Characterizing Family Forest Owners: A Cluster Analysis Approach

Indrajit Majumdar, Lawrence Teeter, and Brett Butler

Abstract: For policy implementation to promote better stewardship on family forestlands, it is necessary to understand what motivates landowners. This study characterizes family forest owners in Alabama, Georgia, and South Carolina, based on their feelings about forest stewardship and their stated reasons for owning forestland. Multivariate cluster analysis suggests that family forest owners are, in fact, a diverse set of owners who can be grouped into three attitudinal types, namely, multiple-objective, nontimber, and timber. The *multiple-objective* ownership type was found to be the largest group (49.1% of respondents) with almost half the family forest owners in the sample population belonging to this category. Owners belonging to the *timber* cluster (29.4%) indicated only timber management and land investment as strong motivating factors behind their forestland ownership, whereas owners belonging to the *nontimber* cluster (21.5%) value the nonconsumptive uses of their forestland such as aesthetic values, biodiversity, recreation, and privacy. FOR. SCI. 54(2):176–184.

Keywords: family forest, cluster analysis, landowner motivation, nonindustrial private forest owners, National Woodland Owner Survey

FORESTS AND FORESTRY DOMINATE THE LANDSCAPE in the South and have played a significant role in the economic development and psyche of the southern United States. Forests, which in presettlement times occupied nearly all of the land area of the South, now occupy only 56% of the land area (Economic Research Service 2002). Also, the changing composition and use of these forests have important implications for timber and nontimber outputs. Some of these changes have resulted from forest conversions to agriculture and subsequent reversions back to forest (Healy 1985) and permanent conversions of forest to urban land along major roads, interstate highways, and near urban centers (Wear and Greis 2002). Other changes occurred as fiber demand increased over time, and harvested lands were replanted with pines. The implications of amenity and recreational values for private lands management have been the topic of research at least since Hartman (1976). It is widely recognized that forests provide significant amenity and recreational values, which may lead to reductions in harvest by nonindustrial private forest landowners (Lee 1997).

Although forests provide both market and amenity outputs, these outputs are not necessarily complementary. The dominant market output is timber, most typically obtained by clearcutting, which often conflicts with production of high-quality amenity benefits such as scenic value or habitat for wildlife. Thus, the values held by private landowners for amenities play a role in influencing private forest management by changing the harvest date, amount of timber produced from any given stand, and silvicultural practices (or lack thereof) (Hartman 1976).

With the unprecedented recent growth in the number of private forest landowners, there is an increased need to research and investigate the motives of these landowners to manage their land for timber and/or nontimber use. Three broad categories of ownership constitute what we consider private forestlands: family owned or individual owners, industrial ownership, and institutional financial investors (e.g., timber investment management organizations). Whereas the latter two of these are considered to be primarily in the business of forestland management for profit and invariably their management actions focus on timber harvests, the objectives of the former, individual forestland owners, are diverse and less predictable. Individual and family forest landowners hold 42% of the nation's timberland (261.6 million acres) and 59% (127.6 million acres) of the timberland in the South (Butler and Leatherberry 2004). Given their numbers, it is important to study their diverse objectives, goals, and intentions for managing their lands.

Substantial research has been done over the past few decades, focusing mainly on ways to understand nonindustrial private forest (NIPF) owner behavior and ways to motivate these landowners to practice active forest management to boost timber supply. The relationship between harvesting decisions and the characteristics of landowners (Binkley 1981) has been the focus of most studies on private forest management behavior. Pattanayak et al. (2002) reported that timber supply is a function of the endogenous distribution of forest inventory, which is correlated with ownership and management characteristics. However, the relationship between forest amenity characteristics and private forest harvest has not been well established. In the

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recent past the focus of NIPF studies has shifted attention to the nontimber amenity preferences of landowners and the capabilities of forests as providers of "ecosystem services" to society. Also researchers are increasingly acknowledging the fact that family forest owners comprise various motivational types (Kurtz and Lewis 1981, Marty et al. 1988, Bliss and Martin 1989, Kline et al. 2000, Kluender and Walkingstick 2000, Butler 2005, Finley et al. 2006) and emphasizing the importance of using different approaches when trying to reach them for educational purposes.

Previous studies conducted at state and substate levels have confirmed that family forest owners do tend to be heterogeneous in their forest management motivations and objectives. However, those heterogeneous characteristics have not been well represented in policymaking. To make that body of research more relevant to national policymaking, we examined family forest owners' motivations across a multistate region. The results show that subgroups of forest owners can be differentiated by their stated reasons for owning forestland and confirm recent studies that financial benefits are not a significant motivating factor for a large number of timberland owners. We use an empirical validation procedure to evaluate the accuracy of the forest owner classification procedure in practice.

