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Can local communities in Zimbabwe be trusted with wildlife management?: Evidence from contingent valuation of elephants

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Can local communities in Zimbabwe be trusted with wildlife management?: Evidence from contingent valuation of elephants

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Abstract

If local communities living adjacent to the elephant see it as a burden, then they cannot be trusted to be its stewards. To assess their valuation of it, a CVM study was conducted for one CAMPFIRE district in Zimbabwe. Respondents were classified according to their preferences over the elephant. The median WTP for the preservation of 200 elephants is ZW$260 (US$4.73) for respondents who considered the elephant a public good while the same statistic is ZW$137 (US$2.49) for those favouring its translocation. The preservation of 200 elephants yields an annual net worth of ZW$10,828 (US$196) to CAMPFIRE households. However, the majority of households (62%) do not support elephant preservation. This is one argument against devolution of elephant conservation to local communities. Adequate economic incentives must be extended to local communities if their majority is to partake in sound elephant conservation. External transfers constitute one way of providing additional economic incentives.

JEL CLASSIFICATION: C25, H41, Q26

KEYWORDS: CAMPFIRE, contingent valuation, double bounded spike model, elephant, Zimbabwe

1 Introduction

Agriculture and wildlife conservation compete for the scarce land in rural Zimbabwe. Wildlife conservation must compete economically with agriculture, which is the prime source of rural communities' livelihood, if it is to be accepted as an alternative land-use. Thus the survival of wildlife depends on whether it is an asset or liability to the communities living adjacent to it. More often, even when the people in wildlife abundant areas are furnished with community development benefits from wildlife revenues, they still lose out in economic terms from the presence of wildlife (Emerton 2001). Of interest in the policy realm is assessing the economic value that the local communities living adjacent to national parks, game reserves and safari areas assign to wildlife, given that some people potentially consider it a public good while others consider it a public bad. If the economic value of wildlife were larger, relative to alternative economic activities, then it would

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imply that wildlife conservation might be enhanced through devolution of wildlife user rights to the local communities.

This has been tried in Zimbabwe. At the initiative of the parks and wildlife agency, the property rights regime under which wildlife in communal areas is managed changed substantially in 1989.[1] The program is known as CAMPFIRE, an acronym for Communal Areas Management Programme for Indigenous Resources. This paradigm attempts to involve the rural people as partners, to marry conservation with development. CAMPFIRE entails giving local communities, through their administrative local authorities called Rural District Councils (RDCs), (a) greater control over formerly public wildlife in communal areas in defined territories, (b) enhanced capacities to add value to local wildlife, and (c) specific financial rewards likened to alleged conservation value of wildlife within their territories (Gadgil and Rao 1995). CAMPFIRE begins when the RDC is granted the legal authority to manage its wildlife resources. Over the years, the RDCs have harvested their natural resources and earned income in the following ways: leasing trophy hunting concessions, utilizing forestry and forest products, leasing eco-tourism sites and making live animal sales. The incomes from CAMPFIRE has increased from 350 000 USD in 1989 to 2,3 million USD in 2001. Out of a total of more than 20 million USD in revenues, almost 90% come from sport hunting fees. Almost half of the total revenues have been disbursed to the participating communities (Hasler 1999). These revenues have mostly been used to provide social infrastructure i.e. construction of schools, clinics, boreholes, etc.

In this paper, we analyze whether the underlying tenant for this policy holds. We concentrate on the elephant as the representative wildlife since the elephant is the most important species to the local communities both in terms of the damage it causes to crops and the value it contributes to CAMPFIRE revenues. In general, the benefits from the elephant are (i) products that can be consumed directly, such as income from live sales, meat, hides, trophies, (ii) tourism, (iii) ecological and environmental services such as maintenance of the African savannas and biodiversity, (iv) possible future uses such as touristic, pharmaceutical, industrial and agricultural applications, and (v) intrinsic values such as religious, cultural, aesthetic, existence and bequest significance (Emerton 2001). The costs that the elephant imposes include (i) management costs such as costs of equipment, capital, wages, running costs, policing, etc, (ii) costs to other livelihood activities in the form of crop destruction, human injury, damage to structures, etc, and (iii) opportunity costs in the form of alternative land, money, time or resource uses. The benefits of the elephant potentially accrue at both global and local levels while the costs occur exclusively at the local level. The international component of elephant benefits gives room for international transfers to help locals with, and reward locals for, elephant conservation. This has been the motivation for international support to CAMPFIRE. However, external aid should reach to the producer communities if these are to respond to it as increased demand for conservation.

The objective of this paper is to estimate the willingness to pay (WTP) for the preservation of a sub-population of the African elephant (*Loxodonta africana*) in Zimbabwe by rural communities who live adjacent to a designated game reserve, taking into account the reality that some people consider it a public good while others consider it a public bad. We do this by employing the contingent valuation method (CVM) for the case of one CAMPFIRE district, Mudzi. The rest of the paper is arranged as follows: Section 2 reviews literature on the economic valuation of non-marketed environmental goods (bads). Section 3 describes the survey area while section 4 describes the survey, presents sample characteristics and gives economic rationale for the bid function. Section 5 presents estimation results while concluding remarks are given in section 6.

[1] Though efforts started in 1985, CAMPFIRE is officially recognized to have emerged in 1989.

2 Economic Valuation of Non-marketed Environmental Goods (Bads)

Many environmental projects generate both winners and losers. If a respondent is asked to state her WTP in an open-ended contingent valuation question, it might not occur to her to state a negative WTP if she dislikes the project (Kriström 1995). With the dichotomous choice question format, it is difficult to pose the question in such a way that potential losers are identified. The most commonly employed approach for capturing welfare losses in contingent valuation studies has therefore been to make assumptions regarding the negative tail of the WTP distribution, after eliciting the WTP for a change in the provision of an environmental amenity. Nonetheless, this approach typically does not allow respondents themselves to bid negative amounts (Clinch and Murphy 1999). By restricting WTP to being non-negative, contingent valuation studies routinely ignore the fact that many environmental amenities manifest themselves as costs to some and benefits to others.

We use an approach where respondents are split into two sub-samples according to their stated preference for the project and each sub-sample is analysed separately (cnf. Clinch and Murphy, 1999). The first question asked the respondent how his/her household weighed the benefits and costs of living with the current elephant population of 200, by considering only those benefits and costs applicable to them. The district-wide elephant population was estimated at 200 and all respondents were asked about this population.

