Incentives for Biodiversity Conservation Beyond the Best Management Practices: Are Forestland Owners Interested?

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ABSTRACT. *With the growing recognition of the role of environmental services rendered by private lands, landowner involvement has become a critical component of landscape-level strategies to conserve biodiversity. In this paper, we examine the willingness of private forest owners to participate in a conservation program that requires adopting management regimes beyond the existing regulations for silvicultural best management practices. Results from a multinomial logit model indicate both program attributes and landowner characteristics significantly influencing participation. While the mean incentive payment necessary to induce participation is $95.54 per ha per year, this amount varied among respondents with different forest ownership objectives.* (JEL Q23, Q24)

I. INTRODUCTION

Non-industrial private forests (NIPF), or family forests, constitute 60% of the 86 million hectares of forestland in the southern United States (SRS USDA FS 2002). These forests provide a myriad of socioeconomic and environmental benefits such as wood products, recreation and scenic beauty, clean water and air, biodiversity, and rural employment. The growing recognition of the role of NIPF in biodiversity conservation has led to the promotion of both mandatory and voluntary practices to improve habitats on private forests (Kline, Alig, and Johnson 2000a, 2000b; Langpap 2004). For example, in the northwest United States, laws such as the Oregon Forest Practices Act impose restrictions on timber harvesting, including stipulations on set-aside and streamside zone requirements. Similarly, many states encourage forest owners to voluntarily comply with silvicultural best management practices (BMPs). Regulatory measures such as the Endangered Species Act (ESA) have been criticized in view of the inequitable distribution of costs and perverse incentives they entail to landowners (Shogren et al. 1999). Also, there is a growing controversy concerning whether the ESA constitutes taking private property away from individuals for public use without just compensation. For example, U.S. Congressman Pombo is sponsoring HR 3824 bill, which proposes significant revisions to the existing ESA. Many biologists are also discouraged by the species-focused approach of the ESA and favor more comprehensive, ecosystem-based approaches (Michael 2003). These limitations have led to a growing interest in incentive programs to further biodiversity at a landscape level while ensuring continued private ownership of the land. Several programs such as Conservation Reserve Program, Soil Bank Program, Environmental Quality Improvement Program, and Forest Legacy Program are designed to

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provide incentives for agricultural and forest landowners to undertake environmentally friendly practices. In the face of specific incentives, forest landowners are likely to implement forest management practices beyond the existing BMPs (Kline, Alig, and Johnson 2000a, 2000b). Currently, adoption of BMPs in several states such as Florida is voluntary and is mainly intended to mitigate the negative impacts of forestry operations such as logging and road construction. Proactive management of habitat for biodiversity conservation, however, requires additional habitat enhancing practices in addition to existing BMPs. Past studies indicate that only about 11% of the landowners in the U.S. South undertake practices that improve wildlife habitat (SRS USDA FS 2002).

The objective of this paper is to examine the willingness of forest owners to adopt biodiversity-enhancing management practices. Specifically, using data from a 2005 survey of NIPF owners in Florida, we analyze how land, landowner, and program characteristics influence NIPF landowner participation in incentive programs designed to provide habitat for biodiversity beyond the existing BMPs. Employing an attribute-based choice experiment (ACE) method, we also estimate the associated mean willingness-to-accept (WTA) values.

Past literature on the factors influencing landowner participation has shown varying results (Langpap 2004). While Bell et al. (1994), in an analysis of NIPF in Tennessee, observed that income, experience with forestry, primary land use, and information about land use programs affected landowners' decision to adopt conservation practices. Nagubadi et al. (1996), found no significant effect of owner characteristics on participation in the USDA Forest Service's Stewardship Incentives Program (SIP)[1] in Indiana. More recently, in the Pacific Northwest, Kline, Alig, and Johnson (2000a, 2000b) observed that the landowners' willingness to adopt a 200-foot harvest buffer along streams and delay timber harvests varied significantly by forest ownership objectives. Langpap (2004) analyzed conservation incentive programs for endangered species and found that younger landowners who had acquired property more recently, who owned more woodland, and who were interested in wildlife conservation would be more inclined to participate. These variations in the literature indicate that landowner participation is not only influenced by landowner characteristics but also by the program characteristics and the institutional environment in which the program operates.

