Valuing Forest Ecosystem Services: A Comparison of the Effects of Attitudes and Demographic Characteristics on Willingness to Pay

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Environmental value estimates that result from non-market valuation studies are key inputs to cost-benefit analysis in support of policy decisions (Hanley et al. 2003). Determining whose values should be included in the analysis can improve the usefulness of estimates for cost-benefit analysis and policy making. Identifying the extent of the market for environmental goods and services can be accomplished in part by estimating effects of individuals' characteristics on willingness to pay for the provision of an environmental good or service. This study investigates the effects of demographic and attitudinal factors on willingness to pay (WTP) for a forest easement program in an area of Michigan's Upper Peninsula (UP).

A variety of economic techniques exist that provide ways of estimating values for public goods by asking individuals to state their preferences for the provision of an environmental good (Carson 2000). Contingent Valuation (CV) is a stated preference method that uses survey questions to elicit an individual's willingness to pay (WTP) to achieve an environmental improvement or to avoid an environmental injury (Mitchell and Carson 1989, Bennett and Adamowicz 2001). The CV method presents respondents with a hypothetical, or constructed, market that provides information about the environmental good to be valued, how it will be provided, how it will be paid for, and asks the respondent to make a decision about the provision of that good (Mitchell 2002).

Contingent valuation studies typically collect information on respondent characteristics, including demographic characteristics as well as attitudes towards the resource being valued. Attitudinal information is an important component of nonmarket valuation surveys because attitudes that improve understanding of the motivations that underlie individuals' choices (McLelland 2001), and attitudes are often used to corroborate CV results. The connections between environmental values, attitudes and behavior have been well established in the environmental behavior literature (Dietz et al. 1998, Nordlund and Garvill 2002, Johnson et al. 2004, Tarrant and Cordell 1997, Stern et al. 1995, Poortinga et al. 2004). However, comparatively few studies in the nonmarket valuation literature have examined the effects of attitudes on the nonmarket values of environmental goods and services. Contingent valuation (CV) studies that have included attitudes in the analysis of WTP values report a positive relationship between pro-environmental attitudes and WTP (Bandara and Tisdell 2003, Streever et al. 1998, Stevens et al. 1991). Some studies have considered the effects of general environmental attitudes on WTP (Spash 1997, Kotchen and Reiling 2000), while others have included effects of attitudes specific to the resource being valued in the analysis (Streever et al. 1998, Stevens et al. 1991).

In this study, attitudinal data collected from a mail survey of Michigan residents is included in a CV model to test the hypothesis that environmental attitudes can be used to explain WTP. It is assumed that there are certain types of environmental values that underlie individuals' attitudes towards resource management. The conceptualization of environmental values and attitudes in this paper is based on the hierarchical framework established by Stern et al. (1995), in which values underlie attitudes and attitudes predict behavior. Respondent attitudes can be conceptualized using an anthropocentric/biocentric value scale, which differentiates between individuals who believe in the instrumental value of natural resources and the environment for the benefit of humans (i.e. anthropocentric) and those who support the intrinsic value and ecological and life support roles of natural resources (i.e. biocentric) (Steel et al. 1994, Tarrant and Cordell 2002). This analysis tests the hypothesis that differences between individuals with anthropocentric versus biocentric forest management attitudes explain WTP.

The use of attitudes in this analysis is also based on the Theory of Reasoned Action and the Theory of Planned Behavior. Several studies have used these theoretical frameworks to explain the effects of attitudes on WTP (Barro et al 1996, Kerr and Cullen 1995, Ajzen and Driver 1992). Within this context, WTP is viewed as a behavioral intention, and attitudes toward a policy or management practice specific to the resource being valued can be linked to individuals' intentions to support a particular program (Pouta and Rekola 2000). These theoretical frameworks are based in social psychology and provide a way of connecting values for a resource to specific attitudes toward supporting a particular management approach or natural resource policy (Pouta and Rekola 2000). Attitudes analyzed within this context can be useful for predicting WTP for a particular natural resource policy and can help understand whether the WTP values elicited from respondents represent actual behavioral intentions or general environmental attitudes (). Attitudes in this study are used to understand underlying beliefs (e.g. anthropocentric vs. biocentric) as well as to understand the effect of attitudes specific to resource management and policy on WTP values.