If the respondents indicated that the benefits of living with an elephant population of 200 exceeded the costs, B > C, then they would be expected to have a non-negative WTP for the preservation of the current elephant population.[2] They were then presented with a proposal that the government was considering translocating the current elephant population of 200 from their district to other districts so that the people there could also benefit from the elephant since it is a national heritage. However, they could avoid the elephant translocation if their community could pay an annual 'translocation avoidance' tax to the government (*see questionnaire in Appendix for exact question formulation*). They were then asked whether their household was willing to pay an annual 'translocation avoidance' tax of ZW\$$x$ for as long as these animals shall be in their area, given that all other households who do not find the elephant to be a nuisance will also pay the same amount, so that they could be allowed to continue living side by side with an elephant population of 200.[3][4]

If the respondents indicated that the benefits of living with an elephant population of 200 were surpassed by costs, B < C, then they would be expected to have a positive WTP for the translocation of the current elephant population. They were therefore presented with a similar proposal differing only in that they had to pay a 'translocation and compensation' tax in order for the government to be able to carry out the translocation of the current elephant population from

[2] Actually, some respondents may say that benefits exceed costs yet they will eventually report a zero WTP, possibly due to the eventual correction of initially misrepresented preferences in the wake of a demand for them to declare concrete evidence of their preferences by making a payment. To allow for such zero WTP we categorise those for whom benefits exceed costs as having a non-negative WTP, rather than positive WTP.

[3] The starting bids that were chosen on the basis of data collected in a pilot survey were $x\epsilon\{30, 190, 250, 330, 500\}$. We used the 20th, 35th, 50th, 65th and 80th percentiles.

[4] In fact, the double bounded dichotomous choice with open-ended follow-up question format was used here. The annual 'translocation avoidance' tax presented for the same project in the second question was (i) some lower amount ZW\$$x_L$ if the respondent answered 'no' to ZW\$$x$, or (ii) some higher amount ZW\$$x^H$ if the respondent answered 'yes' to ZW\$$x$. The respondents were eventually asked to state their household's maximum WTP for the project presented to them.

their district to other districts, where the nuisance that they have been experiencing from these animals will consequently be transferred. They were then asked whether their household was willing to pay an annual 'translocation and compensation' tax of ZW$x for as long as these animals shall live in the other area, given that all the other households who find the elephant to be a nuisance will also pay the same amount, so that the translocation and compensation exercise of an elephant population of 200 could be carried out.[5]

Even though our approach enables us to classify respondents into distinct categories based on their assessment of elephant benefits and costs, we have a challenge of disentangling and appropriately analysing potential zero WTP that could eventually be reported by some respondents. This information is obtained from an open-ended follow-up question and a debriefing question. All respondents who reported zero WTP despite their elephant benefits exceeding costs or elephant benefits being surpassed by costs attributed their zero WTP to the budget constraint.

The elicitation format was a double-bounded question followed by an open-ended question. In the analysis of the double bounded responses we assume that the preferences are the same in the first and second stage (see e.g. Haab and McConnell 1997). However, when estimating the model we introduce the spike information obtained from the follow-up open ended question (Kriström, 1995). Let us assume a linear WTP function

$$WTPj = \alpha z_j + \varepsilon_j$$

where z_j is a vector of socio-economic characteristics (including an intercept), α is the corresponding parameter vector and ε is an error term, where $\text{var}(\varepsilon) = \sigma^2$. If the error term is logistically distributed and we allow for a spike at zero, mean WTP for individual j is $\ln(1 + \exp(az_j))/\beta$, where β is the marginal utility of money (Kriström, 1995). Mean WTP for individual j is $\alpha z_j/\beta$.[6]

3 The Survey Area

Mudzi rural district lies in the north-eastern part of Zimbabwe on the border to Mozambique. The whole district's area of 4,222 square kilometres lies in agro-ecological regions IV and V, which are best suited for extensive cattle and wildlife ranching.[7] The district has a population of 23,995 households, 16 administrative wards, 7 chiefs, 9 headmen and 700 village heads. The Ministry of Public Service, Labour and Social Welfare (1997) reported that, according to the Food Poverty Line and Total Consumption Poverty Line, Mudzi was the fourth poorest district in Zimbabwe. Mudzi borders Nyatana game reserve and in 1992 Mudzi Rural District Council (RDC) got Appropriate Authority (AA) status to manage its share of wildlife in Nyatana alongside the adjacent Rushinga and Uzumba-Maramba-Pfungwe (UMP) RDCs.[8] In 1993, a safari operator called Zindere Safaris was contracted for 5 years (March 1993 to February 1998) to utilise the annual wildlife harvesting quotas issued by the Department of National Parks and Wildlife Management (DNPWLM). The

[5] The double bounded dichotomous choice with open-ended follow-up question format was also used here.

[6] It can be noted that this result requires that $\exp(\alpha z_j) \epsilon (0,1)$. We assume that the α and z_j vectors we are working with give us such a result.

[7] Based primarily on the amount and reliability of rainfall, Zimbabwe is divided into five agro-ecological regions of generalised land use potential. For purposes of agriculture, region I is excellent land while region V is marginal land.

[8] The landscape of Nyatana is such that there could be long term movements of wildlife between and amongst the three rural districts' boundaries even though in the short run distinct clans of wildlife can be identified and ownership assigned to the three RDs.

safari operator paid an annual concession fee of ZW$15,000 (US$2,300) and 80% of the trophy fees. In 1994, 12 elephant bulls were translocated into Nyatana game reserve with the help of Zindere Safaris and an organization called Elephant for Africa. In the late 1990s, a buffer zone was established and the safari operator harshly enforced the buffer zone borders denying adjacent communities access to fodder, timber and grass. Due to enormous pressure from the communities the safari operator's contract was not renewed.

Since March 1998 a new safari operator called Umfurudzi Wilderness Safaris has been engaged to utilize the wildlife harvesting quotas on a 20-year contract. In 1999 eight elephant bulls were translocated into Nyatana game reserve with the help of Elephant for Africa and the new safari operator. Elephant translocations are resented by some communities who argue that the elephant is already locally overpopulated considering the high incidence of elephant intrusion. At the time of the survey there were plans to re-stock Nyatana game reserve with an elephant population of 100, among other species, with grants from Elephant for Africa and USAID.

Two wards, Mukota A and Chimukoko, with a population of 3,009 households and covering 1,009 square kilometres have been designated as CAMPFIRE wards. These are the only wards in Mudzi that border Nyatana. 70% of wildlife revenue is shared equally amongst 7 villages in these two wards while the remaining 30% is retained by the RDC for district development (15%) and administrative expenses (15%). The villages decide how to use their share of the proceeds from game without any interference from the RDC. The revenue has been used to undertake various community projects such as buying scotch-carts for ferrying local materials for construction of the local clinic, building a classroom block at the nearby school, construction of blair toilets, a pre-school and roofing teachers' houses, buying cattle for hiring out to members, maize trading, sinking boreholes and water trophies for livestock, buying some fence, textbooks, building materials for the local school and building a court-room for the traditional chief. The RDC audits the villages' books of accounts and adjudicates misuse cases.

