possible from examining the third hypothesis. It was just shown that respondents were willing to pay £1.01 in order to avoid the complete set of options that imply a commercial use of the Black Rhino and related horn products (WTP_{LT}=WTP_{FP}). Further, it was shown that respondents were willing to pay £2.51 in order to avoid hunting (WTP_{H}=WTP_{FP}). The difference between these two values (i.e. [WTP_{LT}=WTP_{FP}]-[WTP_{H}=WTP_{FP}]) provides a measure of how much individual's were willing to pay to avoid all uses of the species apart from hunting. This difference is statistically different from zero (see Table 6) and is found to be equal to -£1.50 (Table 5). The negative sign attached to this value implies that individuals are willing to pay this sum in order to allow for certain types of Rhino utilisation except hunting. It appears that respondents are not giving a negative welfare-based valuation to some management options, such as de-horning and darting, while they are to others that are similar in intrusiveness, such as trophy hunting. Therefore, it may be concluded that there is a clear conflict between use and non-use values in the case of trophy hunting but not in the case of the other uses (darting, de-horning, commercial uses, and live sales).

Figure 2 illustrates and summarizes the arguments presented in this section. The mean non-use value for the existence of black rhinos lies somewhere within the range of £12.67 to £15.18 per UK household (or between £5 and £10 if the median is used), depending upon the lifestyle afforded to the animal in that jurisdiction. There is a mean positive WTP in support of both the removal of sport hunting from the BRCP (about £2.51) and of the inclusion of the rhino horn trade (about £1.50).

8. Motivations behind conflicting values

In this section we use regression analysis to try to explore the motivations behind the conflicts presented above. More specifically we will be examining the impact of various attitudinal and socio-economic variables on the WTP distributions obtained from the study. Two types of WTP responses were elicited which required a different econometric modelling approach. The first type of WTP response was in the form of total WTP responses directly obtained for each of the three conservation scenarios. Since these three WTP distributions were collected in a step-wise fashion *from the same* individual, it may likely be the case that they were not independent (Hoehn, 1991). This possible interdependence would be captured by a significant contemporaneous correlation between the error terms of the three WTP functions. The correlation of the stochastic elements of the three main WTP equations as well as the form of the associated variance covariance matrix introduces additional information over and above that available when the individual equations are considered separately. Neglecting this information (by treating each WTP function as separate) may lead to inefficient parameter estimates (Srivastava and Giles 1987).

To account for this contemporaneous correlation between the error terms associated with the three dependent variables we employ an asymptotically efficient feasible GLS estimation model (or seemingly unrelated regression (SUR) model). The GLS model applies to the stacked model:

$$\mathbf{WTP}_m = \mathbf{X}_m\boldsymbol{\beta}_m + \boldsymbol{\varepsilon}_m \qquad (1)$$

where the subscript refers to m=1…3 equations, $\mathbf{WTP}_m, \boldsymbol{\beta}_m$ and $\boldsymbol{\varepsilon}_m$ are vectors, $\mathbf{X}_m$ is a data matrix .

It is assumed that $\boldsymbol{\varepsilon}_m \sim N(\mathbf{0}, \boldsymbol{\Omega})$ and the variance-covariance matrix of $\boldsymbol{\varepsilon}_m$ has the general form:

$$\Omega = \begin{bmatrix} \sigma_{11} & \sigma_{21} & \sigma_{21} \\ \sigma_{21} & \sigma_{22} & \sigma_{32} \\ \sigma_{31} & \sigma_{23} & \sigma_{33} \end{bmatrix} \qquad (2)$$

The disturbances are assumed to be un-correlated *within* each equation but are contemporaneously correlated *across* WTP responses.[7] The use of a GLS framework has been frequently applied for the estimation of systems of demand equations where we don't have a simultaneity problem (i.e. demand equations don't interact) but the cross-equation error terms are related. That is, the demand equations are not linked structurally (as in a system of simultaneous equations) but statistically through the 'jointness' of the error terms' and through the non-diagonality of the associated variance covariance matrix. This framework was extended to model CV data where we have multiple WTP responses from the same individual. The estimation procedure followed was a two staged Feasible GLS approach described in Green (1997) and Srivastava and Giles (1987) and is similar to the seemingly unrelated regression model (SUR) when the $\boldsymbol{\Omega}_{mm}$ is unknown.