For example, in a program that focuses on tree planting and stand improvement, a landowner's decision to participate could be motivated by the monetary benefit the program provides (Nagubadi et al. 1996). On the other hand, in situations that involve provision of habitat for wildlife, a landowner's perceived risk of regulation might influence his decision to participation (Kline, Alig, and Johnson 2000a; Langpap 2004). Such concerns among landowners about future regulations might be particularly relevant for the U.S. Pacific Northwest, an area characterized by a controversial regulatory environment (Kline, Alig, and Johnson 2000a, 2000b; Langpap 2004).

Past studies also indicated how different program characteristics influence landowner participation (Kline, Alig, and Johnson 2000a). However, these studies have not examined how landowner preferences vary with different combinations of characteristics of incentive program alternatives. By focusing on program characteristics and associated utility measures, this paper provides critical information on not only the attributes of a conservation program that attract landowners most but also the extent of incentive payments required for various alternatives. Several states such as Florida and Oregon are developing comprehensive regional wildlife conservation plans specifically to provide habitat for rare

[1] Between 1991–2002, SIP provided $73 million in cost-shares to 45,102 landowners who treated 4.39 million acres to produce a variety of environmental services such as reduced soil erosion, enhanced water quality and wildlife habitat, and tree planting and timber stand improvement which help to sequester greenhouse gases.

and threatened species at landscape levels. This paper could help improve the success and sustainability of such efforts by providing a mechanism to identify program elements that would ensure effective participation of landowners. The remainder of the paper is organized as follows. In Section 2 an overview of the study area and research context is given. Section 3 presents the conceptual framework of the model. Section 4 details the data collection methods and analysis. In Section 5, results are presented and finally, a summary and policy implications of the findings are presented in Section 6.

II. STUDY AREA AND RESEARCH CONTEXT

Forests in Florida comprise over 6.5 million hectares (half of which are classified as NIPF) and contribute over $7 billion annually to the state's economy (Carter and Jokela 2002). Besides providing economic, social, recreational, and environmental services, these NIPF are also home to threatened and endangered species such as the red cockaded woodpecker, gopher tortoise, and flat wood salamander. Because development pressures place many of these lands at high risk of habitat degradation (Kautz and Cox 2001), a variety of management practices have been suggested to promote forest health and wildlife habitat on these lands. Prominent among these practices are periodic prescribed burning (Long 1991), removing invasive species (Jose et al. 2002), delaying timber harvesting beyond the financially optimal rotation age, and creation and/or maintenance of streamside management zones (SMZ) to protect riparian buffers (Kline, Alig, and Johnson 2000a, 2000b).

Past studies indicate that very few landowners actually pursue the suggested practices. Specifically in Florida, less than a third of large (40+ hectare) landowners implement practices designed to enhance timber growth, improve wildlife habitat, protect water quality, and/or enhance scenic values (English et al. 1997). Protection of wetlands was also cited as the least frequently used conservation practice by these landowners. Further, Jacobson (1998) observed that about 47% of NIPF owners in Florida were not actively managing their lands. One reason for not actively managing forestlands is the investment cost (Jacobson 1998). In fact, the USDA Forest Service report, "Southern Forest Resource Assessment," (SRS USDA FS 2002) observes that many landowners consider "doing nothing" to be a practical and cost-effective approach. Therefore, landowners may be more likely to adopt biodiversity-enhancing management practices when economic incentives are offered (Shogren et al. 1999). Thus a predictive model of landowner participation in such an incentive program and estimate corresponding willingness-to-accept (WTA) values is needed.