4 The Survey

A questionnaire was administered in Mudzi rural district in December 2000 to 570 randomly selected households.[9] Given the objective of valuing the elephant from the adjacent communities' perspective, the extent of the market was demarcated by proximity to Nyatana game reserve. Thus, our interest was in households that live in wards that have been designated as CAMPFIRE wards. The questionnaire sought basic household data, household participation in CAMPFIRE activities, data on human-wildlife conflict and compensation, stated preference survey and data reliability (*see questionnaire in appendix*). The focus groups and pilot study indicated that it was difficult to obtain time series data on incomes and production. The heads of the households or their interview representatives were the interviewees and in both cases responses can be interpreted as coming from the heads themselves. The age range of the heads of households was 17 to 90. The basic sample characteristics are shown in table 1.

[9] Given the rapidly changing economic situation in Zimbabwe, we give justification why results from data collected in December 2000 are still relevant in section 5.1. The reasons centre on the microeconomic nature of our study and our focus on one particular rural community and its relationship with wildlife, a relationship which we do not believe has been shifted significantly by the events that have unfolded in Zimbabwe post-2000. In any case, any potential effects of the rapidly changing economic situation on our study only serve to amplify the case against devolution of wildlife to communities, a case which we put forward.

4.1 Economic rationale for the bid function

The objective of stated preference surveys is to elicit respondents' valuation of the projects described to them in scenarios. The reliability of each survey is typically measured through the estimation of a bid function relating WTP responses to a variety of covariates collected in the survey. The goal is to assess the extent to which expectations from (i) economic theory, (ii) prior intuition, and (iii) observed empirical regularities are fulfilled. The analysis of those variables that can potentially affect WTP can shed light on the robustness of the survey design and implementation of the study. From a policy perspective, the reasons behind differences in WTP can therefore be better understood (Köhlin 2001).

Since we are dealing with household-level data, household characteristics such as household size, sex of the household head, age of the household head, education of the household head and total annual household income are expected to be important in explaining the households' WTP. The discussion in this section will be cast for the case of WTP for the preservation of the current elephant population. The discussion can easily be extended to the case of WTP for the translocation of the current elephant population.

It is reasonable to think that larger households would benefit more than proportionately from a public good than smaller households. As such household size is expected to have an effect on WTP for the preservation of the current elephant population. Male-heads are more in contact with nature and have more ways to cope with the elephant nuisance than their female counterparts hence male-headed households are expected to have higher WTP for the preservation of the current elephant population. Education helps people to appreciate the (use and passive use) value of the elephant, or lack of it, since they can easily comprehend the externalities associated with it. Also, people with higher levels of education might have more opportunities to earn (additional) income from off-farm activities or they might have bigger farms hence they are relatively more cushioned from the negative effect of the elephant. Households with higher annual incomes are expected to afford relatively higher WTP as they may have less income constraints. Age of the household head might influence how the elephant is valued depending on the extent to which the different age categories of household heads uphold culture and traditions or are affected by the elephant.

Attitudinal variables are also expected to be important in explaining the households' differences in WTP for the preservation of the current elephant population. In this broadly defined category we have variables such as support of parks agency driven elephant conservation; respondents were asked whether they would support parks agency driven elephant conservation rather than community driven elephant conservation. Wildlife revenue investment decisions are expected to differ between the parks agency and the communities. A plausible scenario is one where investment by the community increases the threat of elephant intrusion while perceived investment by the parks agency could reduce it. In community driven conservation, the community might use wildlife income to purchase communal livestock and declare some land adjacent to the wildlife reserve a buffer zone. For members with personal livestock this decision reduces grazing land, increases grazing competition, denies everyone access to other resources in the buffer zone and possibly does not reduce human-elephant conflict. Indeed, in many CAMPFIRE areas, in general, and Mudzi, in particular, wildlife incomes have been used for social infrastructure rather than intrusion preventive measures. In parks agency driven elephant conservation, the parks agency might be expected to use wildlife income to fence off the wildlife reserve. Households potentially support parks agency driven elephant conservation rather than community driven elephant conservation regardless of whether they consider the elephant a public good or nuisance.

The next set of potentially interesting variables is that indicating the elephant's access to the

means of livelihood of households and the household's risk of suffering elephant intrusion. The following variables are in this category: existence of intrusion mitigation measures, distance to the elephant reserve, labour-days spent guarding against elephant intrusion, average size of intruding elephant herd, and having agriculture as a main livelihood activity.

Those households who have cushioned themselves from elephant intrusion by installing mitigation measures such as thorny shrub fences are expected to regard the elephant as being less of a nuisance, all other things being equal. Distance to the elephant reserve captures a certain kind of risk of elephant intrusion; if agricultural activities of a household are closer to the elephant reserve there is a greater chance that they will be intruded, ceteris paribus. The households that spend relatively more labour-days guarding against elephant intrusion, all other things remaining equal, are more likely to view the current elephant population as a public bad because their guarding efforts indicate a higher level of intrusion risk. Furthermore, guarding against elephant intrusion represents an opportunity cost of labour. If a larger elephant herd potentially has access to a household's assets then that household is expected to have a lower WTP for the preservation of the current elephant population compared to those households who face intrusion threats from a smaller herd. Households whose major source of livelihood is agriculture would be expected to be more concerned about probable elephant intrusion than those whose livelihood is financed elsewhere, *ceteris paribus.*

There are two potential effects of using labour guarding against elephant intrusion. On the one hand, this labour investment could manage to reduce the threat from elephant intrusion in which case the households that spend relatively more labour-days guarding against elephant intrusion are more likely to view the current elephant population favourably if such labour has zero opportunity cost. By spending relatively more labour-days guarding against intrusion the household affords to cushion itself from the adverse effects of intrusion. If labour has a zero opportunity cost the household cannot enhance welfare by moving labour from intrusion prevention activities since the reallocated labour will not bring a return from any other activity i.e. intrusion prevention is all the labour is suited/valuable for. On the other hand, this labour investment could take away scarce labour from other more productive uses in which case the households that spend relatively more labour-days guarding against elephant intrusion are more likely to view the current elephant population as a public bad because there is an opportunity cost of labour. The household would surely want to reallocate labour into other more productive activities and increase welfare. In must be noted that, in both cases, spending relatively more labour-days guarding against elephant intrusion might indicate a higher level of intrusion risk which potentially contributes to viewing the elephant as a public bad. In our view, the households that spend relatively more labour-days guarding against elephant intrusion, all other things remaining equal, are more likely to view the current elephant population as a public bad because their guarding efforts indicate a higher level of intrusion risk and opportunity cost of labour.

If a larger elephant herd potentially has access to a household's assets then that household is expected to have a lower WTP for the preservation of the current elephant population compared to those households who face intrusion threats from a smaller herd. Households whose major source of livelihood is agriculture would be expected to be more concerned about probable elephant intrusion than those whose livelihood is financed elsewhere, *ceteris paribus.*

5 Estimation Results

We begin by estimating the determinants of respondents seeing the elephant as a public bad. Knowledge of the characteristics of those households who are likely to view the elephant as a negative externality could help in designing appropriate compensation schemes or targeting devolution of elephant user rights to specific groups of people. This is done with a simple probit model. Next we use the double-bounded spike model to estimate the WTP functions for the two sub-samples where the elephant is considered either a public good or a public bad. The results are reported in Table 2.

