Ethics in Wildlife Management: What Price?

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ABSTRACT

This paper argues that there may be instances where assessing wildlife for monetary valuation might be quite reasonable and useful for public policy, even when there are strong arguments against valuation of wildlife and nature. A case of deer population management is considered where continued growth of the deer population will lead to more property damage and habitat loss. However, deer population control raises ethical questions on the rights of animals to exist and on the rights of humans to arbitrarily interfere. The contingent valuation methodology (CVM) is used to value preferences for deer management for the purpose of guiding public policy. The valuation estimates show that ethical concerns about killing deer affect the level of willingness to pay in a quite a logical manner. However, for individuals with rights-based preferences, CVM is not appropriate. The survey results also show that individuals with rights-based preferences are a small minority in this particular example.

KEYWORDS

Ethics, contingent valuation, wildlife, willingness to pay, cost-benefit analysis

That wildlife can be attributed a monetary value or that ethical beliefs can be priced has been dismissed by philosophers and some economists. A frequently cited argument is that of Sagoff (1988a, 1988b). Arguments that wildlife valuations are illogical and incorrect are made against a broad range of valuation studies but are such arguments applicable to every situation in which wildlife or ethical beliefs are assessed for monetary valuation? This paper examines one case, deer population management in Maryland, USA, which utilises valuations of wildlife management to consider public policy. It will be argued that in specific circumstances, valuing wildlife management options can be a useful tool to choose one moral end over another. Also the analysis will show that ethical beliefs do impact on the valuation estimates in a logical manner.

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Sagoff's (1988a) argument against valuing nature is in the form of a trenchant criticism of cost-benefit analysis (CBA) and in particular contingent valuation (CVM). He argues that when people consider the environment they are expressing opinions and views not desires or wants whereas practitioners of CBA consider desires or wants as preferences. One error involved in CBA, Sagoff suggests, manifests itself when people either refuse to specify finite sums or object to answering willingness to pay (WTP) questions in contingent valuation. Sagoff interprets objections to answering such questions as indicating the logical absurdity of the questions and assimilating such responses as values and preferences involves a 'category mistake'. The mistake is that 'the analyst asks of beliefs about objective facts a question that is appropriate only to subjective interests and desires' (1988b, p. 94). Keat (1997) also finds that there are some logical or categorical errors involved but not quite in the character that Sagoff suggests. Rather than treating judgements as if they were preferences, which is how Sagoff presents the matter, Keat sees the errors as 'treating judgements about what is morally right as if they were judgements about what would contribute to the well-being of the person who makes these judgements' (1997, p35).

Booth (1997) argues that CBA is an inappropriate valuation criterion when a subject is deemed morally considerable. He states that while instruments can have a price, moral beings are priceless and therefore it is not appropriate to value moral beings using the same criterion. Similarly Etzioni (1986, p. 168) says that a true moral position cannot be bought off in exchange for something of instrumental value. However, Booth does allow that one moral end can be chosen above another, though such a choice would force a moral dilemma. Engaging in deer population management could be viewed as one choice in a moral dilemma, one in which the health and safety of humans and the preservation of the non-human ecosystem is prioritised. However, such views are not universal among philosophers. Ariansen (1998) argues that direct moral relationships can only occur between humans. Ariansen states that 'sentient animals are, as far as we know, in a position where they are unable to see wilfully inflicted pain as different from any other occurrence of pain' (1998, p. 159). And that 'so long as the principle of fairness – that equal cases should be treated equally – is incomprehensible to the non-human, it will be impossible to offer ethics to animals. In line with this, it is impossible to morally offend animals, although it is possible to inflict pain on them in manners which morally offend humans' (1998, p. 159). Therefore, in undertaking deer population management it is not possible to morally offend deer and CBA may be an appropriate valuation criterion. However, the manner in which the population management is undertaken may offend some humans.