The second type of WTP data obtained from the study were the *marginal* WTP values for the avoidance of additional intrusive management policies. These were the (implicit) WTP values for avoid trophy hunting and the WTP to avoid all intrusive polices expect hunting. Whereas the modeling of the distribution for the total WTP values had to address the issue of cross-equation correlation, the choice of the appropriate econometric specification for marginal WTP had to tackle the potential problems generated from the large percentage of zero responses found in these two distributions.[8] The distribution of WTP to avoid hunting contained 50% zero responses while that for having trade options (except hunting) contained 48% zero responses. Using simple linear regression in this case will lead to biased and inconsistent results (Green 1997). We thus used a limited dependent variable modeling approach whish is suitable for the analysis of open-ended WTP data that contain non-trivial percentage of zero responses (see Kontoleon 2003 for a review).

The specific limited dependent variable model employed to this data was the inverse hyperbolic sign double hurdle dependent model. Details of this model can be found in Kontoleon (2003). The model suggests that these marginal WTP distributions are generated by a two-tire decision making processes. The first decision or hurdle that the individual has to overcome is over whether they were indifferent between alternative conservation regimes that entail different management options. Given that the individual is *not* indifferent but has a preference in favor of a particular option, a

[7] By allowing for the possibility of contemporaneous correlation between the error terms across equations, the variance covariance matrix will not necessarily be diagonal.

[8] Multivariate least squares regression suggested that there was no correlation between the WTP to avoid hunting and WTP to have trade options. Thus the main modelling challenge here was to address the presence of large percentages of zeros.

second decision is made as to the size of the bid that the individual would be willing to pay in support of this option.

This double hurdle data generating process can be described by the following observability rule:

$$WTP_n = WTP_n^* \text{ if } \quad WTP_n^* = \beta' X_n + \varepsilon_n > 0 \ \textbf{\textit{and}} \ I_n^* = \alpha' Z_n + v_n > 0 \qquad (3)$$
$$WTP_n = 0 \quad \text{otherwise}$$

The variable, *I*,* represents a latent variable that determines whether one is indifferent between the *means* of conservation and WTP_n^* is the latent/notional WTP that determines the form of the observed WTP distribution (note that no restrictions are placed on the range of *WTP**, i.e. $WTP_n^* \in (-\infty, +\infty)$). The vectors X and Z include the variables that determine the latent continuous variables and β' and α' are their associated parameter vectors. The terms ε and v denote the disturbances of each decision. A feature of such a model is that the determinants of each decision are allowed to differ while the common variables (in X and Z) may have opposite effects. Also in its most general form the above model does not impose any restriction on the relationship between the two decisions. That is, it allows for the possibility of the error terms ε and v to be correlated by following a pre-defined joint probability distribution.

Using (3) and by assuming that ε and v follow a bivariate normal distribution,[9] we can construct a likelihood function with the form:

$$\begin{aligned} L_{DHD} = & \prod_0 [1 - P(v_n > -\alpha' Z_n) \cdot P(\varepsilon_n > -\beta' X_n / v_n > -\alpha' Z_n)] \times \\ & \prod_1 P(v_n > -\alpha' Z_n) \times \\ & \prod_1 P(\varepsilon_n > -\beta' X_n / v_n > -\alpha' Z_n) f(y_n / \varepsilon_n > -\beta' X_n, v_n > -\alpha' Z_n) \end{aligned} \qquad (4)$$

The first segment of Equation 4 captures the probability of being indifferent between the means of conservation, while the remaining two components determine the payment decision *given* an individual is not indifferent. This particular hurdle model that allows for the possibility that the error terms of the two decisions are correlated is akin to the 'double hurdle dependent' model (see Blundell and Meghir 1987; Jones and Yen 1994; Garcia and Labaega, 1996.

Two additional elements were added to the modelling process. The first catered for the violations of the assumption of bivariate normality of the error terms. This was achieved by applying an inverse hyperbolic sine (IHS) transformation of the dependent variable (see Kontoleon 2003 for details). Secondly, the variance of the likelihood function was parameterised in order to account for heteroscedasticity.[10]

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[9] With the form:

$(\varepsilon, \mathrm{v}) \sim \mathrm{BVN}(0, \Omega)$, where $\Omega = \begin{bmatrix} \sigma_\varepsilon & \sigma_\varepsilon \cdot \rho \\ \sigma_\varepsilon \cdot \rho & 1 \end{bmatrix}$

[10] Since we had poor *a priori* knowledge a to that which variable should be used to parameterised the variances of the WTP decisions, we followed an iterative process examining various specifications.