[Insert Table 2 here]

We begin with analyzing the results of the first stage probit model. The results show that households headed by older people have a higher probability of viewing the elephant as a nuisance. We could say that, in our study, the majority of older household heads and their households find the elephant to be a liability. Thus when you go into the district and try to find out who does not like the elephant, the majority of them will tend to be older household heads and their households. But in the group of people disliking elephants there will be both young and old household heads.

A lower level of education increases the probability of viewing the elephant as a public bad. This might be so for two reasons. Firstly, poorly educated household heads seem not to appreciate the positive externality from the elephant. This may be because the positive externality also comprises passive use values, which are not easily measurable. When the positive externality from the elephant is undervalued there is the likelihood that the intrusion threat posed by the elephant will be harshly penalised. Secondly, people with low levels of education might have few opportunities to earn (additional) income from off-farm activities or they might have smaller farms hence they derive their livelihoods from the activities that are directly negatively affected by elephants. The observed negative effect of distance to the elephant reserve on the probability that a household views the current elephant population as a nuisance is expected. Intuitively, the farther away one is from the elephant reserve the lower the risk of elephant intrusion, *ceteris paribus*. Conversely, the closer one is to the elephant reserve the higher the risk of elephant intrusion.

Households that have experienced intrusion from larger elephant herds are more likely to believe that the benefits are lower than the costs of preservation. This should follow from the expectation that actual damage is directly related to the size of the intruding elephant herd.

Those households who spend relatively more labour-days guarding against elephant intrusion are more likely to view the elephant as a public bad. Guarding against elephant intrusion is likely an indication of intrusion risk. Those who spend more time guarding therefore face a higher level of intrusion risk. Furthermore, more time spent guarding against elephant intrusion represents a greater opportunity cost of labour – the time could have profitably been used in competing agricultural or other tasks or leisure.

Poor households, with low household incomes, are more likely to view the elephant as a public bad. Here, similarly to the case of less educated people, poor households seem not to reckon, at least some part of, the positive externality from the elephant. Consequently, the negative effect of the elephant is emphasized.

The results from the probit model show that households who view the elephant as a public bad typically have these characteristics: older household heads and/or lower levels of household head's education. Furthermore, more time spent guarding against elephant intrusion, proximity to the elephant reserve, susceptibility to larger elephant herds and low household income reinforces their perception of the elephant as a net cost.

The message that can be drawn from these results is two-pronged: Firstly, appropriate compensation schemes should be designed so that they can adequately benefit households who view the elephant as a public bad. These households can not be expected to support conservation measures until their view of the elephant as a negative externality has been changed. The appropriate compensation schemes should improve the incentive system at the local level rather than at the district level.

Secondly, where devolution of elephant user rights is targeted to specific groups of people it is advisable not to target it to groups that are composed of a majority of households with the stated anti-elephant characteristics. In areas where CAMPFIRE operates, decisions are taken on the basis of the majority-voting criterion, where the voting unit is the household. In the absence of sufficient incentives, dominance of households with the stated anti-elephant characteristics in the group to which devolution is targeted is likely to lead to the failure of collective action in community-based elephant conservation.

We now consider the results from the double-bounded spike model. The coefficients for the bid in both situations where the elephant is considered either a public good or a public bad are highly significant and have the expected positive sign.[10] The coefficients show that the probability of accepting the presented bids decreases as the size of the bid increases. Thus we are dealing with an ordinary commodity whose demand increases as the price falls.

Now focussing on the group of people who dislike the elephant, there will be both young and old household heads and their households, though older household heads and their households will be in the majority. Given that the presented bids for elephant translocation are proxies for damage suffered at the feet of the elephant, we would expect both young and old household heads and their households to seek for an opportunity to be presented with bids which capture the damage they suffer. Our results show that younger household heads and their households have a higher probability of accepting the presented bids for the translocation of the elephant.[11] Thus the few younger household heads whose households dislike the elephant tend to suffer more damage from the elephant than the many households in the same group who are headed by older heads. Therefore, in our study, those older household heads and their households in the public bad category tend to be more tolerant of the elephant despite the damage they suffer from it because their damage is not as high as that suffered by the other households in the same group which are led by younger heads.

In the class of those households who view the elephant as a public bad, those households headed by people with relatively higher education had a greater probability of accepting the presented bids for the proposed elephant translocation. A higher level of education enhances the appreciation of the externalities associated with the elephant; the positive externality from the elephant also comprises passive use values which are not easily measurable and the damage inflicted during elephant intrusions is not usually obvious. In the case of elephant damage, in some instances, one has to extrapolate the trend of growth of a destroyed crop to assess the loss incurred from elephant intrusion. Such assessments even burden specialist agricultural officers and that is one

[10] We entered the bid in the model with a negative sign hence the positive bid coefficient should be interpreted as showing that the bid is negatively related to the probability of accepting the bid in the double-bounded spike model.

[11] This result should not be read as a contradiction with that from the probit model. One might erroneously contemplate a contradiction emanating from the fact that older household heads and their households are more likely to consider the elephant as a public bad and yet they are less likely to accept the bid. In the double-bounded model we are comparing the younger and older household heads who form the group of households who view the elephant as a public bad. They both suffer damages but the younger heads tend to suffer relatively more than their older counterparts.

of the reasons why schemes to compensate elephant intrusion victims have not taken off in many places. So a higher level of education enriches the appraisal of the externalities associated with the elephant and thereby leads to greater acceptance of the presented bids. It can also be argued that the higher likelihood of accepting bids is not just coming from the education function of enhancing the appreciation of externalities associated with the elephants but might also be due to higher off-farm income earning opportunities and bigger farm sizes that highly educated people tend to access.

In the double-bounded spike model where the elephant is considered a public bad, we find a positive and highly significant coefficient for those that state that they support parks agency driven elephant conservation rather than community driven elephant conservation. Thus, support for the parks agency increases the probability of a household accepting the presented bids for the proposed elephant translocation. This shows the tendency of households who support the parks driven elephant conservation to accept contributing the presented amounts of money meant for the removal of the elephant. This represents the vote of confidence that such households have on the parks agency's capability to reduce human-elephant conflict.