Other significant factors that often determine the effectiveness of a conservation program include the number and distribution of land parcels that get enrolled (Parkhurst et al. 2002). Besides effectiveness from a biological point of view, when a larger number of landowners in a specific area participate, implementation and monitoring costs per landowner could be lower. From an individual landowner point of view, the costs and risks, if any, associated with implementing the program to him/her may be smaller with higher participation rates due to the ability of nearby landowners to exchange information and experiences. Particularly, for practices such as prescribed burning and invasive species control, the unit costs of implementing them may be lower and the practices more effective when a larger number of landowners enroll. Therefore, whether the number of participating landowners in a program has an impact on landowner participation decisions is examined.

III. CONCEPTUAL FRAMWORK OF THE MODEL

Following Holmes and Adamowicz (2003) and Shrestha and Alavalapati (2004), we applied the attribute-based choice experiment (ACE) design to model and analyze forest owner decision to participate in a conservation incentive program and estimate the corresponding WTA values. In an ACE design, the products or services tested for respondents' preferences are presented as sets of distinct attributes (or features) with variations (or levels) in each attribute (feature). This allows the researcher to capture the trade-offs people make between the attributes of alternative goods and services and their levels and estimate the probability of choosing different attribute combinations (Louviere 1988, 1994). In analyzing the adoption potential of the proposed four biodiversity enhancing practices, for example, the landowners evaluate trade offs associated with each practice, as well as different levels within a practice. As such, the ACE technique can be used to assess how landowners prefer different attributes of the management practices, what economic and non-economic criteria influence their preferences, and determine the characteristics of a conservation package that would most likely be adopted.

Random utility theory (McFadden 1974) provides the theoretical basis for attribute-based choice experiment (ACE) modeling and value estimation. The basic assumption underlying the theory is that the true but unobservable utility of a good or service j is composed of both deterministic (v) and random components (ε). In our study, each attribute (management practice) combination for alternative conservation programs is specified as alternative j in a choice set C. The alternative j is a specific alternative representing a change in management with its conditional indirect utility level U_j for a landowner and is expressed as

$$U_{ij} = v_{ij} + \varepsilon_{ij}. \quad [1]$$

The selection of alternative j over alternative h implies that the utility of U_{ij} is greater than that of U_{ih}. The utility is random because although respondents know with certainty their choices, the researcher's knowledge is stochastic since it is based only on the observed behavior of respondents during the choice experiment. Accordingly, the probability, $p(\cdot)$, of an individual i choosing alternative j is expressed as

$$p(ij|C) = p[U_{ij} > U_{ih}] = p[(v_{ij} + \varepsilon_{ij}) > (v_{ih} + \varepsilon_{ih})], j \neq h. \quad [2]$$

Assuming that the utility function error terms are independently and identically distributed (IID) and follow a type 1 extreme value (Gumbel distribution) and the choice probabilities have a closed-form solution, the model is estimated using the following multinomial logit (MNL) specification (Shrestha and Alavalapati 2004):

$$p(ij) = \frac{\exp^{\mu v_{ij}}}{\sum_{ij \in c} \exp^{\mu v_{ih}}}, \quad [3]$$

where μ is a scale parameter.

If utility U_{ij} is assumed to be linear, additively separable, and $\mu = 1$, it can be represented as

$$U_{ij}\ \mu(\beta + \beta_1 z_1 + \beta_2 z_2 + \ldots + \boldsymbol{\beta}_{\mathbf{n}} z_n + \beta_a s_1 + \beta_b s_2 + \ldots + \boldsymbol{\beta}_{\mathbf{m}} s_k), \quad [4]$$

where β is a constant term that can be partitioned into alternative specific constants (ASC), and $\boldsymbol{\beta}_{\mathbf{n}}$ is the vector of coefficients attached to the vector of program attributes $\mathbf{z}$, and $\boldsymbol{\beta}_{\mathbf{m}}$ is the vector of respondents' individual characteristics s that influence utility.