The best-fit results from the analysis of both the GLS and the hurdle model are presented in Tables 9 through 12. [11, 12] The description of the explanatory variables that were used is provided in Table 7. These include both socio-economic and attitudinal variables. The latter included proxy variables for the latent motives underpinning people's stated WTP values. For example, the variables 'extinction' and 'genetic value' were used as proxies for latent concerns over preserving a species as a source of (consumptive and non-consumptive) use-related flows. Also, the dummy variable 'children' (which equals 1 when children are present in the household) was used as a proxy for bequest motivations for conservation. Finally, the variable 'animal welfare' aimed at capturing any animal welfare concerns that may motivate WTP for conservation.[13] The impact of these explanatory variables on the elicited WTP values is discussed in the following two sub-sections.

8.1 Regression results from GLS model on total WTP values

Turning first to the coefficients estimates from the GLS model we first note that higher order polynomials were used for age and income signifying some non-linearities between these co-varieties and the dependent variable. The presence of such quadratic effects are consistent with many other findings from regression analysis of OE WTP data (e.g. Johansson 1999). To account for multicolinearity between the polynomials we expressed the age and income variables in deviation form (Bradely and Srivastava 1979). The coefficients on age are significant in all three equations, whereas those for income are significant only for the WTP_H and WTP_{LT} distributions. Women are associated with a lower WTP in all three management scenarios while people with a higher education level would be WTP more for the full programme (WTP_{FP}). The presence of children in each household has a significant and positive influence on WTP for the WTP_{FP} and WTP_H scenarios but not for WTP_{LT} This last finding suggest the presence of possible strong bequest

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The variables that satisfied the IM-test were 'education' for the WTP_H model and 'sex' for the WTP_{LT} model. We see that both these co-efficients are highly significant.

[11] Before we turn the discussion of parameter estimates two observations must be made on the results of the FGLS model. First, note in that table the high correlation co-efficient between the WTP decisions ranging between 0.6 and 0.83 (see Table 10) A Breusch-Pagan ML test suggest that these co-efficients are highly significantly from zero. Thus the error variance covariance matrix, $\mathbf{\Omega}_{mm}$, is *not* diagonal. Also note that not all WTP equations had the same specification. That is, $\mathbf{X}_m$ is not the same across all m. The specification of each model was reached using repeated incremental F-tests (bottom-top approach). If all the three equations were specified by the same covariates and/or the variance covariance matrix, $\mathbf{\Omega}_{mm}$, was diagonal the use of a GLS model would be superfluous (Kennedy, 1992 p. 170). Yet, these two finding suggest the use of the joint GLS model (as opposed to using three separate models for each WTP equation) was justified.

[12] The information matrix (IM) test (Chesher 1984) was used to jointly test for homoksedasticity and normality in the two regression models in their standard (un-transformed versions). The construction of the test statistic followed the appraoch taken in Reynlods and Shonkwiler (1991) and Gao *et al* (1995). After employing the IHS transformation and parameterising the IM test could not reject the null of joint normality and homoskedasticity in both models. Also note that the correlation coefficient, ρ, between the errors terms of the indifference and payment decision was found to be statistically different from zero. These results confirm suggest that the appropriate IHS double hurdle dependent model provided the appropriate specification.

[13] Hence, the variables, 'children', 'extinction' and 'genetic value' would capture the concern for providing flows from Rhino conservation to other people or 'altruism effect', while the 'animal welfare' variable is intend to capture concerns for the species itself ('animal welfare effect').

(relative to animal welfare) motives: individuals value the prospect of certain Rhino flows to be channelled to their children in the future (e.g. ecotourism, rhino-horn products etc.).

Turning to the attitudinal variables we see that WTP for Rhino conservation using all available management options (WTP_{FP}) is positively associated with a higher appraisal for the genetic importance of wildlife (the coefficient on the gene-value index is significant and positive) while WTP for conservation that would not allow for utilisation of the species (WTP_{LT}) is positively affected by ones' animal welfare sentiments ('animal welfare'). People's opinion about the conservation programmes has a significant positive effect in all three decisions, signifying the importance of reliability in designing CV experiments. Finally, individual's attitudes towards re-opening legal trade positively influences WTP for the two scenarios that include trade options (WTP_{FP} and WTP_{H}) but has no effect on the scenario where trade options are excluded (WTP_{LT}). The results suggest that altruistic concerns are associated with higher WTP for the scenarios involving human utilisation of the species while animal welfare concerns are the driving force behind higher WTP values for the scenario involving limited uses to humans but enhanced welfare to Rhinos.