Literature Review

The two most widely researched aspects of NIPF behavior, which have been at the center of studies over the past few decades, are their harvest (Binkley 1981, Boyd 1984, Dennis 1990, Hyberg and Holthausen 1989, Pattanayak et al. 2003) and reforestation behavior (Alig 1986, Newman and Wear 1993, Kline et al. 2002) [1]. The sheer number and diverse profile of family forest owners [2], ranging from small-scale forest owners to large-scale owners with their associated ownership and forest characteristics suggest that they are a heterogeneous group. Almost four of seven family forest owners in the South own less than 10 acres of land, but this large number of owners (almost 2.7 million) represents only 5.6% of all family forest acres in the South. Categorizing forest owners at scales larger than state level has been explicitly considered in only a few studies on NIPF behavior in the United States (Kline et al. 2000 examined forest owners in several counties in parts of two states: western Oregon and western Washington). Most studies have been focused on developing attitudinal typologies at either state or substate levels owing to sampling constraints or assumed differences over large areas. To our knowledge none of the previously published studies have attempted to classify family forest owners across multiple state boundaries.

Using data from a survey of 146 Finnish landowners in southern Finland, Kuuluvainen et al. (1996) used K-means cluster analysis to empirically identify four groups of NIPFs based on their objectives as "multiobjective owners," "self-employed owners," "recreationists," and "investors." Karpinnen (1998) studied the values and management behavior of small-scale forest owners in southeastern Finland by applying the typology created by Pietarinen (1987) and classified forest owners into four types, "multiobjective

owners," "self-employed owners," "recreationists," and "investors," as suggested by Kuuluvainen et al. (1996). Lewis (1979) and Kurtz and Lewis (1981) used Q-methodology to construct a taxonomy of family forest owners in the eastern Ozarks of Missouri and identified four attitudinal types, which were identified and described as "timber agriculturists," "timber conservationists," "forest environmentalists," and "range pragmatists." In the United States, Kline et al. (2000) used similar methods to empirically identify four groups of NIPF owners in western Oregon and western Washington: "timber producers," "multiobjective owners," "recreationists," and "passive owners."

More recently, a survey and subsequent cluster analysis of 866 family forest owners in Arkansas identified four distinct groups of family forest owners: "timber managers," "resident conservationists," "affluent weekenders," and "poor rural residents" (Kluender and Walkingstick 2000). The types described by Kluender and Walkingstick (2000) were constructed using a combination of demographic and management behavior characteristics. Using objective demographic characteristics of the landowners as variables to classify them fails to explicitly take into account the subjective attitudinal or psychic constructs of landowner motivations, which can be considered as latent qualities of the landowner. Although forest management actions may differ from landowners' philosophies about forestland stewardship, it is expected that their perceptions and motivations determine the nature of their forest management activities in the long run.

Kittredge (2004) suggested that market segmentation may provide a superior approach to outreach compared with the traditional methods that assumed a single homogeneous group of family forest owners. Market segmentation allows the audience to be broken down into some number of relatively homogeneous classes, and the needs and desires of each class can then be ascertained. With the ownership classes characterized, certain classes can be chosen as priority targets for specific outreach programs. For example, Broderick et al. (1996) grouped family forest owners in Connecticut on the basis of their intentions concerning forest stewardship planning. The groups consisted of those who intended to sell their land ("sellers"), those who had a stewardship plan or had protected their land ("planners"), those who intended to develop a stewardship plan ("intenders"), and those who showed little inclination toward stewardship planning ("nonintenders"). Finley et al. (2006) used segmentation analysis to delineate the private forest owners in Massachusetts into four segments and named them as "general cooperators," "conservation cooperators," "neutralists," and "noncooperators." Each of the segments represented distinct levels of interest on the part of private forest owners within a segment to cooperate on certain forest activities with other owners outside the boundary of their individual forest property to further their mutual interests.

Kendra and Hull (2005) used cluster analysis to group family forest owners who had recently purchased forestland in rapidly growing counties in Virginia. In this case, the typology was based solely on the owners' responses to survey items measuring forest ownership motivations. The

resulting six types were then described on the basis of demographic, landownership, and management characteristics and labeled as "absentee investors," "professionals," "preservationists," "young families," "forest planners," and "farmers." This study serves as a recent example of a typology of family forest owners for which the classification was based purely on psychological variables. Although this study is significant in exploring the motivations of new owners and their reasons for acquiring forestland, it is limited in that it only reflects planned future behavior and does not include information on past forest management behavior.