One of the purported advantages of CVM is that it is the only valuation methodology that can estimate existence value. Krutilla, who is credited with introducing existence value into the economics literature, wrote that, 'when the

existence of a grand scenic wonder or a unique and fragile ecosystem is involved, its preservation and continued availability are a significant part of the real income of many individuals' (Krutilla, 1967, p. 779). Later Krutilla wrote that 'in the case of existence value, we conceived of individuals valuing an environment regardless of the fact that they feel certain they will never demand *in situ* the services it provides' (Krutilla and Fisher, 1975, p. 124). Viewing something as having existence value appears superficially to be quite similar to viewing objects or beings as morally considerable where one has 'to be committed to their continued existence and well-being even if they will never be observed or provide any kind of benefit flow' (Booth, 1997, p. 34). While having existence value does not require any payments it presumes that individuals are willing to make trade-offs between existence value and other goods. Whereas to view something as morally considerable does not require any trade-offs and may even preclude them.[1]

The foundation on which CBA rests is the Kaldor-Hicks principle, which says that resource re-allocation is welfare improving if the gainers could compensate the losers and still be better off (Kaldor, 1939; Hicks, 1939). The principle is not concerned with the payment of compensation but the possibility that it could be paid. If payment of compensation is not possible, for instance, if there is opposition on moral grounds to valuation and compensation, then the Kaldor-Hicks principle can not apply. Sagoff (1988a) suggests that respondents will object to questions seeking to value wildlife or nature and in such instances Edwards (1986) and Stevens *et al*. (1991) suggest that these respondents have ethical preferences that might be characterised as lexicographic. A lexicographic or rights based preference ordering is based on binary choices among alternatives, ranked according to a certain rule, and no two alternatives can be of equal rank (Edwards, 1986). Both Stevens *et al*. (1991) and Hanley and Milne (1996) conclude that there is evidence that a minority of respondents may have a rights-based preference ordering and that CBA may not be appropriate. However, Hanley and Milne (1996) concede that a lexicographic preference-ordering rule runs into difficulties when more than one good is prioritised. Even if we acknowledge that there may be a minority with a rights-based preference ordering for which CBA is not appropriate it would be reasonable to use CBA for the majority with egocentric or sociocentric preferences. In such circumstances CBA will be conditional on the segment of the population with egocentric preferences.

It may be too simple to presume that people have either preferences without any concern for extraneous objects and non-human beings or preferences where morals and ethical beliefs govern actions and choices. There is growing evidence that ethical concerns influence the CVM responses of individuals (Kotchen and Reiling 2000, Stevens *et al*. 1991, Spash and Hanley 1995).[2] Spash and Hanley (1995) find that up to 25% of CVM responses are motivated by ethical beliefs.

The fact that ethical beliefs may motivate CVM responses and WTP, or that we can choose one moral end over another does not mean that we can arbitrarily use CVM to value nature, sentient beings or environmental goods. Following the arguments of Edwards (1986), Sagoff (1988a), Stevens *et al*. (1991), Spash (1997), Hanley and Milne (1996) and others there are individuals who object to environmental valuation and these individuals are neither irrational nor have WTP equal to zero. Instead these individuals have a rights-based preference ordering, possibly lexicographic, which is different than the utilitarian model underlying CBA. Alternatively, the object for which a valuation is sought may not be particularly amenable to CVM valuation and it may not be always possible to devise a credible CVM instrument that will provide accurate valuation estimates.[3]

Even so there are instances in which CVM may usefully contribute to public policy discussion even in areas where ethical issues arise. The evidence of Kotchen and Reiling (2000), Stevens *et al*. (1991) and Spash and Hanley (1995) suggest that neither rights based, egocentric or sociocentric preferences exclusively prevail and that people are influenced by ethical concerns. CVM in such circumstances could be a useful methodology to reveal and learn about the actual preferences of members of society instead of presuming that people hold resolute ethical beliefs. Even among philosophers there is disagreement on what beings have moral rights. Booth (1997), who suggests nature has moral rights and is priceless, goes so far as to actually use a CVM estimate attributable to existence value as evidence of expression of ethical concern (1997, p. 45), whereas, Ariansen (1998) argues that it is impossible to morally offend animals.