Attribute-Based Referenda Model

This research presents a nonmarket valuation analysis of major forest ecosystem services in an area of Michigan that was chosen for the importance of its forests to deer habitat, forest migratory songbird habitat and to the sustainability of the local economy. Ecosystem services provide benefits to people, but production of some, such as food and fiber, may occur at a cost to others, such as wildlife habitat or water quality (MA 2003). Many ecosystem services, such as wildlife habitat or biodiversity, are public goods that do not have market values but that may be valued by the public. Although it is important to understand the benefits of ecosystem services to society in order to effectively evaluate tradeoffs that may occur in their provision (NRC 2005), the nonmarket benefits of ecosystem services have not been extensively quantified (MA 2005).

Research on non-market values of managed forest ecosystems naturally lends itself to a multi-attribute approach because of the numerous characteristics of forests managed for multiple uses. Attribute-based methods (ABMs) are growing in popularity as an alternative to the traditional CVM, which has been the most commonly used method for measuring passive use values (Adamowic and Boxall 2001, Holmes and Adamowicz 2003, Holmes and Boyle 2005). Like the CVM, ABMs are based in random utility theory, but they focus on sets of environmental policy-relevant attributes, along with cost, as opposed to one total value, which is the focus of traditional CV studies (Hanley et al. 1998, Bennett and Blamey 2001, Holmes and Boyle 2005).

Numerous studies have compared traditional CVM with ABMs and have concluded that there are several advantages of using ABMs to estimate values of environmental goods with multiple attributes (Boxall et al. 1996, Hanley et al. 1998). A commonly used ABM is the choice experiment (CE), which is a non-market valuation method that is well suited for the estimation of marginal values of environmental attributes (Boxall et al. 1996, Hanley et al. 1998, Lupi et al. 2002, Stevens et al. 2000).

Another type of ABM is the attribute-based referenda model (ABR), which is a hybrid of contingent valuation and attribute-based method stated preference questions (Holmes and Boyle 2005). This method uses an attribute-based description of an environmental good or service and a referendum-style choice between the status quo and a policy alternative to the status quo. The ABR model used in this study is based on a contingent market for an environmental good that is described in terms of multiple attributes. The contingent market used in this survey is a political market that presents respondents with a decision to vote 'yes' or 'no' to a forest and wildlife protection program for the Study Forest.

ABR models, like contingent valuation and attribute-based methods, are based in random utility theory (Holmes and Boyle 2005, McFadden 1974). Within the random utility theoretical framework, utility is assumed to be composed of a deterministic component and a random component. Indirect utility, *u*, is the maximum amount of utility that a household can derive from income, *y*, given prices of goods, a vector of environmental quality variables, ***x***, other respondent characteristics, ***z***, and a component of individual preferences, **g**, known to the individual but not to the researcher,

$$u = u(y, \boldsymbol{x}, \boldsymbol{z}, \varepsilon), \qquad (1)$$

In an ABR model, respondents are asked if they are willing to pay a certain amount to achieve an environmental quality improvement. In this model, the quality improvement is described by changes in the levels of attributes of a forested ecosystem that will be provided by a program at a cost to the respondent. Utility to the individual when an amount p is paid is:

$$u_1 = u(\boldsymbol{x_1}, \boldsymbol{z}, y - p, \varepsilon_1). \tag{2}$$

In this equation, u_1 represents the indirect utility function for an individual who pays the cost of the program; $\boldsymbol{x_1}$ is a vector of forest ecosystem attributes under the forest protection program. If the cost, p, of the program is not paid, the indirect utility function is written as follows:

$$u_0 = u(\boldsymbol{x_0}, \boldsymbol{z}, y, \varepsilon_0) \ . \tag{3}$$

In this equation, u_0 represents indirect utility under the status quo, and $\boldsymbol{x_0}$ is the vector of forest attribute levels without the program. An individual will be willing to pay for the proposed program if:

$$u_1(\boldsymbol{x_1}, \boldsymbol{z}, y - p, \varepsilon_1) \geq u_0(\boldsymbol{x_0}, \boldsymbol{z}, y, \varepsilon_0). \tag{4}$$