We, thus, see that overall the demographic variables are consistent with economic theory and are in line with past CV studies. Moreover the attitudinal and taste variables provide a logical explanation of the direction and magnitude of the WTP responses that is consistent with the discussion on the motivational assumptions underpinning non-use values.

8.2 Regression results from hurdle model on marginal WTP values

Both demographic and attitudinal/motivational questions were used in the specification of the indifference and payment decisions of the hurdle models. Our discussion will focus on the motivational variables since these are of primary concern in this section. In particular, it is of interest to examine why non-users would still be willing to support conservation that entailed certain uses of the species (such sale of rhino horns) rather than others (such as sport hunting). Following the reasoning developed in Section 2 it can be assumed that support for rhino utilization other than hunting would be compatible with ones desire to provide these flows to other people. This would be the result of a form of 'altruistic effect'. Conversely, one's disapproval of sport hunting would be motivated by a relatively stronger 'animal welfare effect'.

Looking first to the decision whether one is indifferent with regard to the introduction of commercial uses of Rhinos (Table 10), we see that both effects have the anticipated sign: positive for the altruistic effect (captured by the 'extinction' variable) and negative for animal welfare effect (captured by the 'animal welfare' variable). We also observe that the altruism effect dominates the animal welfare effect (i.e. the co-efficient on 'extinction' is larger than that on 'animal welfare' while the later is also insignificant).[14]

[14] These are not the true marginal effects on the *probability* of indifference but are the marginal effect on the latent variable I^*. Since here we are interested in the sign and magnitude of the difference between co-efficients the reporting the latter would suffice.

This finding also carries over to the payment decision (WTP_{LT}). The results clearly suggest that concern for the flows that wildlife generates by trade policies for the benefit of *other* people (altruism effect) outweighs the concerns for decreased animal well-being from wildlife utilisation (animal welfare effect).

Turning to the indifference decision concerning the use of trophy hunting, we see that the animal welfare effect dominates the altruistic effect. That is, the likelihood of being unwilling to support a conservation regime that allows hunting increases as ones's animal welfare concerns increase.

Looking at the payment decision we also see that a higher WTP to avoid hunting is associated with higher animal welfare motives. We can thus conclude that both the decision to support a ban on rhino hunting and the decision on how much one would be willing to pay to attain/sustain such a ban can be largely explained by a strong negative animal welfare effect from the introduction of hunting.

Although this negative animal welfare effect from hunting is clearly supported by the data, closer examination of the results suggest that there may be an *additional* conflict between those who enjoy particular forms of wildlife uses (particularly, sport hunters) and those who receive disutility from their enjoyment. Looking at the regression results of Table 11 we see that peoples' attitudes towards the act of hunting (as captured by the variable 'hunting') has a very strong *negative* effect on the likelihood of supporting the ban on hunting. On the other hand we see that the coefficient on one attitudes towards de-horning, a policy with similar intrusiveness to hunting, has a *positive* and significant effect on the likelihood of supporting the ban on hunting. It thus appears that the dis-utility experienced by the non-user from other people's enjoyment of hunting (and not simply the loss of animal welfare) may provide an additional explanation for the conflict between non-use values and hunting.

This effect may be interpreted as kind of *vicarious disutility:* the act of hunting enters the non-users utility function as a 'bad'. Following the discussed of Section 2, we can accommodate this interpretation of the regression results within the framework of the paternalistic altruism model. Past models on altruism implicitly assume that non-use would only receive *positive* utility from another agent's use of a resource and that this utility should be *additive* in cost benefit calculations. The present study suggests that non-users may receive *disutility* from *certain* flows (in our case hunting) enjoyed by certain users (hunters) and that this value would conflict (and not aggregate) with other non-use values. It has been argued that this conflict is conceptually similar to a negative consumption externality.

The current study has shown that non-users do not receive disutility from flows associated with other management options (e.g. sale of stockpiles for medicinal purposes) which are consumed by *other* groups of users (Asian consumers of Rhino horn medicine). On the contrary non-users expressed an *enhanced* welfare when such uses were allowed (WTP for trade option expect hunting was positive) while the probability of supporting such options was positively related to respondents' altruistic sentiments. These findings translate to non-users having a positive WTP to ban certain kinds of wildlife uses (hunting) while supporting others (e.g. dehorning, selling of stockpiles).