CVM AND DEER POPULATION MANAGEMENT IN MARYLAND

The deer population in the state of Maryland affords many benefits to residents but also causes considerable damage to property. Extensive populations of deer destroy household shrubs and gardens, cause numerous traffic accidents and consume large quantities of agricultural crops, especially corn and soybeans. Reported deer-vehicle collisions more than doubled in the eight years to 1996 when there were 3,200 reported collisions (DNR, 1998). Grain crop losses from deer damage in 1996 were estimated at US$38 million (McNew and Curtis, 1997). In some public parks a browse line is evident below which all vegetation has been eaten, destroying other wildlife's habitat and the aesthetic beauty of the park. Deer are also a vector for the spread of Lyme's disease, a severely debilitating disease in humans. The incidence of the disease in humans increased from 12 to 423 cases per year in the ten years to 1996 (DNR, 1998). The increase in the level of deer related property damage in the 1990s paralleled the growth

in the deer population, which was estimated to have doubled to 300,000 in the ten years to 1998.

The situation facing the Maryland State government was that of mediator in a human-wildlife conflict. A survey was undertaken to ascertain the public's experiences with deer and deer damage and their views on deer population management with one component of the survey being a contingent valuation of deer population management options. The survey was conducted by the Survey Research Center at the University of Maryland and involved a telephone survey of Maryland households taken in spring 1998. A random sample totalling 1531 households across Maryland residents was drawn. A response rate of 65% was achieved with a further 14% of households having miscellaneous problems preventing answering the survey, which included the surveyors being unable to contact the appropriate within household respondent. There were 971 usable records leaving an effective response rate of 63%. Of the 971 respondents 838 expressed a preference for a reduction in the deer population and were subsequently asked a CVM question about programmes to reduce the deer population. The remaining 133 respondents expressed a preference for continued deer population growth.

The 838 individuals who expressed a preference for a reduction in the deer population were randomly asked one of two CVM questions about programmes to reduce the deer population. After being described a deer population management programme, respondents were asked a referendum format WTP question, i.e. a yes/no response was elicited. Approximately 58% of individuals responded 'no' to the CVM questions. A no response can arise for several reasons including those proposed by Sagoff (1988a) but also if respondents felt the programme was too expensive with the cost above their WTP. Using follow-up questions to the 'no' response the 58% can be subdivided between19% who felt the programme too expensive, 17% with zero WTP, 9% who were 'concerned about the humane treatment of deer', 2% who had difficulties with either government involvement or increased taxation and 11% who opposed the method of deer population control.[4] The 9% (77 respondents) who were concerned about the humane treatment of deer are the type of respondents that Sagoff (1988a) and Spash (1997) have in mind when they describe CVM as illogical and absurd. Ethical concerns would appear to be the motivation behind these respondents' answers. Edwards (1986), Stevens *et al*. (1991) and Hanley and Milne (1996) have suggested that respondents like these 77 have lexicographic preferences. A question to examine this issue was included in the survey. Respondents who voiced concern about in-humane treatment of deer were asked the following:

> *Do you believe the deer population should not be controlled, even if it meant you would suffer severe property damage from deer?*

Under a lexicographic preference ordering that prioritised deer welfare above personal property an individual would respond yes to this question. Only 11 of the 77 respondents who voiced ethical concerns responded yes – i.e. 14% of 77 with a sampling error of ±8%. These 11 individuals represent less than 1.5% of the original 838 respondents, therefore, lexicographic preference orderings, if they exist, appear to apply only to a very small minority of individuals. But this test is not conclusive evidence of the prevalence of lexicographic preferences. The structure of lexicographic preferences, the nature in which goods are ranked, and how income is allocated, maybe sufficiently complex that the question above was too simple to reveal the true prevalence of lexicographic preferences.

Detractors of CVM would possibly argue that the 13% of respondents, who opposed either the government's involvement, increased taxation or the method of deer population management is further evidence that shows the limits of CVM. However, it is likely that all government programmes have their critics and it is reassuring that the CVM survey is able to identify such individuals.

Either a sharp-shooting or birth control programme was described to respondents as a method to reduce the deer population and was followed by a WTP question. The text of both CVM questions is contained in an appendix. Since the main issue of interest is deer population management, a professional sharp-shooting programme rather than recreational hunting was proposed because it reduces fears about public safety and eliminates objections to recreational hunting. Likewise in the birth control programme it was specifically stated that the process would not cause deer any pain to avoid any respondent beliefs that birth control might harm deer.

