CHOICE MODELING: PUBLIC PREFERENCES FOR ENHANCING BENEFITS FROM PRIVATE FORESTS IN THE ADIRONDACKS

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Abstract.—Recognizing the importance of private land in meeting society's needs for forest-related benefits, public agencies fund programs that provide aid to private landowners to enhance public benefits derived from these lands. This may include technical help, education, tax incentives, and cost-share programs for various management activities. It is important that program goals be aligned with underlying public values and preferences. A random utility model provides the theoretical construct for a choice model in which respondents rank alternatives displaying varying levels of cost and public efforts to improve timber production, wildlife habitats, and recreational opportunities on private forest land. Personal interviews were conducted at the Adirondack Visitor Interpretive Center located in Paul Smiths, NY. Participants completed a conjoint ranking survey and a series of demographic and attitudinal questions. Most respondents believed the availability of forest-related recreation is important to society and that landowners should be permitted to restrict access to their land. However, less than half of the respondents thought landowners should receive incentives to permit public recreation. A nonmetric conjoint analysis (SAS) estimated the parameters of the choice model. Results provide the relative preferences and acceptable tradeoffs between cost and the different program goals (timber, wildlife habitat, and recreational opportunities) of respondents.

1.0 INTRODUCTION

Private landowners own approximately 88 percent of the northeastern forest (USDA Forest Service 1988, 1995). Most of this land, almost three-quarters of the total, is held by a broad assortment of nonindustrial private forest landowners. The mere extent of these holdings makes obvious their potential importance in meeting society's needs for timber, outdoor recreation, wildlife habitats, aesthetics, biodiversity, and other benefits. An understanding of the role that private lands may play along with a greater ability to draw on the potential benefits can reduce the intense pressure being placed on the remaining 12 percent of the land that is in public ownership.

Extensive prior research has focused primarily on the perspectives of landowners regarding benefits derived from their land. In this study, we examined public perspectives toward private lands. For example, what do citizens expect from private forests and what are they willing to give up in order to obtain these benefits? To provide insight into these questions, we administered a conjoint ranking survey and a series of attitudinal questions to visitors at the Adirondack Visitor Interpretive Center located in Paul Smiths, NY. The survey focused on public preferences for and costs associated with enhancing benefits from improved timber management, accessibility for outdoor recreation, and wildlife habitats on private lands.

2.0 METHODS

Conjoint analysis, a form of choice modeling, is a technique for measuring psychological judgments that is used frequently in marketing research to measure consumer preferences for products with multiple attributes (Green et al. 1988). Respondents choose between alternative products or scenarios that display varying levels of selected attributes. The utility of each attribute can be inferred from the respondent's overall evaluations. These partial utilities, or part worths, indicate the relative importance of each attribute's contribution to overall preference or utility. They can be combined to estimate relative preferences for any combination of attribute levels. Conjoint techniques are well suited for soliciting and analyzing preferences in environmental decisions that frequently entail tradeoffs between costs and benefits that are not represented efficiently in market transactions.

A random utility model is used to explain public preferences toward using varying amounts of public funds to enhance different mixes of benefits from timber, recreation, and wildlife habitats on private lands. When presented with a set of alternatives, individuals are assumed to make choices that maximize their utility or satisfaction. The utility that the i^{th} individual derives from the j^{th} alternative (U_{ij}) can be represented as:

$$U_{ij} = X'_{ij}\,\beta + e_{ij} \qquad (1)$$

where X_{ij} is a vector of variables, which may include transformations of variables, that represent values for each of the four attributes of the j^{th} alternative to the i^{th} individual; β is a vector of unknown parameters; and e_{ij} is a random disturbance, which may reflect unobserved attributes of the alternatives, random choice behavior, or measurement error. In the empirical study under consideration, a respondent's utility level (U_{ij}) for each alternative is not observed, but a ranking (r_j) is observed that is assumed to be a proxy for his or her underlying utility.

Following McKenzie (1990, 1993) and others, the analytical capabilities of the conjoint ranking model can be illustrated by assuming that ranking (r_j) can be modeled as a linear combination of the variables representing the attribute levels.

$$r_j = a + b_1x_{1j} + b_2x_{2j} + \ldots + b_nx_{nj} \qquad (2)$$

The estimated partial utilities are the linear effects (b_n's) of a discreet change in the level of the associated attribute on overall preference (n references attributes). Relative overall preference for any alternative (combination of attribute levels) can be determined by summing across Equation 2.