The coefficients for the labour-days against intrusion variable in both models where the elephant is considered either a public good or a public bad have negative signs. This entails that households who spend relatively less labour-days guarding against elephant intrusion have a greater probability of accepting the presented bids for either the proposed elephant translocation or elephant preservation. For the households where the elephant is considered a public bad, less labour-days spent guarding against elephant intrusion mean the imposition of greater costs (i.e. more intrusion) by the elephant and the households are more willing to pay something to get rid of this cost. This result can clearly be understood by noting that in the category of households who view the elephant as a public bad there are low and high labour investors in guarding against elephant intrusion, even though the majority of them would be the high labour investors. In the group of these households who dislike the elephant, those with low labour investment have a greater probability of accepting the presented bids. This implies that they suffer relatively more damage at the feet of the elephant. Why might this be so? It could be the case that by having low labour investment they also get less cushioned from elephant intrusion than their high labour investing peers. This points towards the effectiveness of using labour against elephant intrusion. Of course by investing less labour against intrusion they possibly re-allocate some labour into other activities but welfare losses due to inadequate intrusion prevention might be great. They might also invest less labour due to non-availability of labour i.e. they might be labour-constrained. For the households where the elephant is considered a public good, less labour-days spent guarding against elephant intrusion still mean the imposition of some costs by the elephant but the households are nevertheless more willing to pay for its preservation. This is likely because of proportionately lower costs (i.e. greater benefits) that they get from the elephant since they still report that benefits exceed costs despite their low labour investment. These households do not have to invest so much in preventive activities. In the event that they are not labour constrained, they re-allocate some labour into more productive activities.

The message from the double-bounded spike model is that the WTP responses obtained from the study are not random. Most importantly, the bid coefficients show that the probability of accepting the presented bids is inversely related to the size of the bid. Thus we are dealing with an ordinary commodity whose demand increases as the price falls. Furthermore, the WTP responses are related to some of the covariates collected in the survey, particularly in the sub-sample where

the elephant is considered a public bad.[12]

5.1 Welfare Measures for the Preservation of an Elephant Population of 200

This sub-section reports the mean and median WTP for the preservation and translocation of an elephant population of 200 for the two[13] sub-samples where the elephant is considered as either a public good (N_1=197) or a public bad (N_2=352).

The method of splitting the respondents into (i) those with preference for conservation of the elephant population, (ii) those indifferent to preservation, and (iii) those preferring a translocation of the current elephant population proved to be appropriate. Each of these categories represents 32%, 24% and 44% of the sample, respectively. The splitting method ensured that respondents were confronted with the appropriate project matching their class of preferences. Blindly confronting all respondents in the main sample with the same project would have resulted in a lot of zero responses to the elicitation of WTP.[14] Instead the splitting method allowed us to obtain valuable information about the spectrum of preferences and the magnitude of the negative WTP for the preservation (i.e. the WTP for translocation) of the current elephant population in a designated area.

While the mean WTP for the preservation of the current elephant population for the sub-sample where B > C is ZW$263 (*1.35% of mean annual income or US$4.78*) the mean WTP for the translocation of the current elephant population for the sub-sample where B < C is ZW$146 (*0.75% of mean annual income or US$2.65*). The median WTP for the preservation of the current elephant population for the sub-sample where B > C is ZW$260 (*3.35% of median annual income or US$4.73*) while the median WTP for the translocation of the current elephant population for the sub-sample where B < C is ZW$137 (*1.77% of median annual income or US$2.49*).

The choice of any one of the two welfare measures implies a particular approach to the aggregation of welfare across the population (Hanemann and Kanninen 1999). The mean is equivalent to adopting the Kaldor-Hicks potential compensation principle while the median is equivalent to adopting the majority-voting principle. The Kaldor-Hicks criterion is commonly used but it can lead to logical inconsistencies and it has been severely criticised on ethical grounds (Little 1957, quoted in Hanemann and Kanninen 1999, p325). While the majority-voting criterion could be considered as ethically superior, it has been criticised for not satisfying even potential Pareto efficiency. Thus, the choice of welfare measure is subjective and should ideally conform to the decision rule dominant in the sampled population.

In areas where CAMPFIRE operates, democratic principles have been instilled to replace the paternalistic tendencies of traditional chiefs, headmen, and village heads. Every household is given an equal opportunity to determine the outcome of issues under consideration. Thus, decisions are taken on the basis of the majority-voting criterion, where the voting unit is the household. In appraising the valuation of the preservation of the current elephant population in Mudzi, the median WTP should therefore be utilised, given that the project has already been sanctioned for adoption as attested to by the granting of AA status to Mudzi RDC. Considering the proportions

[12] The direct relationship between distance to the elephant reserve and the probability of accepting the presented bids in the double-bounded spike model is counter intuitive since it suggests that households living farther away have a greater WTP for the removal of the elephant.

[13] We do not report the welfare measures for the third sub-sample (N_3=21) of households that are indifferent to the elephant preservation project. In fact, the mean and median WTP for this sub-sample is zero.

[14] We find spikes of 0.05 and 0.28 for the two sub-samples. These are quite close to the observed fractions of respondents reporting zero WTP for either preservation or translocation of the current elephant population.

of households who are (i) pro-preservation (34%), (ii) indifferent (4%), and (iii) pro-translocation (62%) of the current elephant population in Mudzi, the median WTPs show that the gainers from preservation of the current elephant population, in aggregate, benefit more than the losers. Table 4 depicts the benefit-cost analysis (BCA) of the preservation of the current elephant population.

The table shows that those households who view the current elephant population as a public good derive an annual value of ZW$266,041 *(US$4,837)* from its preservation while those who consider it a public bad suffer an annual cost of ZW$255,213 *(US$4,640)* from its preservation. An examination of the actual annual incomes from CAMPFIRE activities indicate that Mudzi has been generating an annual average of ZW$159,526 *(US$2,900)*, which is lower than the costs suffered by losers from the preservation of the elephant (see Table A3 in the appendix). Those households who are indifferent to the preservation of the current elephant population put a zero valuation on it.

In principle, if a decision were adopted by the government for the local communities to continue preserving the current elephant population, as has been done by issuing AA status to Mudzi RDC, then that would benefit part of the population while harming others but, in aggregate, the beneficiaries would benefit marginally more than the losers. The preservation of the current elephant population in Mudzi yields an annual net worth of ZW$10,828 *(US$196)* for the households in CAMPFIRE wards.[15] However, the majority of the households in the local communities would not support the decision since 62% of them would rather not have the elephant because they view it as a nuisance. Thus if it were left to the local communities to decide whether or not the project of the preservation of the current elephant population in Mudzi should be carried out then the project would be blocked. There is a fear that imposing the project on the basis that, in aggregate, the winners benefit more than the losers, would result in lack of proactive cooperation from the majority and that could lead to the failure of collective action in community-based elephant conservation.

The realisation that a majority of households consider the elephant a public bad is one argument against devolution of elephant conservation to the local communities. Devolution entails the complete surrender of elephant conservation power. Full ownership of the elephant by the local communities would therefore imply the complete power to control the access and use of the elephant, and the capacity to hold the elephant for own use or to alienate or destroy it (Schlager and Ostrom 1993). The spectrum of preferences for the project of the preservation of the current elephant population shows that there have not been adequate incentives trickling down to the local communities to encourage a majority of them to change their perspective of the elephant as an agricultural liability. Devolution of elephant conservation to the local communities in Mudzi could be detrimental to its survival.