Respondent's willingness-to-accept (WTA) values are estimated from the MNL model using Hanemann's (1984) compensating surplus (CS) equation:

$$\mathrm{CS} = -\frac{1}{\beta_c}\left[\ln\left(\sum \exp_{v_{i0}}\right) - \ln\left(\sum \exp_{v_{i1}}\right)\right], \quad [5]$$

where β_c is the marginal utility of income (which represents the coefficient of the incentive payment variable used in the model). The v_{i0} and v_{i1} represent the utility of the initial state and the choice alternative, respectively. The CS function for a marginal change in land management can also be estimated as the ratio of the estimated coefficient of the attribute β_j and the coefficient of the cost attribute β_c. This ratio is the marginal rate of substitution (or part-worth) between income (incentive payment) change and the change in the attribute and is a measure of the marginal value of a change in the attribute under consideration. The application of random utility theory to choice experiments is further explained in Holmes and Adamowicz (2003).

Applying the ACE technique to NIPF decision-making extends previous studies that primarily concentrated on examining the characteristics of the landowners most likely to participate. The ACE technique goes a step forward by providing a predictive understanding of landowners' forest-land use decisions and the relative importance of the characteristics of an incentive program desired by them. As such, results of this approach should be valuable to program planners and conservation agencies in designing appropriate incentive policies and targeting specific potential participants.

IV. DATA AND ANALYSIS

A mail survey was designed and conducted according to the Total Design Method (Dillman 1978) in the spring and summer of 2005. To facilitate easy understanding of the survey, we included a four-page information brochure with descriptions of the role of NIPF in wildlife conservation, conservation incentive programs, and the specific management practices for the choice experiment illustrated with color photos and drawings. Specifically, respondents were asked to assume a hypothetical market situation wherein they have to undertake a set of management practices (even if some of those practices are irrelevant for the lands they currently own) in response to a specified monetary incentive. For example, a respondent expresses his/her willingness to accept a payment in order to undertake streamside management zone as if she has a parcel of forest with riparian characteristics. After incorporating the changes suggested by focus groups of NIPF landowners, the surveys were mailed to a random sample of 1,500 landowners in four counties (Alachua, Putnam, Walton, and Bay) in North Florida who owned at least ten acres of land. The names and addresses of NIPF landowners were obtained from county tax assessor's offices. A reminder postcard and a second mailing followed the first mailing. Of the original 1,500 surveys, 221 surveys were undeliverable. Of the 1,279 delivered, 513 were returned, for a response rate of 40.1%, which is within the range of response rates reported for similar surveys (Loomis et al. 2000). Of the 513 surveys that were returned, 400 were considered usable.

The survey asked NIPF owners questions about characteristics of their property, past management practices, knowledge of incentives programs, and demographic information. In addition, the survey presented landowners hypothetical incentive programs in four choice sets. Each choice set had two options (A, B) representing different combinations of proposed conservation program options and a status-quo option (C), representing current management practices. The respondent was asked to choose one of these three options. (See Figure 1.)

Different combinations of management practices (attributes) in each proposed new option (A or B) represent different levels of the management practices and an incentive in the form of an annual payment. Each attribute had three levels and the incentive payment four levels (Table 1). Different levels for the attributes were arrived at after an extensive review of literature and discussions with local forestry and wildlife experts. For the incentive payment attribute, we estimated the shadow prices of adopting the practices and provided a range of values that captures the estimated prices. In arriving at different combinations of attribute levels in options A and B for the questionnaire, we used a random-selection process,[2] which is said to generate more precise valuation estimates compared to

[2] We thank Jeff Prestemon (U.S. Forest Service, Southern Research Station) for the use of his ingenious design of an Excel spreadsheet for randomizing the choice experiment design.

SCENARIO-3

Program Requirements	*Program A*	*Program B*	*C*
Minimum Harvestable Age for Timber	50 years	30 years	Not interested in enrolling in either program
Create/Maintain Riparian Buffers	200 ft. width	200 ft. width	
Conduct Prescribed Burns	Once in 4 to 6 Years	Once in 2 to 3 Years	
Invasive Species Control	Once in 5 to 7 Years	Once in 2 to 4 Years	
Landowner Participation in Your County	20% Participate	Less than 1%	
Incentive Payment During the Enrollment Period	$40 per acre per year	$70 per acre per year	$0

Please mark the CHOICE you would prefer: A B C

If you chose A or B, how many acres would you enroll? ________ number of acres

If you chose C, please tell us why you would not want to enroll in the programs presented here:

FIGURE 1

An Example of a Choice Set Scenario: Four Such Scenarios Are Presented in Each Survey

fractional factorial design commonly used (Lusk and Norwood 2005). Moreover, the random design process allows for detailed examination of attribute interactions beyond main effects.