The marginal rate of substitution (MRS) is the rate at which an individual is willing to trade one good for another while remaining equally well off (Nicholson 1978). The MRS is determined by the ratio of the marginal responses. Setting the total differential of (2) to the point of indifference and solving yields the marginal rates of substitution or the acceptable tradeoffs for the respective attributes:

$$dr_j = b_1dx_{1j} + b_2dx_{2j} + \ldots + b_ndx_{nj} = 0 \qquad (3)$$
$$dx_{1j} / dx_{2j} = - b_2 / b_1$$

ALTERNATIVE # (1-9)	
EFFORTS TO IMPROVE:	
TIMBER	LESS/SAME/MORE
RECREATION	LESS/SAME/MORE
WILDLIFE	LESS/SAME/MORE
COST	$0/$250/$500
RANK ? (1-9)	

Figure 1.—Sample card layout for the conjoint ranking survey. Each card contained only one level for each of the four attributes.

A nonmetric conjoint analysis of the choice data was performed using SAS. Nonmetric conjoint analysis iteratively derives a monotonic transformation of the dependent ranking variable (SAS Institute 1993). The independent variables (attributes) were effects coded. Two variables were used to represent the second and third levels of each attribute. If the scenario contained level 1 for an attribute, the variables representing levels 2 and 3 were each coded -1. If the level 2 was contained in the scenario, the variable representing level 2 was coded 1 and the level 3 variable was coded 0. Likewise, if the scenario contained level 3, the variable representing level 2 was coded 0 and the level 3 variable was coded 1. Values for the coefficients (partial utilities) for level 2 and 3 are estimated by the model and the partial utility for level 1 is the negative sum of the level 2 and 3 partial utilities for that attribute.

Surveys were conducted in person at the Adirondack Visitor Interpretive Center at Paul Smiths, NY. Each respondent was asked to rank nine alternative scenarios depicting varying levels of public efforts to improve timber quality, recreation availability, and wildlife habitats on private land at varying cost levels. Each alternative was displayed on a sample card (scenario) that contained a different mix of the levels for the four attributes depicted in Figure 1. Only one level of each attribute was presented in a single alternative. An orthogonal sample design was used to select the

particular levels to be included on each card to allow estimation over the entire range of alternatives ($3^4 = 81$) with the minimum number of ranked alternatives. The orthogonal design also allows estimation of partial utilities for each respondent, thus outlining each respondent's preference structure. Respondents also completed a series of attitudinal questions using a 5-point Likert scale (strongly agree/agree/neutral/disagree/strongly disagree) and a brief demographic survey.

Level[a]	1	2	3
Timber	-1.0561	0.5387	0.5174
Recreation	-0.9969	0.4402	0.5567
Wildlife	-1.2935	0.5594	0.7341
Cost	-0.8853	0.5536	0.3317

[a] Levels 1, 2, and 3 correspond to less, same, and more, respectively, for timber, recreation, and wildlife and $0, $250, and $500 for cost.

Figure 2.—Estimated partial utilities (nonmetric conjoint analysis).

Before completing the surveys, respondents took a guided walking tour of demonstration sites that show the effects of a variety of silvicultural treatments on timber growth and quality, wildlife habitats, aesthetics, and recreational opportunities. These topics were discussed during the tour. Upon returning to the visitor center, respondents were provided with an explanation of the purpose and form of the conjoint survey and were given an opportunity to ask questions or discuss any portion of the survey. The walking tour and survey took approximately 45 minutes and 20 minutes to complete, respectively.

3.0 RESULTS AND DISCUSSION

Five hundred and sixty-seven respondents completed the surveys. This included students from several introductory forestry classes from nearby Paul Smith's College. Eighty-four percent of the respondents were male, 19 percent were 30 years or older, while 73 percent were 22 years or younger. Seventy-three percent were raised in an urban environment and 17 percent in a rural area.

While we do not believe that this sample is representative of the public at large, due to the rural location of the survey, inclusion of college students, and possible self selectivity of those choosing to participate in the tour, we believe it provides useful information. As mentioned previously, the orthogonal sample design allows estimation of partial utilities or preference structures for each respondent. Although not fully presented here, these may be segmented by demographic profile to identify and analyze differences in the preferences for various segments of the sample.

The conjoint analyses yielded estimated partial utilities (coefficients) for each level of the attributes (Figure 2). The partial utility measures the corresponding attribute level's contribution to the overall utility of an alternative. The total utility of any combination of attributes can be determined by summing the part worths for each attribute level.