Given the rapidly changing economic situation in Zimbabwe, a comment on why results from data collected in December 2000 may still be relevant is in order. It is true that the Zimbabwean economy has been highly unstable since the fast-track land reform programme which commenced just after the rejection of a proposed new Constitution at a referendum in February 2000. However, our study focuses on one particular rural community and its relationship with wildlife. We do not believe that the relationship of our given rural community to adjacent wildlife has been shifted drastically by the events that have unfolded in Zimbabwe post-2000. The crucial changes in Zimbabwe were brought about by the fast-track land reform programme. This programme affected ownership of land in commercial farming areas not rural communal areas. Furthermore, commercial farming areas are generally in areas of high ecological potential i.e. natural regions 1, 2 and 3. The commu-

[15] While this figure assumes the feasibility of actual compensation of losers from the preservation of the current elephant population in Mudzi, in practice there has not been any compensation of victims of elephant damage, in particular, and wildlife, in general.

nal areas and the majority of wildlife areas that they live close to are in semi-arid to arid areas i.e. natural regions 4 and 5. For instance, our area of study wholly lies in natural regions 4 and 5 and there are no commercial farms nearby. We believe that the estimates we got from data collected in 2000 are still a reasonable reflection of the nature of relationship between our particular community and adjacent wildlife. The major effects that one might count of the rapidly changing economic situation in Zimbabwe on our study are that benign tourism has been dwindling due to increasing political instability and inflation has been rising and the exchange rate has remained overvalued thereby rendering revenues from wildlife uses valueless now as opposed to 2000. Political instability has not significantly affected wildlife income going to CAMPFIRE since such instability has mostly affected non-hunter tourists while CAMPFIRE derives most of its income from hunter tourists, who are relatively risk tolerant. Thus the changing economic situation in Zimbabwe entails that where communities were somehow cushioned from the costs of living with wildlife, such cushioning is no longer substantial, if it still exists, mostly because of inflation and exchange rate effects. Such an outcome does not qualitatively change the nature of our results since a larger proportion of people already view wildlife as a nuisance even with the more valuable revenues than used to be obtained under CAMPFIRE in 2000. Thus the case against devolution of wildlife to communities, which we put forward, is even amplified. To reiterate, devolution of elephant conservation to the local communities in Mudzi could be detrimental to its survival.

But how much would it take in order to reach such a majority in favour of maintaining the elephant population? In order to discuss this, a survival function based on the estimated bid functions in Table 2 is shown in Figure 1; it shows the share of respondents that would vote yes for a preservation of the elephants at various levels of the bids. It shows that in the case of Mudzi we are actually very close to a majority with a positive WTP for maintaining the herd size. We have also superimposed a vertical line representing the average income of ZW$53 from the CAMPFIRE project. If the returns from CAMPFIRE would be distributed evenly among all households in the district, this would shift the proportion that would be better off by elephants to about 65%.[16] Even greater participation rates could be reached if a mechanism could be devised that targeted those with WTP for relocation. An obvious candidate would for example be an insurance scheme where receipts from CAMPFIRE were used to compensate farmers hurt by elephant intrusion.

Adequate economic incentives must thus be extended to the local communities if a majority of them is to be persuaded to partake in sound elephant conservation. Given that studies generally show that a majority of people in countries that are not endowed with the African elephant have a positive WTP for its preservation (see for example Vredin, 1999), external transfers constitute yet another way of providing additional economic incentives to encourage elephant conservation by local communities such as Mudzi. However, external aid should be channelled directly to the producer communities if they are to respond to it in terms of increased interest in conservation. Given that wildlife conservation potentially increases the aggregate welfare of the local communities and that decentralisation of elephant user rights has already been adopted with the inception of CAMPFIRE, co-management should be the preferred mode of communities' involvement in wildlife conservation. This gives room for checks and balances so that mistakes overlooked at the local communities' level can be rectified by other organisations. Co-management acknowledges the multiple jurisdictions

[16] This statement presupposes that the current provision of local public goods by CAMPFIRE is not already internalized in the bids given. Unfortunately, it is impossible to know, ex post, how much of the returns are already internalized by the respondents. Given the obvious problems of targeting the receipts to public goods in a way that is superior than what the households could have done themselves, it is not daring to say that the internalized value is between zero and ZW$53, probably biased towards zero.

that exist in the conservation of the elephant (Hasler 1999) and also takes advantage of the lower costs of provision, monitoring, enforcement, conflict resolution, etc that occurs at the local level. What remains to be done to set co-management in motion is to increase the contestations of the sub-district local communities and establish adequate incentive schemes.

6 Conclusion

Wildlife conservation must compete economically with agriculture, which is the prime source of rural communities' livelihood, if it is to be accepted as an alternative land-use. If the economic value of wildlife relative to the communities' other economic activities were larger, then it would imply that wildlife conservation might be enhanced through devolution of wildlife conservation to the local communities. This paper, focused on the elephant as the representative wildlife since it is the most important species to the local communities both in terms of the damage it causes to crops and the value it contributes to CAMPFIRE revenues. The paper estimated the willingness to pay (WTP) for the preservation or translocation of a designated sub-population of the African elephant *(Loxodonta africana)* in Zimbabwe by rural communities who live adjacent to a designated game reserve taking into account the reality that some people consider it a public good while others consider it a public bad.

The paper shows that households who view the elephant as a public bad typically have older household heads, with low levels of education. Furthermore, more time spent guarding against elephant intrusion, proximity to the elephant reserve, susceptibility to larger elephant herds and low household income reinforces their perception of the elephant as a nuisance. This knowledge could help in (i) designing appropriate compensation schemes or (ii) targeting devolution of user rights to specific groups of people.

The median WTPs for the projects of preservation or translocation of the current elephant population is ZW$260 and ZW$137 respectively. Considering the proportions of households who are (i) pro-preservation (34%), (ii) indifferent (4%), and (iii) pro-translocation (62%), in aggregate, the preservationists benefit the most. However, the majority of households do not support the project hence imposing it could lead to the failure of collective action or if the local communities could decide whether or not to carry out the project then it would be blocked. Of importance to note also is the result that while it is generally believed that poor people are not willing and able to pay for sound environmental management, as many as 44% of the respondents are willing to pay for the preservation of the elephant in Mudzi.

The realisation that a majority of households consider the elephant a public bad is one argument against devolution of elephant conservation to the local communities in Mudzi. The rural communities' perceptions of the elephant are generally useful for other species of wildlife since the elephant is considered a keystone species and, most importantly, an umbrella species in the African Savannas. However, the discussion of the survival function of bids indicated that if adequate economic incentives can be extended to the local communities then a majority of them could be persuaded to partake in sound elephant conservation. External transfers constitute yet another way of providing additional economic incentives to encourage elephant conservation by local communities. It is obvious from this study that CAMPFIRE has not been successful enough in doing this in Mudzi yet.