Data Coding and Model Estimation

Each respondent was presented with four choice sets. In each choice set, respondent was asked to choose one of the two conservation program alternatives to adopt or opt for the status quo. (See Figure 1.) Thus, for each respondent we obtained 12 (4 $\times$ 3) data points. An alternative specific constant (ASC) for the status quo option was created by assigning a value of "1" if that line of data described the status quo alternative and "0" otherwise. Variability in choice selection not explained by the attribute or socio-economic variables is captured by the ASCs (Holmes and Adamowicz 2003). Effects codes using "1," "−1," and "0" were used to code the variables for the attribute levels. The status quo level was chosen as the base and two effects codes variables were created for the other two levels. The coefficients for these two levels were estimated from the model and the parameter value for the omitted attribute was calculated as the negative sum of these coefficients. LIMDEP's (1999) discrete routine was used to estimate the resulting multinomial logit regression model (MNL). A detailed overview of data coding and model estimation is provided by Holmes and Adamowicz (2003).

TABLE 1

Definitions of Program Attributes Used for Choice Experiment

Program Attributes	Levels in Each Attribute
1. Timber harvesting	a. No restriction. b. Harvesting is permitted only after trees are 30 years c. Harvesting is permitted only after trees are 50 years.
2. Maintaining streamside management zone (SMZ)	a. No change to existing SMZ (at least 35 feet). b. Requires an SMZ of at least 100 feet width. c. Requires an SMZ of at least 200 feet width.
3. Conducting prescribed burning	a. No requirements for conducting prescribed burns. b. Conduct prescribed burns at least once in 4–6 years. c. Conduct prescribed burns at least once in 2–3 years.
4. Invasive species control	a. No requirements for invasive species control. b. Control measures required every 5 to 7 years. c. Control measures required every 2 to 4 years.
5. Landowner participation in the program	a. Less than 1% of landowners in your county enroll. b. 10% of landowners in your county enroll. c. About 20% of landowners in your county enroll.
6. Incentive payment (per acre/year)	$10, $20, $40, $70.

Note: In each attribute, level "a" indicates status quo, level "b" indicates a moderate level, and level "c" indicates a higher level of restrictions.

V. RESULT AND DISCUSSION

Descriptive statistics of the analysis indicate that average landholding was 98.94 hectares with 81.26 hectares in forests. The properties were located on an average about 53.5 kilometers from the nearest city having a population of 50,000 or more. Pine forests were dominant, occupying on an average 45.7% of the forestlands. Wetlands, canals, and other water bodies occupied about 9.8% of the forests while mixed forests and hardwoods constitute 28.1% and 7.5% of them respectively. The average forest owner was 61 years old, has owned land for 37 years, attended college, and earned an annual income of $74,649, which is considerably higher than the average Florida household income ($56,331 in 2005). A majority (78%) of the respondents were male. While 58% reside on their property, forestry was a major source of income for only 2% of the respondents. Only 15% were members of a forestry or conservation organization. Land investment was the most important objective of forestland management for 36% of the respondents, followed by timber production (20%), wildlife (14%), recreation and aesthetics (13%), and other purposes (17%).

Most respondents (59.6%) preferred the status quo option over adopting any of the available options. The distribution of responses across all the four scenarios was uniform, indicating no scenario bias in choice selection. We estimated the multinomial logit model and tested for IIA restrictions using the Hausman and McFadden test (Hausman and McFadden 1984); we found no violations of the IIA assumption.