The probability that a respondent is willing to pay for the forest protection program (probability of saying yes) is given by the probability that the utility received from the forest protection program is greater than the utility received under the status quo:

$$\begin{aligned} \Pr(yes) &= \Pr[u_1(\boldsymbol{x}_1, \boldsymbol{z}, y - p, \boldsymbol{\varepsilon}_1) > u_0(\boldsymbol{x_0}, \boldsymbol{z}, y, \boldsymbol{\varepsilon}_0)] \\ &= \Pr[\Delta u > 0] \end{aligned}. \tag{5}$$

The indirect utility function has an unobservable, random component. Indirect utility of individual i from alternative j, therefore, can be expressed as the sum of its explainable and unexplainable components:

$$u_{ij} = v_{ij} + \varepsilon_{ij} , \qquad (6)$$

where v_{ij} is the explainable component of utility to individual *i* from alternative *j*, and **g** is the unexplainable, random component of utility for individual *i* from alternative *j*. The deterministic component of utility is defined as:

$$v_{ij} = \boldsymbol{\alpha} \boldsymbol{x}_{\boldsymbol{j}} + \boldsymbol{\gamma}_{\boldsymbol{j}} \boldsymbol{z}_{\boldsymbol{i}} + \beta\left(y_i - p_j\right), \quad \gamma_j = \gamma_m \quad \forall\ j, m \neq 0 \quad , \qquad (7)$$

where *i* indexes individuals, *j* indexes alternatives, *v* is indirect utility, $\boldsymbol{x}_{\mathbf{j}}$ is a set of program attributes, $\boldsymbol{z_i}$ is a set of respondent characteristics, *y* is income, *p* is the cost of the program and **"**, **(** and **$** are estimable parameters. An individual will vote 'yes' to the program if utility with the program exceeds utility without the program. Because utility is composed of a deterministic and a random component, the following expression represents the probability that an individual will vote for the program:

$$\Pr(yes) = \Pr\left\lfloor v_{ij} + \varepsilon_{ij} > v_{i0} + \varepsilon_{i0} \right\rfloor \quad , \qquad (8)$$

which, when substituting (7) for indirect utility, yields

$$\Pr(yes) = \Pr\left\lfloor \boldsymbol{\alpha}\left(\Delta \boldsymbol{x}_{\boldsymbol{j}}\right) + \boldsymbol{\gamma} \boldsymbol{z}_{\boldsymbol{i}} - \beta p_j > \varepsilon_{i0} - \varepsilon_{ij} \right\rfloor . \qquad (9)$$

Assuming that the error terms follow a standard normal distribution, the probit model can be used to estimate equation 9.

An assumption of the standard probit model is that the error component is independent and identically distributed among individuals and across observations for each individual. However, when an individual responds to more than one stated preference question, it is likely that there are unobservable characteristics specific to that individual that induce correlation across her responses. If this is suspected to be the case, it is appropriate to estimate a random effects probit model (Wooldridge 2002). In a random effects model, the error term is treated as separable into two components: one that is unobservable and specific to each individual and another that is unobservable and due to random response shocks across all individuals and all responses (Boxall et al. 2003).

The utility difference function is specified using a random effects utility model and is written as follows:

$$\Delta u_{ij} = \boldsymbol{\alpha}\left(\Delta \boldsymbol{x}_j\right) + \boldsymbol{\gamma z}_i - \beta p_j + \mu_i + \varepsilon_{ij} \quad , \qquad (10)$$

where μ_i is the individual-specific error term, and ε_{ij} is the random disturbance term across all individuals and observations.