In proposing to estimate the value to the public of programmes to reduce the deer population we were conscious that ethical beliefs might affect how much such programmes were worth to people (Spash and Hanley, 1995; Kotchen and Reiling, 2000). Ethical concerns could arise with either of the proposed population management programmes. With the sharp-shooting programme an important issue is whether it is ethical to kill deer. In the birth control programme there may be ethical concerns about interfering with the natural reproductive cycle of wild animals. Neither the survey questionnaire nor this paper deals with ethical concerns surrounding deer birth control but instead focuses on the ethics of killing deer. Survey respondents were asked, 'do you believe killing deer is ethical?' and to determine whether ethical beliefs affect WTP, estimates of mean WTP are conditioned on the response to this question. Depending on a respondent's beliefs on the ethics of killing deer and whether they were asked about sharp-shooting or birth control four categories are possible and outlined in Table 1.

Table 1: CVM programme-Ethics question categories

CVM programme	**Ethics question**
Sharp shooting	Ethical to kill deer
Sharp shooting	Not ethical to kill deer
Birth control	Ethical to kill deer
Birth control	Not ethical to kill deer

The CVM analysis allows us examine several hypotheses on people's preferences for deer management. Since sharp shooting involves killing deer and birth control does not, it is conceivable that people who believe it is unethical to kill deer would prefer birth control to a sharp shooting programme. With the sharp shooting programme it is possible that people who believe it is ethical to kill deer would be likely to pay more for the programme than people who believe it is unethical. For the birth control programme it is possible that people who believe it is unethical to kill deer would be willing to pay more for the birth control because for them there is no other alternative for population control. If a person believes it is ethical to kill deer neither the sharp shooting or birth control programmes violate ethical beliefs. In this instance there is no reason to assume that WTP for sharp shooting or birth control will differ based on ethical beliefs. These hypotheses, which are listed in the Table 2, can be tested using the data from the CVM.

Table 2. Hypotheses on WTP for deer management conditional on ethical beliefs.

1. $\overline{WTP}$ [5](sharp shooting | ethical to kill)	>	$\overline{WTP}$ (sharp shooting | unethical to kill)
2. $\overline{WTP}$ (birth control | ethical to kill)	<	$\overline{WTP}$ (birth control | unethical to kill)
3. $\overline{WTP}$ (sharp shooting | ethical to kill)	=	$\overline{WTP}$ (birth control | ethical to kill)
4. $\overline{WTP}$ (sharp shooting | unethical to kill)	<	$\overline{WTP}$ (birth control | unethical to kill)

THE MODEL

The respondent in the CVM survey is confronted with a proposal for deer population control at cost *A*. The cost *A* is the actual cost to the respondent if the CVM proposal is implemented and the amount *A* is constructed to differ across respondents. The WTP question seeks either a 'yes' or 'no' response with the interpretation of 'yes, I am willing to pay amount *A* for the CVM proposal described' or 'no, I am not willing to pay amount *A* for the CVM proposal'. In the deer management CVM the amount *A* was selected from a vector of six amounts ($15, 30, 50, 75, 100, 125), which it was believed spanned the distribution of respondents' WTP.[6] Respondent *i*'s indirect utility function is $\nu\ (q, y_i; x_i)$ where q is the deer population control programme, x is a vector of respondent characteristics including ethical beliefs, and y is income. The project is represented as $q^0 \rightarrow q^1$ with cost A. A respondent who accepts the proposal receives utility $\nu\ (q^1, y_i - A_i; x_i)$. When the respondent declines, utility is $\nu\ (q^0, y_i; x_i)$. We specify a linear indirect utility function: $\nu\ (q, y_i; x_i) = \alpha_q x_i + \beta y_i + \varepsilon_{iq}$. The error term ε_{iq} represents what appears to be the random component of utility as observed by the researcher, though not random to the individual. The indirect utility function is the inverse of WTP and therefore WTP can be calculated using the estimated parameters of the indirect utility (Hanemann, 1984). The parameters of the indirect utility function can be estimated by specifying the likelihood function for survey responses, the product of the probabilities of various types of responses. To derive the likelihood function for estimation we can say that there are three types of responses to the CVM question. The first is that people object to the CVM proposal. In this case indirect utility declines and WTP will be negative. The next type of response is where individuals say 'no' to the CVM proposal because the cost of the proposal to the individual is too high. Individuals of this type have positive WTP but their WTP is less than amount *A* that is mentioned in the CVM question. The third type of response is where individuals answer 'yes' to the CVM proposal. For these individuals indirect utility increases when the CVM proposal is implemented and they have positive WTP. An additional type of response is where respondents incur no indirect utility change from the CVM project or have zero WTP. It is arguable that respondents of this type do not receive any utility from deer or have any ethical beliefs on the treatment of deer and therefore can be excluded from model estimation. Of 838 respondents, 145 (17%) indicated zero WTP therefore leaving 693 observations for model estimation. Assuming that G is the cumulative distribution function of indirect utility, the likelihood function is the product of three probabilities:

$$L = \prod_i [G(-\alpha_i)]^{M_i} [G(\beta A_i - \alpha_i) - G(-\alpha_i)]^{N_i} [G(\beta y_i - \alpha_i) - G(\beta A_i - \alpha_i)]^{Y_i} [G(\beta y_i - \alpha_i)]^{-1}$$

An individual's WTP is bounded above by income and this is incorporated into estimation, hence the denominator term in the likelihood function. The exponent variables in the likelihood function are defined as follows: $M_i = 1$ when a respondent opposes the CV proposal, zero otherwise. $N_i = 1$, when the respondent votes 'no' because the proposal is too expensive, zero otherwise. $Y_i = 1$, when the respondent votes in favour of the CV proposal, zero otherwise. The parameter α_i is the vector associated respondent characteristic, calculated as follows:

$$\alpha_i = (\alpha_0 - \alpha_1)x_i.$$

Hanemann (1984) derives a measure of WTP for the linear indirect utility function, which is $E(\alpha_i+\eta_i)/\beta$, where $\eta_i = \varepsilon_{i1} - \varepsilon_{i0}$. Allowing that WTP is bounded above by income mean WTP is calculated as:

$$\overline{\text{WTP}} = E\left(\frac{\alpha_i + \eta_i}{\beta} \middle| \frac{\alpha_i + \eta_i}{\beta} < y_i\right)$$

This calculation does not restrict mean WTP to be positive, therefore, calculated mean WTP for respondents who objected to the CVM is likely to be negative.

CVM practitioners have avoided the concept of negative WTP because of its dubious interpretation. Two alternative questions are considered more appropriate when individuals are likely to incur utility loss from the implementation of a CVM proposal. The first is to ask the individual their willingness to accept compensation (WTA) to allow the utility deteriorating proposal to proceed. The second alternative is to redesign the CVM proposal in such a way that the same individual is asked a WTP question to avoid a utility deteriorating scenario.[7] However, neither approach was used in the present CVM study when the proposal was considered utility deteriorating because of limited resources but the data elicited from the survey can infer information about preferences even though the preferred survey methods were not administered. The objective of the model was to estimate a sufficiently flexible indirect utility function to incorporate the preferences of all individuals with respect to deer management. Estimating negative WTP in this circumstance assumes that the estimated indirect utility function is representative of the whole sample and that the information gathered on the distribution of positive WTP mirrors the distribution of decline in indirect utility of individuals adversely impacted by the CVM proposal. It is assumed that the estimated indirect utility function can reflect the preferences of any individual faced with a choice of either population management programme conditional on either disposition on the ethics of killing deer.

RESULTS

A description of the variables used in model estimation is contained in Table 3.

Table 3. Description of Variables

Variable	Description	Mean	std. dev.
SS	1= sharp shooting CVM question, zero otherwise	0.516	0.50
BC	1= birth control question, zero otherwise (BC=1-SS)	0.484	0.50
ETH	1= believe it is unethical to kill deer, zero otherwise	0.636	0.48
HUNTER	1= deer hunter in household, zero otherwise	0.144	0.35
AGE 35	1= age 35, zero otherwise	0.496	0.50
A	The CVM bid price = 15, 30, 50, 75, 100 or 125 dollars		

For estimation is was assumed that ε_{iq} is independently and identically distributed with a Type I Extreme Value distribution therefore implying that η_i has a logistic distribution.[8] The α's and β are the parameters to be estimated. Table 4 contains the indirect utility function's parameter estimates.