Coefficients on the attribute variables predict each practice's effect on landowners' utility functions and the probability of participation (Table 2). For example, coefficients for all the forest practice attributes are negative, indicating that adoption of these restrictions on forest management produce negative utility to forest owners. Of these eight coefficients, only two attributes that represent the higher form of restriction—no harvesting till the age of 50 and maintaining a minimum streamside management zone of 200 feet are statistically significant suggesting that these are the only levels that have a high likelihood of influencing decision-making. (See Figure 2.) The percentage of landowners participating in a county also did not show any significant relationship, contrary to our own assumptions (Section 2) and some hypotheses made earlier (Parkhurst et al. 2002). The coefficient for incentive payment however, is positive and significant ($p < 0.05$) indicating as expected that higher incentive payments increase landowners' probability of participation.

In the next stage, the individual-specific variables were interacted with the status quo alternative specific constant term (ASC) to analyze the influence of socioeconomic variables on program adoption. The coefficient on the status quo Alternative Specific Constant (ASC), which indicates the marginal utility of the status quo relative to the proposed program alternatives is significant (5% level) and positive (Table 2). This indicates that, everything held constant, forest owners prefer maintaining the status quo to participation in the proposed program suggesting minimal program participation in the absence of financial incentives. Although the McFadden R^2 is low, it is in the acceptable range.

Among socioeconomic variables (Table 2), the coefficient for the respondent's age is positive and significant indicating that the probability of participation, everything else held constant, decreases with the respondent's age (i.e., older respondents are more likely to prefer the status quo rather than participating). On the other hand, the variables representing education, income, and length of ownership are negative and significant suggesting the probability of participating increases with increasing respondent education, income, and the length of land ownership. The coefficients for the variables distance from nearest city, reside on the property, and membership in a forestry or conservation organization are also negative and significant which suggests an increase in participation rates for prop-

TABLE 2
RESULTS FROM MULTINOMIAL LOGIT REGRESSION (MNL) AND RANDOM PARAMETER LOGIT (RPL) ESTIMATION MODELS

	Multinomial Logit Regression (MNL) of the Impact of Program Attributes			MNL with Socioeconomic Variables Included			Random Parameter Logit Estimation		
Variable	Coefficient	Standard Error	t-Ratio	Coefficient	Standard Error	t-Ratio	Coefficient	Standard Error	t-Ratio
Program attributes									
Harvesting after 30 yrs	0.0188	0.0655	0.286	0.0159	0.0736	0.216	−0.0674	0.2415	−0.279
Harvesting after 50 yrs	−0.3767	0.0693	−5.436*	−0.3831	0.0777	−4.929*	−0.6659	0.2655	−2.508*
SMZ of at least 100 feet	0.0738	0.0647	1.14	0.0643	0.0725	0.886	0.2759	0.1873	1.473
SMZ of at least 200 feet	−0.2365	0.0697	−3.396*	−0.214	0.0783	−2.734*	−0.8138	0.4038	−2.015*
Conduct prescribed burn at least once in 2–3 yrs	−0.0671	0.066	−1.016	−0.0699	0.0739	−0.945	−0.256	0.2301	−1.113
Conduct prescribed burn at least once in 4–6 yrs	0.0154	0.0649	0.238	−0.0121	0.073	−0.165	0.0083	0.1484	0.056
Invasive species control at least every 2–4 yrs	−0.0038	0.0652	−0.059	−0.0006	0.0732	−0.008	0.0117	0.2208	0.053
Invasive species control at least every 5–7 yrs	0.0339	0.0662	0.512	0.0006	0.0746	0.008	−0.1193	0.2345	−0.509
10% of landowners in a county participate	0.0688	0.0656	1.049	0.0488	0.074	0.659	0.1535	0.1595	0.963
20% of landowners in a county participate	−0.0418	0.0656	−0.638	−0.0177	0.0735	−0.241	−0.1815	0.2129	−0.853
Incentive ($/acre/year)	0.0179	0.002	9.129*	0.0192	0.0022	8.639*	0.0328	0.0096	3.434*
Alternative Specific Constant	1.2455	0.1662	7.496*	2.9593	0.5272	5.613*	5.1468	1.6372	3.144*
Socioeconomic variables									
No. of miles from nearest city				−0.0072	0.0026	−2.768*	−0.014	0.0064	−2.174*
Years of forestland ownership				−0.0071	0.002	−3.488*	−0.0143	0.0059	−2.426*
Gender				0.1189	0.0816	1.458	0.2044	0.1762	1.16
Income				−0.005	0.0017	−2.983*	−0.0101	0.0043	−2.343*
Has residence on property				−0.1521	0.0663	−2.294*	−0.3035	0.1582	−1.919**
Member of a forestry or conservation organization				−0.3414	0.0884	−3.863*	−0.6559	0.2527	−2.596*
Age				0.0161	0.0051	3.13*	0.0307	0.014	2.2*
Education				−0.5181	0.0817	−6.338*	−1.0089	0.3328	−3.032*
Derived standard deviations of parameter distributions (RPL model)									
NsINCENT							0.0276	0.017	1.622
NsHARV30							0.7897	0.6635	1.19
NsHARV50							0.3342	0.6865	0.487
NsBUF100							0.0696	0.5769	0.121
NsBUF200							1.5117	0.6956	2.173
NsBURN2							0.866	0.5618	1.542
NsBURN5							0.0499	0.5024	0.099
NsINV3							0.6014	0.7087	0.849
NsINV6							0.9187	0.5582	1.646
NsPART10							0.0126	0.694	0.018
NsPART20							0.9134	0.4993	1.829
McFadden R^2	0.16			0.18			0.19		
Log-L	−1,415.92			−1,066.75			−1,061.29		
N	4,524								