Data Collection

The analysis uses data collected from a stated preference mail survey of Michigan residents. The study forest, which forms the focus of the survey, was chosen for the importance of its forests to deer habitat, forest migratory songbird habitat as well as to the sustainability of the local economy.

Survey design

Designing the survey instrument involves a qualitative research phase in which focus groups and individual interviews are both integral parts of the survey design process (Kaplowitz et al. 2004). Questionnaire development was guided by the results of six focus groups, 21 individual pre-test interviews, and interviews with ecologists, foresters and state agency employees. The survey collected stated preference data using a dichotomous choice referendum format and also collected data on attitudes towards forest management in the study area.

The questionnaire uses a forest easement program as the policy context for the contingent market. Forest easements are a form of conservation easement that provide a way of conserving ecological values of forests while at the same time ensuring the continued economic and social benefits generated by forests (Ward and Ervin 2005, Lind 2001b). The forest easement program is described in the survey using a set of six attributes, each of which is allowed to take on three levels (See table 1). The choice sets presented to respondents were created using an orthogonal main-effects 3^6 experimental design of the six attributes, producing 18 total choice sets (Addelman and Kempthorne 1961).

Individuals were presented with descriptions of the importance of the study area for migratory forest songbird habitat as well as its importance for the provision of forest industry and forest-based recreation and tourism jobs. Respondents were asked to respond to a series of statements that reflect attitudes about the goals of forest management in the study area.

Survey Implementation

The survey was mailed to a stratified random sample of 2,000 Michigan households using a modified version of Dillman's tailored design method (Dillman 2000). The sample was designed to represent four geographic strata of Michigan households. Strata were divided to represent: 1) households within the study area, 2) households within the Upper

Peninsula but outside the study, 3) households within the counties of the Northern Lower Peninsula and 4) households within the counties of the Southern Lower Peninsula.

The survey was sent using four contacts: a hand-signed, personalized prenotice letter, a first mailing of the questionnaire, a hand-signed personalized reminder post card, and a second mailing of the questionnaire. Each questionnaire mailing included a hand-signed, personalized cover letter, a survey booklet and a postage-paid business reply envelope. Three first class stamps were included in the first questionnaire mailing of each group as a respondent incentive. Of the 2,000 surveys mailed, 1,899 were delivered to respondents. A total of 954 usable surveys were returned, yielding an overall response rate of 50% (AAPOR 2004).

Model Specification

To estimate the effects of program attributes, socioeconomic characteristics and attitudes on WTP, Equations 9 and 10 are estimated using a series of random effects probit models. Socioeconomic characteristics and attitudes are included in the model as respondent characteristics, $\boldsymbol{z_i}$. The utility difference function is specified as follows:

$$\Delta u_{ij} = \boldsymbol{\alpha}\left(\Delta \boldsymbol{x}_j\right) + \boldsymbol{\gamma}\boldsymbol{z_i} - \beta p_j + \mu_i + \varepsilon_{ij} \ , \qquad (11)$$

where $\boldsymbol{\alpha}$ is a vector of estimable parameters for each of the *k* program attributes, $\boldsymbol{x}$, of alternative *j*, $\boldsymbol{\gamma}$ is a vector of estimable parameters for the effect of respondent characteristics, $\boldsymbol{z_i}$, and β is an estimable parameter for the program cost. Variables included in the estimated models are reported in table 2.

In order to test the hypothesis that forest management attitudes affect WTP, a variable was created that incorporates several attitude variables from the survey, each of which reflects a range of anthropocentric to biocentric attitudes towards forest management in the study area. An index of several attitude statements is preferred to using a set of individual attitude statements because of the potential colinearity among the separate attitude indicators (McClelland 2001). Attitude statements in the following table are therefore summed to form an attitude index variable, *biocentric*, for which high scores reflect biocentric attitudes and low scores reflect anthropocentric ones (See table 3). The sample average for each individual attitude statement was used to impute values for attitude variables with missing values.