9. Discussion.

Different people and constituencies see the object of wildlife conservation very differently: some would like to maintain large stocks of wildlife in order to trade it commercially or to hunt it, others would like to leave some wilderness to their grandchildren, and others still would like to know that there are some beasts on earth living a natural and undisturbed lifestyle. Is it possible for all of these different people to come together in the effort to conserve wildlife and their habitats, or are there fundamental conflicts between these different motivations that will always prevent them from co-operating? This is the issue that we attempted to address here in the context of the conservation of the Namibian black rhinoceros. It was in this context that the capacity for the aggregation of use values (derived from various managed uses there) together with non-use values of the citizens of the UK (derived from the maintenance of a specified lifestyle for a stock of live rhinos) was examined.

This experiment found that non-use values for the Black Rhino conservation programme that included a broad range of utilisation policies are substantial. If the conservative median estimate for the 'full BRCP' at £5 is at all accurate, then this would indicate a non-use value *within the UK* of about £110 million[15]. Even if this estimate is an order of magnitude too great, this would still indicate that very substantial non-use values inhere in northern countries that should be channelled to conservation purposes. What is more, the study suggests that non-use values can be doubled by banning certain kinds of uses of this natural resource.

The indicated non-use values in the UK alone are potentially capable of supplying the full amount of funding required for the conservation of the black rhinoceros in Namibia, and it should clearly be able to supplement fully the funding derived from the various uses occurring within Namibia. However, if non-use value is intended to supplement rather than displace domestic management programmes, then to what extent is this possible? How well do non-use and use values add up?

The study demonstrated that conservation polices that include torture of the species, such as hunting, are associated with negative WTP values (people were found to be WTP to avoid such a policy). These negative non-use values associated with the use of hunting were found to be explained by a negative animal welfare effect induced by animal suffering but also from a negative altruistic effect incited from the act of hunting itself (vicarious disutility effect).

These findings support the argument of this paper that non-use values conflict (and do not aggregate) with specific use values and that these conflicts can be viewed as forms of consumption externalities. That is, they emerge when the utilisation of wildlife from one constituent affects the utility functions of another.

It is also clear that there are other motivations for non-use values. Some of these motivations include the desire to maintain live stocks of rhinos for the benefit of future generations and future uses, and they are clearly not incompatible with any uses that aid the conservation of rhino stocks. Regression analysis revealed that this finding could be explained by a clear ‘altruism effect’: individuals were willing to support policies that entailed wildlife utilisation provided that this aids conservation but also provides flows of goods and services to various other groups of people.

[15] There are 22 million households in the UK.

There are lessons to be learned from this case study that are much broader than this single context. It is clear that developing countries cannot cope with the expenses of conserving and maintaining the stock of their wildlife. Two important alternative financing mechanisms available to them are direct contributions from international funds and revenues raised from various wildlife utilisation policies. The former are mainly supported by non-users while the latter allow for users of the recourse to contribute towards its conservation. Developing countries and conservation agencies should instate the optimal amount and type of markets for both users and non-users so as to maximise conservation revenues. In doing so it is imperative to understand how these markets interact. Can the introduction of one market jeopardise the efficiency of another? Should sustainable utilisation of the species be the overriding objective or is it the preservation of animal welfare?

The Black Rhino study examined the extent to which conflicting perspectives on conservation imply conflicting (or accumulating) values and attempted to discern the optimal policy mix the would minimise such potential conflicts. Our study indicates that in order to maximize the non-use values from rhino existence, the most successful formula seems to be the banning of options that involve an element of enjoyment in harvesting the rhinos (hunting and darting) while allowing other commercial uses of the animal like the sale of stockpiled horns and dehorning operations. Interestingly, it does not appear that there is any additional withdrawal of support associated with intrusive management options other than those associated with sporting activity. Therefore, there are conflicts between the various values of wildlife, but not perhaps as substantial as the paralysis in international policy making might suggest. From our research we believe that most people in the UK do support the commercial use of wildlife and wildlife products in support of conservation, but they reject the concept of encouraging the taking of pleasure in doing so. An optimal conservation policy would make use of those uses of wildlife which are compatible with non-use value, and would especially make substantially greater efforts at harnessing the non-use values that exist in the northern countries.

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11. Appendix

Table 1. WTP for Endangered Species

Species and Habitats	WTP in US$ p.a., p.p.	Additional information
Namibian black rhinos	15-20	Swanson et al. 2002
Bald eagle	19.28 - 28.25	Stevens *et al*. (91), donation
Bald eagle	10.62 - 75.31	Boyle *et al.* (87)
Striped shiner	1 - 5	Boyle *et al.* (87)
Northern spotted owl	34.8	Rubin *et al.* (1991), p.h.
Whooping crane	31	Loomis *et al*. (93), p.h
Wild turkey	7.11 - 11.86	Stevens *et al*. (91), donation
Coyote	3.40 - 5.35	Stevens *et al*. (91), donation
Bottlenose dolphin	7.0	Pearce (96), 90US$
Sea otter	25	Loomis *et al*. (93), p.h
Monk seal	62 - 103	Samples et al. (90), 1
Blue whale	40	Loomis *et al*. (93), p.h
Humpback whale	125 - 142	Samples et al. (90), 1
Sea turtles	13	Loomis *et al*. (93), p.h

Notes: i) Values not adjusted for inflation
ii)ph: per household; 1: once-only payment; p.p.: per person: p.a.: per annum
ii) See Swanson et al. 2002 for reference details.