* Significant at $p < 0.05$; ** significant at $p < 0.1$

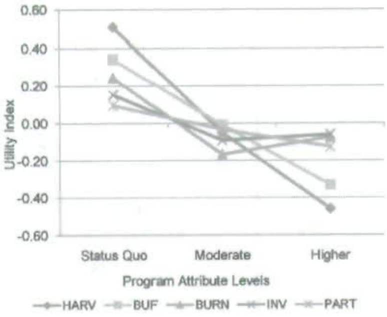

FIGURE 2
Respondents' Utility Levels Associated with Various Program Characteristics

erties more distant from a city, if the respondent resides on property, and if he/she is a member of a forestry or conservation organization. These results suggest a plausible pattern explaining forest owners' participation in an incentive program designed to improve habitat for wildlife. Landowners holding forestlands close to cities may view them as capital investments and may be reluctant to participate in forest/wildlife management programs that may restrict their options. These tend to be relatively older people, who do not live on their forest property, and are not associated with any forestry or conservation organization.

In a multinomial logit (MNL) model, the coefficients are fixed across individuals. As the data are comprised of several choice responses per survey, correlated errors may occur across responses. Therefore, we used a random parameters logit (RPL) model to test for potential correlations even though no violations of the IIA assumption were found for the MNL model. In RPL, some or all parameters are allowed to be distributed across individuals. The results of our RPL model, where the program parameters are normally distributed, are given in Table 2. The signs and statistical significance of coefficients of the RPL model parameters are similar to that of the MNL model.

The implicit prices or part-worth utilities representing the marginal value of implementing the forest practices (Table 3) were calculated following Hanemann (1984). The WTA estimates for higher levels of restrictions, that is, delaying timber harvesting till the age of 50, maintaining a 200-foot SMZ, undertaking prescribed burning every two to three years, and invasive species control every two to four years are, respectively, \$52.61, \$33.03, \$9.13, and \$0.53/ha/year. These values however varied according to landownership objectives. For landowners with timber production objective, for example, the WTA values for delaying timber harvesting up to 50 years is \$104.86/ha/year. The same for respondents with wildlife conservation objective is just \$10.11/ha/year. For all the four practices together, landowners with financial investment as the dominant management objective sought the highest WTA (\$151.08/ha/year) compared to other groups. These results are in conformity with observations made earlier

TABLE 3
Landowners' Marginal Willingness to Accept (WTA) Estimates for Adopting Forest Practices that Promote Habitat for Wildlife