Results and Discussion

Five random effects probit models were estimated to identify the effects of forest ecosystem characteristics, environmental attitudes and demographic characteristics on WTP. Model 1 included forest easement program attributes: forest industry jobs, forest-based recreation and tourism jobs, forest migratory songbird species diversity, number of forest migratory songbird species of conservation concern, and effects of deer browse on tree regeneration. Results showed statistically significant preferences for forest ecosystem services in the study forest, and results were consistent for program attributes through all subsequent model versions. Estimation results indicate that an increase in the number of forest industry jobs, the number of forest-based recreation and tourism jobs, bird diversity and habitat for songbirds of conservation concern increases the probability of an individual voting 'yes' for the easement program. An increase in the area affected by deer browse reduces the probability of voting 'yes' for the program, as does an increase in the cost of the program to a household.

Model 2 includes program attributes as well as demographic characteristics. Results indicated that demographic characteristics have significant effects on WTP. Many socioeconomic characteristics were originally included in the model, but several were dropped due to a lack of explanatory power. Regardless of different combinations of socioeconomic variables in the model, program attribute coefficients and standard errors remained consistent. The variables that were dropped include income, resource dependence (measured by employment of any family member in a natural resource based industry), ethnicity, religion and gender. Income was not found to have a significant effect on WTP in the analysis reported here.[1] While income is typically expected to have a positive and statistically significant relationship with WTP, income elasticity of WTP is often found to be less than one in contingent valuation studies (Carson et al. 2001, Hanemann 1994). Age, membership in a hunting club, and politically conservative views had a significant negative effect on WTP, while membership in environmental organizations, higher education level, residence in urban areas and recreational use of the study forest had a significant positive effect.

Model 3 includes program attributes and environmental attitudes, and results showed that environmental attitudes have strong explanatory power in predicting WTP. Attitudes were measured by the attitudinal index variable reflecting a range of anthropocentric to biocentric environmental attitudes. Model 3 results, reported in table 4, show that *biocentric* has a positive and highly significant effect on WTP. This indicates that individuals who hold biocentric attitudes towards forest management in the study area are more likely to vote for the forest easement program than individuals who hold anthropocentric attitudes. Model 4 included program attributes, demographic characteristics and environmental attitudes, and results showed statistically significant results consistent with results from Models 2 and 3.

Model 5 included program attributes, demographic characteristics, environmental attitudes, and interaction terms between program attributes and attitudes. Results for program attributes, demographic characteristics and attitudes were generally consistent with results from Model 4, especially when evaluated at the mean of the *biocentric* variable. Interaction terms were explored for all the non-price attributes, but only two were significant. The price attribute was not interacted with *biocentric* to facilitate interpretation of the marginal implicit prices (otherwise both the numerator and the denominator are varying making comparisons less obvious), These interaction terms were included to determine whether attribute tradeoffs differed for respondents with different types of environmental attitudes. The two interaction terms reported in table 4 are *indjobs*biocentric*, an interaction of the number of forest industry jobs with the program and the environmental attitude variable, as well as *birdcons*biocentric*, an interaction of the number of species of conservation concern under the easement program and the attitude variable. Both interaction terms were statistically significant, suggesting that the attitude toward the resource has an effect on the tradeoffs individuals are willing to make between program attributes.

Likelihood ratio and likelihood dominance tests were conducted to compare the performance of the five models. The likelihood ratio test statistic for comparing Model 2 to Model 1 is 65.86 with 7 degrees of freedom with a p-value of <0.005 leading to a rejection of the hypothesis that the restrictions do not matter. This indicates that the inclusion of demographic characteristics or attitudes improves explanatory power of the base model. The likelihood ratio test statistic for comparing Model 3 to Model 1 is 99.42, with 1 degree of freedom and a p-value of <0.005, which again indicates that the restriction matters and that the inclusion of environmental attitudes improves the explanatory power of the base model. Models 2 and 3 are restricted versions of Model 4 and the likelihood ratio test statistic comparing models 2 and 4 is 80.62, with 1 degree of freedom and a p-value of <0.005, and the test statistic for comparing models 3 and 4 is 47.06 with 7 degrees of freedom and a p-value of <0.005. The hypothesis that the restrictions imposed on models 2 and 3 as compared to model 4 do not matter is rejected. A comparison of models 4 and 5 yields a likelihood ratio test statistic of 45.76 with 2 degrees of freedom and a p-value of <0.005. The inclusion of the interaction terms improves the explanatory power of the model.