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APPENDIX A

Table A1: Summary statistics for the open-ended WTP question with 200 elephants

	In the Market		**Out of the Market**
	Positive WTP ***(Costs>Benefits)***	Negative WTP ***(Costs<Benefits)***	Zero WTP ***(Costs=Benefits)***
Number of households (including those with zero WTP in the market)	352	197	21
H/holds with zero WTP in the market	99	15	Not applicable
Mean WTP including zero WTP in the market	110.43	389.54	Not applicable
Median WTP including zero WTP in the market	50.00	250.00	Not applicable
Mean WTP excluding zero WTP in the market	153.64	421.65	Not applicable
Median WTP excluding zero WTP in the market	100.00	250.00	Not applicable

Table A2: Summary statistics for the open-ended WTP question with 100 elephants

	In the Market		**Out of the Market**
	Positive WTP ***(Costs>Benefits)***	Negative WTP ***(Costs<Benefits)***	Zero WTP ***(Costs=Benefits)***
Number of households (including those with zero WTP in the market)	345	198	27
H/holds with zero WTP in the market	133	14	Not applicable
Mean WTP including zero WTP in the market	74.29	258.36	Not applicable
Median WTP including zero WTP in the market	20.00	175.00	Not applicable
Mean WTP excluding zero WTP in the market	120.90	278.02	Not applicable
Median WTP excluding zero WTP in the market	100.00	175.00	Not applicable

Table A3: Mudzi Rural District's Annual Income from CAMPFIRE Activities (ZW$)

Year	**GDP Deflator**	**Current (ZW$)***	**Current (US$)***	**Deflated (ZW$)**
1994	19.356	28,000	3,410	144,656
1995	21.205	-	-	-
1996	26.676	44,488	5,958	166,767
1997	30.997	59,488	4,780	191,912
1998	40.059	50,000	2,051	124,813
1999	62.541	226,926	5,919	362,838
2000	100.000	125,695	2,817	125,695

Source: *WWF SARPO, HARARE & WORLD BANK

Figure A1: Proportions of 'YES' responses from the starting bid in the sub-sample (B > C)

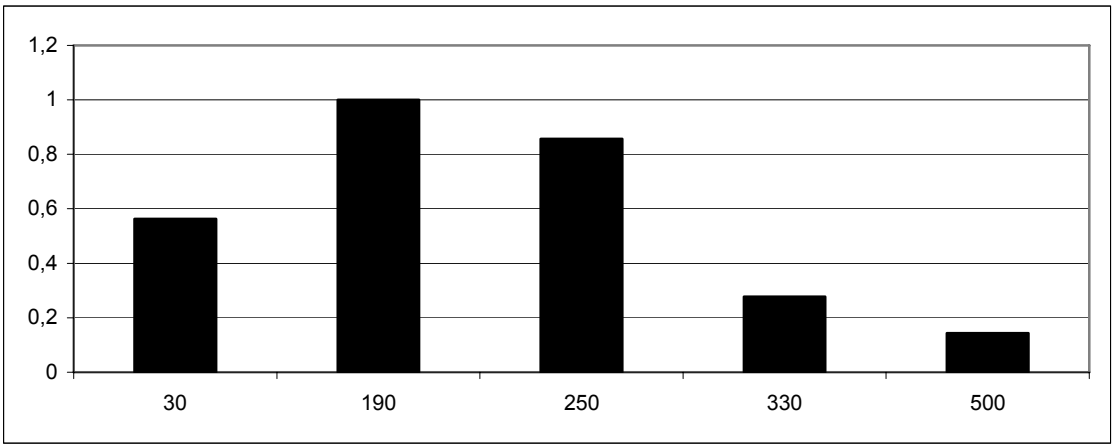
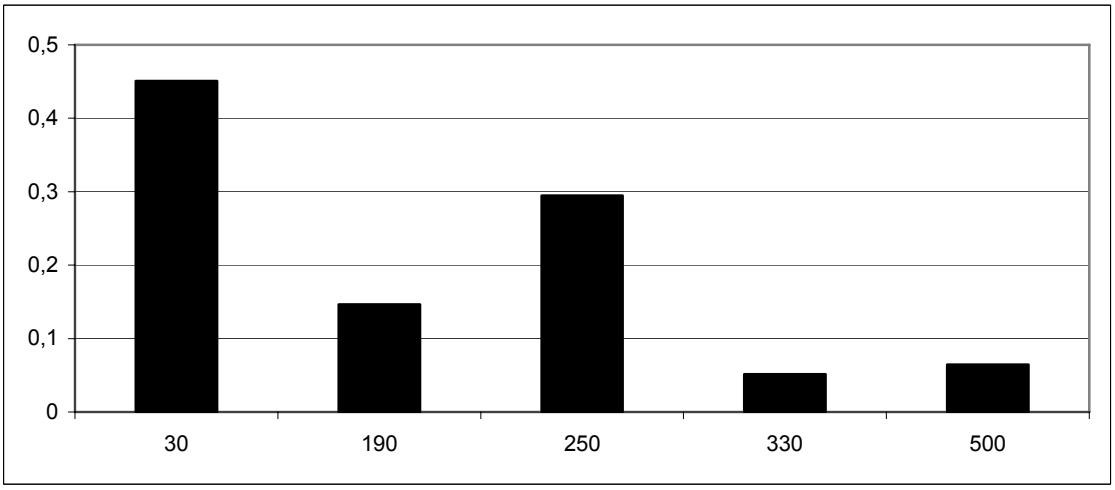


Figure A2: Proportions of 'YES' responses from the starting bid in the sub-sample (B < C)



APPENDIX B.

QUESTIONNAIRE FOR THE STUDY ON THE RURAL COMMUNITIES' PERSPECTIVE OF THE ECONOMIC VALUE OF THE ELEPHANT: MUDZI RURAL DISTRICT, ZIMBABWE DECEMBER 2000 (translated from the Shona questionnaire excerpt of valuation questions)

In answering the questions in the next section may you note that in this rural district there is an estimated elephant population of ***200***. In general, the benefits from elephants are (i) products that can be consumed directly, such as live sales, meat, hides, trophies, (ii) education, (iii) tourism, (iv) research opportunities, (v) ecological and environmental services such as maintenance of the African savannas and biodiversity, (vi) possible future uses such as touristic, pharmaceutical, industrial and agricultural applications, and (vii) intrinsic value such as religious, cultural, aesthetic, existence and bequest significance. The costs that elephants impose include (i) management costs such as costs of equipment, capital, wages, running costs, policing, etc, (ii) costs to other livelihood activities in the form of livestock losses, crop destruction, human injury, damage to structures, etc, and (iii) opportunity costs in the form of alternative land, money, time or resource uses and profits forgone, including unsustainable use. Remember that the elephant accounts for over 80 percent of all the wildlife perpetrated agricultural damage but it also accounts for over 65 percent of all CAMPFIRE revenues.