Table 4. Indirect Utility Function Parameter Estimates

Parameter	Variable	Parameter Estimate	Standard Error
β	Y	16.806	1.161**
α_1	SS ETH	1.105	0.177**
α_2	SS (1-ETH)	-0.501	0.197**
α_3	BC ETH	1.095	0.193**
α_4	BC (1-ETH)	1.994	0.222**
α_5	HUNTER SS	-0.260	0.283
α_6	HUNTER BC	-1.211	0.272**
α_7	AGE 35	0.394	0.154**
Log likelihood		-676.4	
No. of observations		693	

** Statistically significant at 95%

The statistical significance of the various a coefficients indicates that individual's preferences for the deer management programmes differ based on personal characteristics. For example, people older than 35 years derive more utility from deer population control programmes than younger people do, presumably because older people fear property damage and deer-vehicle collisions more.

Hunters receive less utility than others from the birth control programme, i.e. statistically significant negative parameter estimate for α_6. The differences in preferences based on ethical beliefs can be seen from the parameter estimates α_1–α_4 but these differences are reflected in the estimates of WTP in Table 5 and discussion is deferred to the differences in WTP. The intercept term in the indirect utility function is the combination of α_1 to α_7 that applies to each individual. Which combination depends on whether the respondent was asked about sharp-shooting or birth control, whether the respondent believes it is ethical to kill deer, whether there is a deer hunter in the respondent's household and the respondent's age.

The estimates of mean WTP are calculated directly from the indirect utility function's parameter estimates and are conditional on the four categories listed in Table 1. The first row of Table 5 shows estimated mean WTP of respondents who believe it is ethical to kill deer and were questioned about the sharp shooting programme. Estimated mean WTP is just above $75 and with 95% confidence we can say that actual mean WTP is between $61 and $90.[9] For respondents who believe it is unethical to kill deer and who heard the sharp shooting proposal, estimated mean WTP is negative, and the 95% confidence interval indicates that this estimate is significantly different than zero. Mean WTP for the birth control proposal is substantially higher when respondents believe it is unethical to kill deer.

Table 5. Estimates of Mean Willingness to Pay (WTP) – dollars

	CVM programme	Ethics question	Mean WTP	95% Confidence Interval	Respondents in each category
1	Sharp shooting	Ethical to kill deer	75.2	61.8 – 89.5	35%
2	Sharp shooting	Unethical to kill deer	-20.3	-39.6 – -2.3	17%
3	Birth control	Ethical to kill deer	66.5	53.0 – 80.1	30%
4	Birth control	Unethical to kill deer	119.9	101.3 – 140.1	18%

Table 2 listed four hypotheses that could be tested using the CVM model. The first was that mean WTP of respondents to the sharp shooting proposal who believed it was ethical to kill deer is higher than mean WTP of respondents who believed it was unethical to kill deer, i.e. $\overline{WTP}$ (sharp shooting | ethical to kill) > $\overline{WTP}$ (sharp shooting | unethical to kill). The estimates in rows 1 and 2 of Table 5 clearly support this hypothesis. The second hypothesis was that $\overline{WTP}$ (birth control | ethical to kill) < $\overline{WTP}$ (birth control | unethical to kill). The estimates from rows 3 and 4 support this hypothesis, as the confidence intervals do not overlap. The third hypothesis was that assuming respondents believed it was

ethical to kill deer we would not see a difference in WTP of the two programmes, i.e. $\overline{WTP}$ (sharp shooting | ethical to kill) = $\overline{WTP}$ (birth control | ethical to kill). Comparing rows 1 and 3 of Table 5 we can test this hypothesis. The confidence intervals overlap and therefore statistically there is no difference between the estimates of mean WTP in these two cases. The fourth hypothesis was that for respondents who believed it was unethical to kill deer, WTP would be higher for the birth control programme, i.e. $\overline{WTP}$ (sharp shooting | unethical to kill) < $\overline{WTP}$ (birth control | unethical to kill). The estimates from rows 2 and 4 provide empirical support for this hypothesis.