In the models discussed above, the program attribute variable coefficients are almost identical to those estimated in Model 1, and changes in the estimated coefficients for the program attributes estimated between Models 2, 3 and 4 are almost negligible. Results for program attribute variables, therefore, are very stable across the first 4 models. Estimated coefficients in Model 5 differ slightly from coefficients in the first 4 models due to the inclusion of interaction terms between some of the attributes and the attitude variable.

Welfare Estimates

The ratio of each attribute coefficient, "$_k$ or ($_h$, to the cost parameter estimate, **$**, yields marginal dollar estimates for each individual attribute (Hanemann 1994). These values are referred to as implicit prices (IPs) of the attributes and represent the marginal rate of substitution between an attribute and the cost attribute (Morrison et al. 1999). Implicit prices of attributes can be calculated by dividing parameter estimates by the estimated coefficient on the cost variable, as shown in the following equation:

$$IP_k = -\left(\frac{\hat{\alpha}_k}{\beta}\right) ,$$

where *k* indexes each attribute used in the choice design, **"** is the estimated coefficient of any model attribute and **$** is the coefficient on the cost variable. The marginal rate of substitution can be calculated in the same way between any two model attributes to determine how much respondents are willing to give up of one attribute to have an additional unit of another, without changing utility.

Marginal implicit prices of each program attribute are consistent across Models 1, 2, 3, and 4. However, implicit prices calculated from results of Model 5 reveal differences in WTP for forest easement program attributes *indjobs* and *birdcons* according to differing levels of biocentrism of respondents. Table 5 reports marginal implicit prices for the Model 4, which demonstrated better explanatory power than Models 1, 2 and 3, as well as implicit prices at different levels of *biocentric* for Model 5. It can be seen that individuals with higher levels of biocentric attitudes are willing to pay less for an additional forest industry job than individuals with more anthropocentric attitudes. Conversely, individuals with highly biocentric attitudes are willing to pay much more for an additional songbird species of conservation concern than individuals with anthropocentric attitudes. Individuals with low levels of the biocentric indiex (anthropocentric) actually have a negative effect for programs that improve the lot of songbird species of conservation concern.

Conclusions

This research uses data collected from a mail survey of 2,000 Michigan residents to estimate the nonmarket values of forest ecosystem attributes of an area of Michigan's Upper Peninsula. The analysis employs the contingent valuation method, based on random utility theory, within an attribute-based referendum format. Attributes for which nonmarket values are estimated in this study reflect the ecological and social importance of the study forest. This study estimates nonmarket values for forest industry jobs, forest-based recreation and tourism jobs, forest migratory songbird species diversity, number of forest migratory songbird species of conservation concern and the effects of deer browse on tree regeneration. The results of this research show that ecological and social attributes of forests are valued by individuals in Michigan.

Results also suggest that environmental attitudes have greater explanatory power than demographic characteristics alone in predicting WTP. If improved understanding of *who* values *what* is sought, attitudes should be included along with demographic characteristics in nonmarket valuation analyses. Including environmental attitudes in nonmarket valuation studies can substantially improve one's ability to explain preferences and WTP. This research contributes to a broader understanding of the factors that influence individuals' behavior, which can be a useful input to the policy making process. Information on the types of individuals likely to support certain policy actions can help predict which members of the public will be more willing to support particular conservation initiatives.

Attitudinal data collected in this study focused on attitudes specific to the resource being valued and provided information on individuals' views of particular resource management strategies. This approach, based on the Theory of Reasoned Action and the Theory of Planned Behavior, allows the establishment of a connection between attitudes, WTP, and intended behavior of survey respondents. Results of the analysis indicate that attitudes are strong predictors of WTP and this provides evidence that WTP can be treated as a behavioral intention and not simply an expression of a general environmental attitude.