Stated Preference Survey

a. The district-wide elephant population is estimated to be 200. Considering those benefits and costs of elephants that are applicable to your household, how do you think the benefits of living with elephants compare with the associated costs?

(i) benefits > costs (***go to question b***)
(ii) benefits < costs (***go to question c***)

b. The government is considering translocating the current elephant population of ***200*** from your district to other districts so that the people there can also benefit from elephants since they are a national heritage. However, preliminary calculations show that it is possible to avoid the elephant translocation if your community can pay annual 'translocation avoidance' taxes to the government for as long as the animals shall be in your area. The revenue from this tax will then be distributed to the communities without elephants so that they can also benefit somehow from these animals. Would your household be willing to pay an annual 'translocation avoidance' tax of ZW$***x*** for as long as the animals shall be in your area, given that all other households who do not find elephants to be a nuisance will also pay the same amount, so that you could be allowed to continue living side by side with the ***200***? Y [***go to (i)***] N [***go to (ii)***]

(i) Suppose it turned out that the true annual 'translocation avoidance' tax is ZW$$x^H$, would your household be willing to pay it? Y [*skip(ii)*] N [*skip(ii)*]
(ii) Suppose it turned out that the true annual 'translocation avoidance' tax is ZW$$x_L$, would your household be willing to pay it? Y N
(iii) What would be the maximum annual 'translocation avoidance' tax that your household would be willing to pay? :_____[***Probe if zero***]

c. The government is considering translocating the current elephant population of ***200*** from your district to other districts so that your pain of living side by side with the elephants will be eased. It is expected that the people there will experience the nuisance that you have been experiencing from these animals. Nevertheless the government will insist that these people do live with these elephants and receive financial compensation annually. The government does not have the money to fund the translocation and annual compensation of the potential new neighbours of these elephants and preliminary calculations show that it is possible to

translocate the elephants if your community can pay an annual 'translocation' tax that could then be used for this translocation and compensation exercise of the ***200***. Your community will be expected to continue paying this annual 'translocation' tax for as long as the animals shall live in the other area. Would your household be willing to pay an annual 'translocation' tax of ZW$***x*** for as long as the animals shall be in the other area, given that all other households who find elephants to be a nuisance will also pay the same amount, so that you could be allowed to continue living free from these elephants? Y [***go to (i)***] N [***go to (ii)***]

(i) Suppose it turned out that the true annual 'translocation' tax is ZW$$x_L$, would your household be willing to pay it? Y [*skip(ii)*] N [*skip(ii)*]
(ii) Suppose it turned out that the true annual 'translocation' tax is ZW$$x^H$, would your household be willing to pay it? Y N
(iii) What would be the maximum annual 'translocation' tax that your household would be willing to pay? :_____ [***Probe if zero***]

Table 1: Basic sample and sub-sample characteristics

	Full sample N=570		B > C sub-sample N_1=197		B < C sub-sample N_2=352	
Characteristics	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**
Household Size	5.61	2.67	5.35	2.90	5.72	2.49
Sex of Household Head (M=1,F=0)	0.66	0.47	0.64	0.48	0.67	0.47
Age of Household Head (years)	41.84	14.87	37.23	12.53	44.53	15.35
Education-years of Household Head	5.25	4.29	6.85	3.96	4.34	4.17
Distance to Elephant Reserve (km)	10.23	10.32	14.74	12.52	7.46	7.53
Size of Intruding Elephant Herd	5.71	6.34	3.38	6.81	7.19	5.69
Existence of Mitigation Measures (Y=1,N=0)	0.36	0.48	0.21	0.41	0.45	0.50
Support Parks Driven Ele. Conservation (Y=1)	0.28	0.45	0.36	0.48	0.22	0.42
Agriculture as Main Activity (Y=1,N=0)	0.85	0.35	0.81	0.39	0.89	0.31
Labour-days Against Elephant Intrusion	39.17	45.40	14.46	34.06	53.89	44.99
Annual Household Income (ZW$)	19,488	42,493	26,748	55,948	15,763	33,520

Table 2: Determinants of the characterisation of the elephant as a public bad and estimates from the double-bounded spike model

Variable	**Probit Prob (B<C)**		**Double-bounded spike model**			
			B < C		B > C	
	Coeff	P-value	Coeff	P-value	Coeff	P-value
Intercept	0.1052	0.777	0.4120	0.567	2.8623	0.000
Bid			0.0142	0.000	0.0128	0.000
Household Size	-0.0299	0.239	-0.0083	0.862	-0.0297	0.646
Sex of Household Head	0.0076	0.956	-0.1150	0.638	-0.2522	0.472
Age of Household Head	0.0172	0.004	-0.0170	0.066	-0.0053	0.715
Education of Household Head	-0.0396	0.043	0.0631	0.089	0.0292	0.553
Distance to the Elephant Reserve	-0.0275	0.000	0.0731	0.000	0.0173	0.220
Size of Intruding Elephant Herd	0.0189	0.088	0.0120	0.621	-0.0168	0.496
Existence of Mitigation Measures	-0.1515	0.367	0.2570	0.336	0.2069	0.644
Support Parks Driven Conservation	-0.1540	0.260	1.5663	0.000	0.3295	0.291
Agriculture as Main Activity	-0.0418	0.829	0.6900	0.091	0.5459	0.158
Labour-days Against Intrusion	0.0106	0.000	-0.0079	0.012	-0.0088	0.069
Household Income	-0.0420	0.010	0.0138	0.694	-0.0127	0.724
Nobs	549		352		197	

Table 3: Mean and Median WTP for the preservation and translocation of an elephant population of 200.

Preservation Sub-Sample (B > C)		Translocation Sub-Sample (B < C)	
Median WTP	Mean WTP	Median WTP	Mean WTP
260.06 (163.2 - 357.9)	262.79 (169.4 - 356.1)	136.77 (24.7 – 248.8)	146.16 (48.1 – 244.2)

The exchange rate is 1US$=ZW$55. 95% confidence intervals in parentheses. Standard errors calculated with the Delta method.

Table 4: Benefit-cost analysis of the preservation of an elephant population of 200

Preference	**N**	**Sub-Population**	**Spike Median**	**BCA**
B > C	197	0.34 x 3009 = 1023	260.06	ZW$266,041
B < C	352	0.62 x 3009 = 1866	-136.77	- ZW$255,213
B = C	21	0.04 x 3009 = 120	0.00	ZW$ 0
	570	3009		ZW$ 10,828

Figure 1: Survival function of bids to keep and relocate elephants