Figure 1. Management Options for Black Rhinos

Option A - Increase in Entry Fees
- Photographic safaris, viewing of animals in the wild.
- *Reduce IDC by 6%.*

Option B - Sales of Live Rhinos
- A small number of animals (eg. 6 of 670) can be sold each year on a long term basis.
- *Reduce IDC by 10%.*

Option C - Sales of Stockpiled Horns*
- Existing stockpiled horns may be marketed in a controlled trade setting.
- *Reduce IDC by 17%.*

Option D - Dehorning Operations*
- Safe procedure: shooting adult rhinos with tranquilliser guns and then sawing off their horns. Rhino horn re-grows: a horn is replaced in about 10 years.
- Harvested horns could be sold in a controlled trade set-up (eg. 83 of 670 rhinos).
- *Reduce IDC by 14%.*

Option E - Darting Safaris
- Tourist-hunters shoot rhinos with tranquilliser guns.
- Annual demand: around 10 hunts.
- *Reduce IDC by 4%.*

Option F - Trophy Hunting
- Tourist-hunters shoot and kill adult black rhinos.
- In small numbers (eg. 3 of 670 rhinos) and in a controlled way it would not endanger the survival of rhino populations.
- *Reduce IDC by 9%.*

Table 2. Attitudes towards Rhino management options

	In favour %	Against %
Increase entry fees	93.44	6.56
Sale of Rhinos to zoos	55.64	44.36
Sale stock-piled horns	82.68	17.32
De-horning operations	77.17	22.83
Darting Safaris	38.85	61.15
Sport Hunting	9.19	90.81
Trade of wildlife products	74.80	25.20

Note: N=381

Table 3. Correlation Coefficients between attitudes on management options

	Entry Fees	Rhino Sales	Stockpiles	De-horning	Darting	Hunting	Trade
Entry Fees	**1**						
Rhino Sales	0.127 (0.0131)	**1**					
Stockpiles	-0.0181 (0.7251)	0.1503 (0.0033)	**1**				
De-horning	-0.0916 (0.0741)	0.1223 (0.0169	**0.4841** (0.0000)	**1**			
Darting	-0.0216 (0.6743)	0.2149 (0.0000	**0.3773** 0.0000	**0.4585** (0.0000)	**1**		
Hunting	-0.0121 (0.8141)	0.1989 (0.0001	(0.1902) 0.0002	0.1864 (0.0003)	**0.4124** (0.0000)	**1**	
Trade	-0.0236 (0.6459)	0.1158 (0.0238	**0.4851** (0.0000)	**0.3995** (0.0000)	**0.2489** (0.0000)	0.0330 (0.5205)	**1**

Notes: Significant correlation coefficients in bold; Level of significance in parenthesis

Table 4. Summary Statistics of WTP for all three scenarios

	WTP for the full BRCP	WTP for the BRCP with no hunting	WTP for the BRCP with no legal trade options
Mean	12.67	15.18	13.68
St. Error	*(0.96)*	*(1.08)*	*(1.12)*
Median	5	10	5

Note: units are pounds sterling. Sample size=381

Table 5. Value of Several Components of the BRCP -Summary Statistics

	Value of legal trade options minus hunting	Value of hunting	Value of all legal trade options
Mean	1.50	-2.51	-1.01
St. Error	*(0.60)*	*(0.28)*	*(0.66)*
Median	0	0	0

Note: units are pounds sterling. Sample size=381

Table 6. Hypothesis testing

	Null Hypothesis	t-statistic Decision	Wilcoxon test
Avoiding trophy hunting	$WTP_H = WTP_{FP}$	*Reject*	*Reject*
Avoiding all legal trade options	$WTP_{LT}=WTP_{FP}$	*Cannot reject*	*Cannot reject*
Legal trade options minus hunting	$[WTP_{LT} - WTP_{FP}]=[WTP_H - WTP_{FP}]$	*Reject*	*Reject*