The results confirm the hypothesis that attitudes are predictors of WTP and support the results of other studies that have shown that it is appropriate to include attitudes in nonmarket valuation analyses. This study showed that biocentric and anthropocentric values that underlie environmental attitudes play an important role in estimating nonmarket values of environmental goods and services. Results provide insight into the factors that influence individuals' choices and behavior, which can be a useful input to the policy making process. Information on the types of beliefs and values that motivate individuals to support certain policy actions can help predict which members of the public will be more willing to support particular conservation initiatives.

By connecting types of underlying beliefs (i.e. anthropocentric and biocentric) to attitudes that connect to resource management policies specific to the resource being valued, this research provides information in support of attitudes as important predictors of WTP as well as indicators of the intended behavior of individuals.

Table 1. Survey Attributes and Levels

Variable Name	Attribute Name	Status Quo Level	Attribute Levels
indjobs	Number of forest industry jobs in the area	675	600, 675, 710
rtjobs	Forest-based recreation and tourism jobs in the area	190	170, 190, 250
birddiv	Percent of area with high migratory forest songbird species diversity	35%	38%, 55%, 75%
birdcons	Number of migratory songbird species of conservation concern that are *at or above their target population* (out of 19 possible species)	6	7, 12, 17
deer	Percent of area with deer browse high enough to affect tree regeneration	69%	67%, 58%, 49%
cost	Cost to your household in increased annual taxes	$0	$20, $90, $400

Table 2. Variable Definitions

Variable	Definition
indjobs	Number of forest industry jobs in the study forest
rtjobs	Number of forest-based recreation and tourism jobs in the study forest
birddiv	Percent of study forest with high migratory forest songbird species diversity
birdcons	Number of migratory forest songbird species of conservation concern that are at or above their target population level (out of 19 possible species)
deer	Percent of area with deer browse high enough to affect tree regeneration
cost	Cost to household in increased annual taxes
age	Dummy variable that equals 1 if respondent is over age 60, 0 otherwise
huntclub	Dummy variable equal to 1 if respondent is a member of a hunting club, 0 otherwise
envorg	Dummy variable that equals 1 if respondent is member of an environmental organization, 0 otherwise
educ	Education dummy variable that equals 1 if respondent has college education or above, 0 otherwise
polview	Dummy variable that equals 1 if respondent self-reports to be politically conservative, 0 otherwise
urban	Dummy variable that equals 1 if respondent lives in urban area, 0 otherwise
rec	Dummy variable that equals 1 if respondent has participated in recreational activities in or near the study area, 0 otherwise
biocentric	Attitude index created by summing responses to environmental attitude statements [Ranges from 7 (indicating strongly anthropocentric attitudes) to 33 (indicating strongly biocentric attitudes)]

Table 3. Attitude Variables Included in the Calculation of *biocentric*

Variable	Attitude statements/questions and scale
imptcons	How important is it to you to protect habitat for migratory forest songbird species of conservation concern in the Western U.P. Study Forest? 1 (Not at all important) ø 4 (Very important)
prothab	In my opinion, the Western U.P. Study Forest should be managed to protect habitat for migratory forest songbird species of conservation concern even if it results in economic losses to forest-based industries. 1 (Strongly disagree) ø 5 (Strongly agree)
Incrdiv	In my opinion, the Western U.P. Study Forest should be managed to increase migratory forest songbird diversity even if there are economic losses to forest-based industries. 1 (Strongly disagree) ø 5 (Strongly agree)
concernhab	How concerned are you about migratory forest songbird diversity in the Western U.P. Study Forest? 1 (Not at all concerned) ø 4 (Very concerned)
humneed	In my opinion, the Western U.P. Study Forest should be managed to meet the needs of people. 1 (Strongly agree) ø 5 (Strongly disagree)
commneed	In my opinion, the Western U.P. Study Forest should be managed to meet the needs of communities that are economically dependent on forests, no matter what effect this has on the environment. 1 (Strongly agree) ø 5 (Strongly disagree)
mtnindjob	In my opinion, the Western U.P. Study Forest should be managed to maintain forest industry jobs. 1 (Strongly agree) ø 5 (Strongly disagree)
biocentric	Attitude index created by summing responses to all attitude statements listed above 7 (Anthropocentric attitudes) ø 33 (Biocentric attitudes)