DISCUSSION

Included in the CVM model were all respondents that expressed some sort of view, either positive or negative, on deer population management. Respondents may have sociocentric, egocentric or rights-based preferences but it may not be simply a matter of deciding which, and instead something in between may actually prevail. The results from the CVM model on deer management show support for this hypothesis. We find that WTP for the deer management programmes is affected by ethical beliefs about killing deer.

The estimates also clearly show that a section of the sample object to the deer management programmes and have negative WTP. When the CVM programme is considered objectionable, CVM best practice is to estimate WTA or alternatively WTP to avoid the undesired outcome rather than estimate negative WTP. However, as mentioned earlier this practice was not undertaken in this CVM study. The meaning of negative WTP in this context is as a measure of loss to the individual. The estimate of negative WTP is statistically significant indicating that this is not a trivial amount. However, the negative WTP estimate of $20 might be viewed low when we consider that this estimate of WTP is for respondents who it is argued believe wildlife and nature priceless. But most of these same respondents who objected to the CVM proposal because they had concerns for the humane treatment of deer revealed in a subsequent survey question that they did not have lexicographic preferences and did not consider deer population conservation priceless. Therefore, while negative $20 is not a substantial amount, it is consistent with other evidence from the survey.

Another interpretation of why the estimate of negative $20 from respondents who it might be argued believe wildlife and nature priceless is not substantially lower relates to the scale of the CVM proposal. Killing a relatively small number of deer from a healthy and rapidly growing population would not threaten the species' extinction therefore the loss in monetary terms to respondents when a small number of deer are killed is relatively small.

The estimates of mean WTP in Table 5 in a sense put a value on ethical beliefs. The difference between the two estimates of mean WTP for either the sharp shooting or birth control management options is whether it is ethical to kill deer. Depending on whether respondents believe it is ethical to kill deer they are WTP $95 extra for the sharp shooting deer population management programme or $53 less for the birth control management programme. But the purpose of CVM analysis is not to price ethical beliefs. The inclusion of variables like ethical beliefs is to help interpret responses to valuation questions and is recommended by the NOAA panel that issued a report assessing the reliability of CVM (Arrow *et al*., 1993). The rationale is that respondent characteristic variables may provide an internal test of plausibility. The valuation estimates presented here differ depending on ethical beliefs in a plausible and logical manner; respondents are WTP more when their ethical beliefs are not violated.

The purpose of the CVM analysis is to provide information to policy makers and the estimates of mean WTP in Table 5 provide a substantial amount of information to aid decisions. Using information on the sample of respondents we know that roughly 35% of the sample of 693 respondents have mean WTP of $75, 17% have mean WTP of negative $20, 30% have mean WTP of $67 and 18% have mean WTP of $119, depending on the particular programme and ethical beliefs. These results tell policy makers how different minorities in society value deer management programmes and that there is no obvious 'right' policy. However, this information should assist in making informed and considered decisions.

CONCLUSIONS

Philosophers and some economists view the valuation of wildlife and nature as absurd and nonsensical. Nonetheless, CBA continues to be used to assess the merits of development that affects wildlife and nature. To those who object to CBA the issues are quite clear: wildlife and nature have a moral right to exist, humans do not have the right to arbitrarily destroy, and it does not make sense to ask people to value something for which they only hold opinions or views. Proponents of CBA would argue that in most circumstances valuation estimates adequately incorporate ethical motivations and that CBA is a tool that helps inform choices even in the case of moral dilemmas where one moral end is chosen above another.

The issue of deer population management in Maryland has clear ethical issues including whether it is ethical to kill deer, about the rights of individuals to protect their private property, concerning the prevention of a debilitating disease and the conservation of habitat for all wildlife. A satisfactory outcome

that does not deteriorate the moral standing of deer, other wildlife, habitat and humans is not possible in this human-wildlife conflict. The dilemma facing Maryland State Natural Resource managers involves choosing one moral end above another. Though CVM has its limitations it can provide quantitative valuations of natural resources based on respondents' considered responses to hypothetical scenarios, which in turn can help decide budget-constrained choices.