Notes: all tests are two-sided and all decisions on H_0 are at the 95% level.
WTP_H for WTP for programme without hunting
WTP_{FP} for WTP for full programme with all management policies
WTP_{LT} for WTP for programme without any management policies the require legal trade

Figure 2. Decomposition of Black Rhino Values

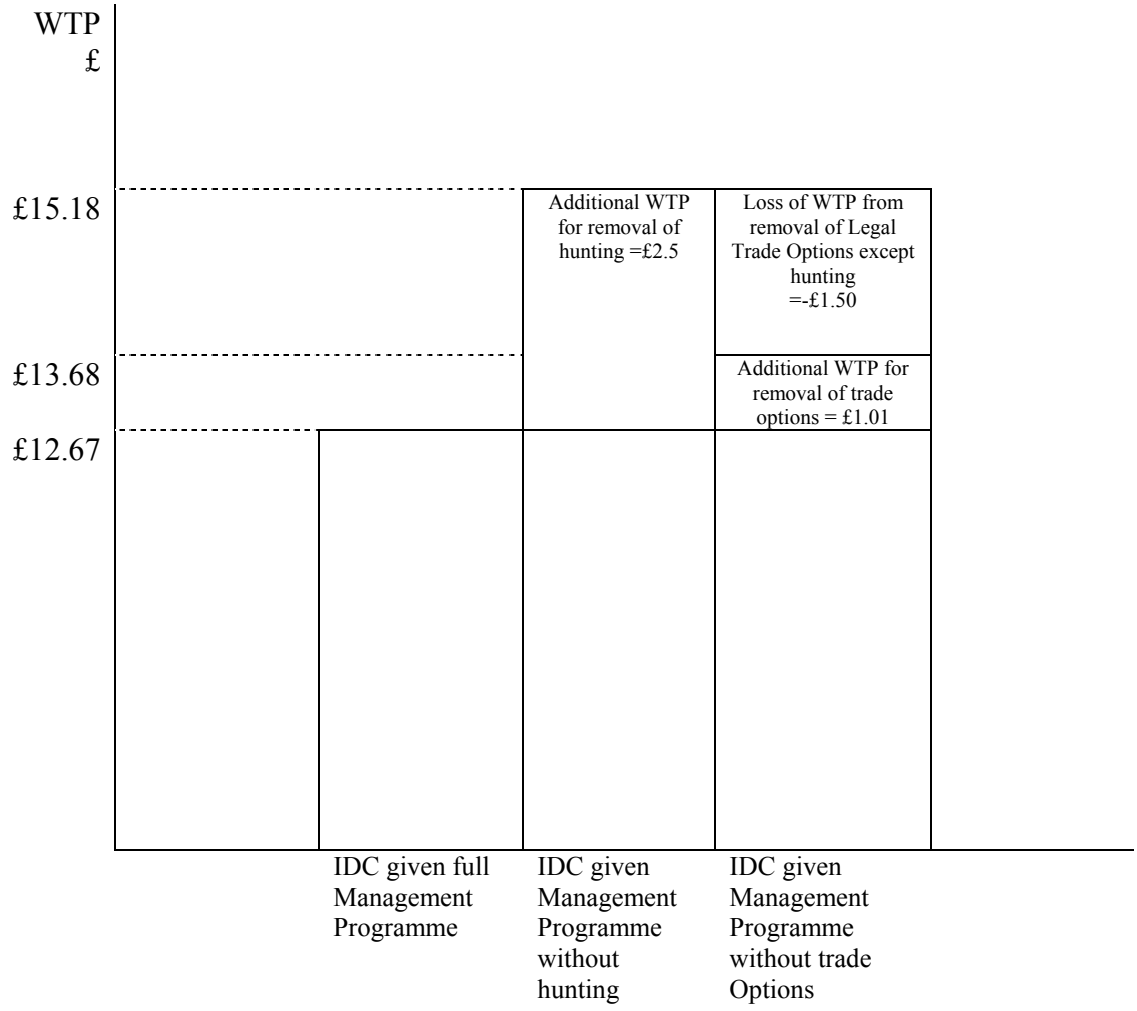

Table 7. Explanatory Variables for Regression Analysis

VARIABLE	DESCRIPTION
Sex	Sex =1 for male
Age	Age in years
Age^2	Age squared
Income	Annual disposable income
$Income^2$	Annual disposable income squared
Children	Children =1 if children present in the household
Education	Years of education
Genetic value	Concern for the conservation of the genetic value of species
Extinction	Concern for the extinction of species
Animal Welfare	Concern for the well-being of wildlife
Opinion Index	Opinion about questionnaire
Trade	Attitudes towards trade in wildlife products
Hunting	Attitudes towards wildlife hunting
De-horning	Attitudes towards de-horning
Horn sale	Attitudes towards sale of stock piles.