	Willingness to Accept (WTA) Estimates By Dominant Land Management Objective (in US\$ per ha/year)					
Forest Practice	All Landowners	Financial Investment	Timber Production	Recreation and Aesthetics	Wildlife	Other
Delay timber harvest up to 50 years	52.61	67.61	104.86	44.14	10.11	−4.74
Maintain 200 feet streamside management zone (SMZ)	33.03	40.63	28.69	13.76	48.45	37.42
Undertake prescribed burning every 2–3 years	9.37	31.04	−13.26	12.19	25.57	0.95
Undertake invasive species control every 2–4 years	0.53	11.80	−12.86	12.77	−3.03	−10.34

by Kline, Alig, and Johnson (2000a, 2000b). The mean incentive payments necessary to induce owners to forego harvest, for example, according to Kline, Alig, and Johnson, were higher for owners with primarily timber objectives ($316/hectare/year) than for owners with both timber and non-timber objectives ($133/hectare/year) or primarily recreation objectives ($94/hectare/year).

The negative WTA estimates for some practices suggest that landowners would be more accepting of these restrictions and may be willing to pay the costs associated with them (Hiselius 2005). The WTA values for moderate level of restrictions are, however, not statistically significant. Landowners' indifference to these moderate levels of restrictions could be due to two reasons. One, timber harvesting under plantation management in Florida is mostly carried out when trees attain about 25 years, so the restriction on delaying harvesting until the trees are 30 years seemed to not be a large burden. Similarly, under Florida's current silvicultural BMPs, an SMZ of up to 70 feet is often maintained and hence an SMZ of 100 feet width did not seem to influence forest owners' decisions to follow this practice. Second, in respect of negative value for invasive species control, forest owners interested in timber production and wildlife management may value the inherent benefits of invasive species control. Also, it appears that the reluctance to adopt prescribed burning may be explained by forest owners' apprehensions about the risk and liability[3] associated with undertaking this practice rather than the cost. This is consistent with respondents' comments provided in the survey indicating that many wanted the program sponsors to undertake prescribed burning and invasive species control on their behalf. The low values associated with prescribed burning and invasive species control perhaps also reflect the non-linearity in forest owners' utility function that is unaccounted for in a simple two-level attribute modeling.[4]

VI. SUMMARY AND CONCLUSIONS

With the increasing concerns for healthy forests and enhanced wildlife habitat, private forest owner involvement has become a critical component of biodiversity conservation in the United States. Since providing environmental services is largely a public good, forest owners have little incentive to adopt such management on their own beyond the existing silvicultural BMPs. This study examined the willingness of non-industrial private forest owners of Florida to adopt a conservation program that requires restrictions beyond the existing BMPs in return for financial incentives. Applying an attribute-based choice experiment design, the adoption potential of the identified biodiversity-enhancing management practices and estimated costs associated with such adoption was assessed. The results indicate that the mean WTA for the adoption of the practices at their highest level of restrictions would be in the range of $37 to $151/ha/year. This suggests that market-based policy incentives would help further biodiversity on NIPF.

The results also suggest that younger forest owners with higher incomes, educations, and more years of forestland ownership would be more willing to adopt the suggested forest practices. There is also an increased probability of forest owner participation if the property is located farther from city, if the forest owner resides on the property, and if he/she is a member of a forestry or conservation organization. These results suggest that target specific outreach actions are required to promote biodiversity practices on NIPF. While considering these results, however, one should bear in mind the dynamic nature of the NIPF community, particularly as it

[3] Risk of wildfire escaping into the surrounding residential areas.

[4] Smith and Osborne (1996) provide a detailed discussion on internal consistency of value estimates in stated preference methods.

applies to the southeastern United States. Florida is one of the fastest growing states in terms of residential development and forest areas and rural lands are the primary targets for development. In addition, a significant decline in NIPF tree planting in the South in the next 50 years is predicted because of increased plantation costs and reduced levels of external assistance (Kline, Alig, and Johnson 2002). The recent decline in pulpwood and sawtimber prices in this region has also reduced the profitability of forest management. These factors perhaps explain the reluctance of some forest owners to undertake these practices. They also provide an empirical basis or justification for extending financial incentives to forest owners to ensure the sustainability of family forests in the long run.

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