Since the partial utilities are expressed on a common scale, the attributes can be compared by looking at the ranges of these utilities. The relative importance scores shown in Figure 3 were computed by taking the utility range for a particular attribute and dividing it by the sum of all the utility ranges. These scores indicate the relative importance of the particular attribute in the respondents' overall evaluation of the alternatives but do not indicate whether more or less of the attribute is preferred. On average, wildlife habitat was the most important aspect of the decisions for these respondents. The other attributes appeared to be about equal in importance. Cost, however, was not statistically significant.

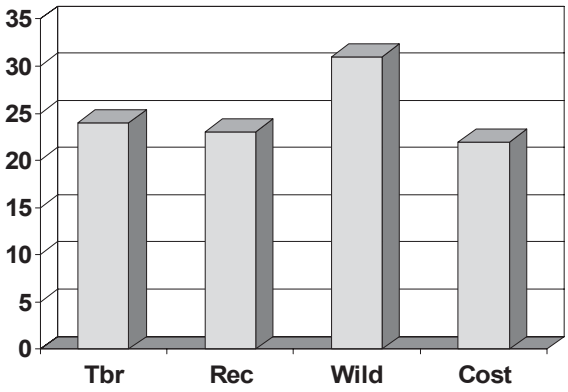

Figure 3.—Relative importance scores.

Examining the differences in the estimated partial utilities as the level of the associated attribute changes provides insight into the resulting impact on utility or overall preference. For example, a movement from the current (same) level of emphasis on timber management to a higher level (more) while holding all other attributes constant would decrease total utility slightly (0.0213 = 0.5387 - 0.5174). Respondents, on average, were basically indifferent to increasing efforts to improve timber management. Similar increases in emphasis on recreation and wildlife would result in utility increases of 0.1165 and 0.1747, respectively. However, providing a lower level of emphasis on management resulted in a decreased overall utility or preference of 1.5948 for timber, 1.4371 for recreation, and 1.8529 for wildlife. This information may be useful to managers or policy makers considering changes in programs impacting any of the attributes.

We also estimated the model for several demographic subsamples. We examined differences by gender, age group (22 years or younger and 30 or more years), and environment in which the respondent spent the first 16 years or his or her life (urban or rural). Preferences were surprisingly similar among the different groups. Although wildlife was the most important attribute for both men and women, it was slightly more important to women. Men were inclined to give slightly more consideration to timber and recreation management than women. Again, wildlife management was the most important attribute for respondents age 22 or younger and for those 30 and older. The older respondents weighted timber and recreation management more heavily than the younger respondents did. Respondents brought up in a rural environment weighted wildlife and recreation management more heavily in their decisions than did those brought up in an urban environment.

Several interesting results emerged from analyzing responses to the attitudinal questions. Most respondents (86%) strongly agreed or agreed that the availability of forest recreation is important to society, and 81 percent believe landowners should be permitted to restrict access to their land. However, only 48 percent believe landowners should be given incentives to allow public recreation on their land.

Most respondents (92%) also strongly agreed or agreed that rare or threatened species should be protected and 75 percent believe that landowners should be given incentives to enhance wildlife habitats on their lands. Nearly 57 percent agreed that keeping land in forest was important and would vote to give tax relief to landowners who agree not to develop their land.

Nearly half of the respondents believe landowners should be permitted to do as they please with their land, but 88 percent disagreed with the statement that "Society has no responsibility to provide healthy forests for future generations." About half of the respondents agreed that land should provide an economic return to cover expenses associated with ownership, though many believe too much emphasis is placed on economics in land-use decisions. Most respondents agreed that both ecology and economics should be considered along with the needs of future generations.

Nearly 90 percent of the respondents agreed that wood products are important to society, but only about 40 percent agreed with separate statements indicating that either public or private lands should be a source for wood products. Seventy-three percent agreed that landowners should be able to earn a profit from their land.

4.0 CONCLUSIONS

This analysis indicates that a variety of respondents interested in management of private forest lands in the northeast were very concerned about changes in efforts to improve wildlife habitats. Respondents preferred more efforts to improve wildlife habitat and were dissatisfied with lower levels. A similar pattern emerged for recreation, but differences among the levels of effort were less pronounced. Respondents also expressed dissatisfaction with less effort toward improving timber management but were indifferent toward increases beyond current levels. Responses among the demographic groups that we examined were remarkably similar, although some minor differences were noted. Additional analysis is needed to understand how respondents' preferences regarding management are affected by their attitudes toward private property, responsibilities to future generations, and economic

considerations. These results can be useful to policy makers to determine levels of public support for efforts to improve management on private lands.

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