Table 8. Regression results from GLS model

	Coefficient	St. Error	T-value
Sex	-0.998	0.524	-1.907
Age	-0.244	0.120	-2.032
Age^2	0.003	0.002	1.781
Income	0.000	0.001	0.117
$Income^2$	0.000	0.000	-0.402
Children	0.489	0.228	2.146
Education	0.190	0.110	1.729
Genetic value	0.712	0.321	2.217
Opinion Index	1.127	0.233	4.835
Trade	1.117	0.520	2.148
Constant	1.268	2.758	0.460
Adjusted R^2		0.1866	
F-Statistic		4.635067	
P-value		0.0000	
WTP_H			
Sex	-1.169	0.450	-2.598
Age	-0.155	0.080	-1.938
Age^2	0.002	0.001	1.415
Income	0.001	0.001	1.375
$Income^2$	0.000	0.000	-2.280
Children	0.465	0.196	2.374
Education	0.093	0.124	0.744
Opinion index	0.936	0.200	4.671
Trade	0.881	0.447	1.971
Constant	0.316	2.363	0.134
Adjusted R^2		0.1945	
F-Statistic		4.942606	
P-value		0.0000	
WTP_{LT}			
Sex	-2.195	0.529	-4.150
Age	-0.243	0.130	-1.869
Age^2	0.003	0.001	2.827
Income	0.001	0.001	1.489
$Income^2$	0.000	0.000	-1.810
Children	0.189	0.230	0.820
Education	0.055	0.146	0.378
Animal Welfare	1.046	0.578	1.810
Opinion Index	0.892	0.238	3.757
Trade	-0.468	0.526	-0.889
Constant	2.588	2.804	0.923
Adjusted R^2		0.1740	
F-Statistic		4.869285	
P-Value		0.0000	

Table 9. Correlation matrix of residuals

	WTP_{FP}	WTP_{H}	WTP_{LT}
WTP_{FP}	1		
WTP_{H}	0.8167	1	
WTP_{LT}	0.6626	0.6224	1

Breusch-Pagan test of independence: chi2(3) = 568.975, Pr = 0.0000. Independence can be rejected.

Table 10. IHS Regression Results: WTP to have trade options expect hunting.

	Co-efficient	Std. Error	t-statistic
Indifference decision			
Education	0.531	0.346	1.536
Income	0.001	0.001	1.754
Extinction	0.973	0.504	1.931
Animal welfare	-0.028	1.114	-0.025
Constant	-2.976	1.610	-1.849
Payment Decision			
Sex	1.122	0.703	1.595
Income	0.000	0.000	0.265
Horn sale	0.685	0.216	3.180
Hunting	-0.736	0.239	-3.075
Family	0.495	0.269	1.838
Extinction	0.442	0.214	2.065
Animal welfare	-1.161	1.092	-1.063
Constant	-4.967	2.009	-2.472
Variance			
Sex	0.258819	0.142035	1.822
Constant	1.432697	0.138175	10.369
ρ	.2650148	.0609802	4.346
N		318	
Log likelihood		-678.51671	
Wald chi2(4)		5.39	
Prob > chi2		0.00249	

Table 11. IHS Regression Results: WTP to pay to avoid hunting

	Co-efficient	Std. Error	t-statistic
Indifference decision			
Dehorning	0.129	0.052	2.468
Hunting	-0.415	0.099	-4.214
Education	0.113	0.066	1.720
Extinction	-0.142	0.285	-0.497
Animal welfare	0.802	0.382	2.098
Constant	-0.694	0.711	-0.976
Payment Decision			
Sex	-0.609	0.354	-1.720
Income	0.000	0.000	1.712
Hunting	-0.138	0.379	-0.364
Dehorning	-0.094	0.122	-0.769
Opinion Index	0.355	0.230	1.544
Children	0.375	0.196	1.914
Extinction	1.433	0.976	1.468
Animal welfare	1.619	0.787	2.059
Constant	-2.852	2.069	-1.379
Variance			
Education	0.305968	0.122539	2.497
Constant	0.833041	0.23207	3.59
ρ	0.341509	0.100383	3.402
N		378	
Log likelihood		-715.28771	
Wald chi2(5) =		23.29	
Prob > chi2		0.0003	