Table 4. Estimation Results from Random Effects Models[1]

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	-0.8885*** (0.1277)	-0.1652 (0.3417)	-3.9474*** (0.3437)	-3.0921*** (0.4614)	-2.3440*** (0.5279)
indjobs	0.0076*** (0.0009)	0.0077*** (0.0009)	0.0076*** (0.0009)	0.0077*** (0.0009)	0.0327*** (0.0044)
rtjobs	0.0065*** (0.0012)	0.0067*** (0.0012)	0.0065*** (0.0012)	0.0067*** (0.0012)	0.0073*** (0.0012)
birddiv	0.0122*** (0.0026)	0.0126*** (0.0026)	0.0126*** (0.0026)	0.0129*** (0.0026)	0.0127*** (0.0027)
birdcons	0.0225** (0.0095)	0.0226** (0.0096)	0.0232** (0.0094)	0.0230** (0.0095)	-0.0979** (0.0455)
deer	-0.0177*** (0.0054)	-0.0177*** (0.0054)	-0.0184*** (0.0054)	-0.0185*** (0.0054)	-0.0110*** (0.0056)
cost	-0.0068*** (0.0004)	-0.0068*** (0.0004)	-0.0065*** (0.0004)	-0.0066*** (0.0004)	-0.0068*** (0.0004)
age		-0.0206*** (0.0049)		-0.0177*** (0.0046)	-0.0183*** (0.0047)
huntclub		-0.4880*** (0.1835)		-0.3605** (0.1731)	-0.3872** (0.1769)
envorg		0.9380*** (0.2591)		0.6797*** (0.2433)	0.6823*** (0.2482)
educ		0.4961*** (0.1569)		0.4100*** (0.1475)	0.3983*** (0.1506)
polview		-0.3583** (0.1526)		-0.1485 (0.1443)	-0.1493 (0.1474)
urban		0.5565** (0.2435)		0.5526** (0.2282)	0.5670** (0.2333)
rec		0.4410** (0.1872)		0.3817** (0.1762)	0.3953** (0.1800)
biocentric			0.1589*** (0.0161)	0.1435*** (0.0161)	0.1042*** (0.0202)
*indjobs*biocentric*					-0.0012*** (0.0002)
*birdcons*biocentric*					0.0063*** (0.0023)
Rho	0.7393*** (0.0182)	0.7249*** (0.0199)	0.6983*** (0.0202)	0.6868*** (0.0217)	0.6979*** (0.0206)
# of observations	3264	3264	3264	3264	3264
# of groups	841	841	841	841	841

[1] Note: Standard errors in parentheses; ***Significant at the: 99% level; ** Significant at the 95% level;*Significant at the 90% level

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
% correctly predicted	75%	77%	76%	78%	78%
Log Likelihood	-1308.54	-1275.61	-1258.83	-1235.30	-1212.42
Pr > χ^2	<0.0000	<0.0000	<0.0000	<0.0000	<0.0000

Table 5. Marginal Implicit Prices of Program Attributes for Model 4 and Model 5 at Different Levels of the Variable *biocentric*

Attribute	Model 4	Model 5			
		At mean *biocentric* (18.86)	At low *biocentric* (9)	At medium *biocentric* (17)	At high *biocentric* (25)
indjobs	1.17	1.38	3.22	1.72	0.40
rtjobs	1.02	1.08	1.08	1.08	1.08
birddiv	1.95	1.89	1.89	1.89	1.89
birdcons	3.48	3.03	-6.06	1.30	8.76
deer	-2.80	-2.96	-2.96	-2.96	-2.96

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Endnotes

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[1]In this study, 11 individuals in the sample reported an annual household income of $200,000 or greater, and income was significant in versions of the model where these individuals were dropped from the analysis.