The results presented show how analysing ethical beliefs in the context of CVM studies is useful for explaining valuation responses. Respondents with ethical beliefs on killing deer answered the CVM questions in a logical manner, as WTP estimates are higher for deer management programmes that are consistent with respondents' ethical beliefs. Even so, further research integrating economic and attitudes-behaviour literature would be helpful to understand how ethical beliefs affect CVM responses and valuation estimates.

NOTES

I wish to thank two anonymous reviewers who made a number of suggestions that helped improve the paper.

[1] Thanks to an anonymous referee for clarifying this point.
[2] However, questions have also been raised as to whether ethical motives give rise to legitimate economic values (Brookshire *et al*. 1986; Rosenthal and Nelson, 1992; More *et al*., 1996; Nelson, 1996).
[3] See Mitchell and Carson (1989) for more detail on best practice in survey and CVM methodology to value public goods.
[4] There were two deer control CVM questions, one involving sharp-shooting the other birth control. A similar breakdown of the 'no' responses in both questions is as follows. Of 432 sharp-shooting respondents 63% voted 'no' while 54% of the 406 birth control respondents voted 'no'. The 63% sharp shooting (or 54% birth control) 'no' votes can be attributed to 19% (20%) who felt the sharp-shooting programme was too expensive, 17% (17%) with zero WTP, 15% (3%) who were 'concerned about the humane treatment of deer', 2% (2%) who had difficulties with either government involvement or increased taxation and 9% (12%) who opposed the method of deer population control.
[5] $\overline{\text{WTP}}$ denotes mean WTP
[6] For more detail on the design and implementation of CVM surveys see Mitchell and Carson (1989).
[7] There is large literature on the disparity between WTP and WTA responses. See for example Mansfield (1999), Shogren *et al*. (1994), Hanemann (1991).
[8] The model was also estimated with the assumption of normally distributed errors, with virtually identical results.
[9] The confidence intervals were calculated over 10,000 drawings from the parameter vector according to the variance-covariance matrix estimated. This method is similar to the simulation approach suggested by Krinsky and Robb (1986).

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APPENDIX

The CVM component of the questionnaire began with a description of Maryland's deer population and their associated benefits and damages and a question on respondents' preference for continued deer population growth. If respondents responded that they would not like to see the deer population continue to increase they were asked either the sharp shooting or birth control question below.

> Ten years ago, there were about 150,000 deer in Maryland. Now, there are twice as many deer in Maryland – about 300,000.
>
> This growth means that deer are now easier to see in areas where people can enjoy them. But, it also means deer now cause more crop losses, damage to private landscaping, as well as damage to cars from collisions. And, it has led to the spread of lyme disease among people.
>
> Would you like to see the deer population continue to increase?

The Sharp-shooting Proposal:

A proposal being considered to control the deer population is to hire professional hunters as sharpshooters. These sharpshooters will be instructed to reduce the deer population in specific areas where deer damage is highest. The sharpshooters will be safe to use in areas where people live nearby. The objective will be to reduce [your county's] deer population by ten percent in total for the next five years.

If this were to be used in [your county], it should reduce deer damage to cars, crops and landscaping. On the other hand, there will be fewer deer, and the likelihood of seeing deer will decrease.

This proposal to reduce [your county's] deer population by ten percent using sharpshooters would cost your household [15, 30, 50, 75, or 100] dollars in higher state income taxes for one year. Keeping in mind that you would have [15, 30, 50, 75, or 100] dollars less to spend on other things, would you vote for it or vote against it?

The Birth Control Proposal:

A proposal being considered to control the deer population is to use deer birth control. This method of control can be used in areas where people live nearby. Qualified personnel will be hired to administer the contraceptive by methods that will avoid pain to the deer. This birth control will be used to control the population in specific areas where damage is highest. The objective will be to reduce [your county's] deer population by ten percent in total for the next five years.

If this were to be used in [your county], it should reduce deer damage to cars, crops and landscaping. On the other hand, there will be fewer deer and the likelihood of seeing deer will decrease.

This proposal to reduce [your county's] deer population by ten percent using birth control would cost your household [15, 30, 50, 75, 100, or 125] dollars in higher state income taxes for one year. Keeping in mind that you would have [15, 30, 50, 75, 100 or 125] dollars less to spend on other things, would you vote for it or vote against it?