Various studies have been conducted to explore the family forest owner attitudes in the South. Although grouping landowners into homogeneous attitudinal groups was not explicitly considered in these studies, they do give some insight to perceptions of an average forest owner. Bliss and McNabb (1992) found that 43% of Alabama family forest owners believed that forestry should be regulated on private lands to protect the environment. However, a recent study by Kennedy and Roche (2003) revealed that 55% of Alabama family forest owners believed that "providing timber and wood products" was the most important role of their forests. Birch (1997) found in Alabama that 27% of landowners felt that "residence" was the primary objective of landownership and 56% reported having performed timber harvests in the past.

In a study on the NIPFs of Florida, Jacobson (1998) found 64% of landowners to be "absentee owners" not living on their forestland and concluded that such owners are more likely to hold land for aesthetic beauty, wildlife habitat, and recreation rather than timber. Newman et al. (1996) reached a similar conclusion from a mail survey of the NIPFs of Georgia. Lorenzo and Beard (1996) found a significantly high correlation between the participation of NIPFs in government assistance programs and acreage of ownership in Louisiana.

To summarize this section on the review of past studies, specifically those on family forest owners in the South, we see a lot of variation regarding their motivations and the management strategies they use. Emphasizing the diversity of family forest owners in the South, Wicker (2002) stated, "available research information is insufficient to define an average private southern forest landowner."

Landowner Model

Economically rational forest landowners will maximize utility from their forest holdings by equating individual preferences for timber and nontimber values to the total capacity of the land to provide for these two benefits given resource and budget constraints. Based on Vincent and Binkley's (1993) model for a single stand, the optimal point of maximum utility depends on the interplay of the production trade-offs (the combinations of timber and nontimber units that the stand can produce) and the consumption (psychic) trade-offs that are determined by the landowners' perception of the relative value of timber and nontimber (nonmarket) output of the forest. They argue that for a single stand, unless the relative price line is either "too"

steep or "too" flat, the multiple use option is always superior and reject the possibility of a corner solution where the landowner chooses either to produce only timber or only nontimber. We support Vincent's and Binkley's argument that the most plausible option for family forest landowners in general is to practice multiple-use forest management in absolute terms. We argue, however, that based on the psychic price (value) that individual landowners' perceive from nontimber benefits, which typically do not have any market price, the slope of the relative price (value) line can differ to such a degree that it may be possible to group/classify landowners' based on their motivation to manage for either primarily timber or primarily nontimber or both.

To illustrate our point, consider three family forest landowners A, B, and C who own single forest stands where each stand can produce two products, timber (T) and nontimber (NT). We assume a strictly concave production possibilities frontier (PPF) for each of the three landowners consistent with the standard microeconomic assumption of increasing opportunity costs as one produces more units of a product (Figure 1). The landowners maximize their utility at the tangential point between the PPF and the relative price (value) line such that landowner A produces A_T and A_{NT}, landowner B produces B_T and B_{NT} and landowner C produces C_T and C_{NT} quantities of timber and nontimber products (Figure 1). The object of this article is to test the validity of the existence of similar family forest landowner groups in the Southeast as represented by landowners A, B, or C using multivariate statistical techniques.

Data and Methods

This study is based on an analysis of National Woodland Owner Survey (NWOS) data of family forest owners in three Southern states: South Carolina, Georgia, and Alabama. NWOS is conducted as part of the Forest Inventory and Analysis program of the US Forest Service. The response rate (for details on sample design and sample size refer to Butler et al. 2005, p. 11–12) to this mail-based survey was 49%. A total of 1,854 family forest owners who participated in the NWOS in 2002, 2003, and 2004 were included in our analyses.

As part of the NWOS a self-administered questionnaire is mailed to family forest owners as the primary survey
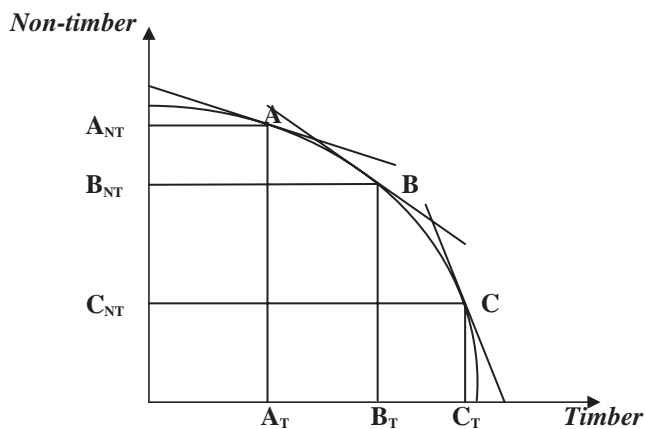

Figure 1. Landowner behavior model.

instrument with supplemental telephone interviews conducted for nonrespondents to augment response rates (Butler et al. 2005). The questionnaire included 30 questions concerning the following:

➤ Forestland characteristics.
➤ Ownership objectives.
➤ Forest use.
➤ Forest management.
➤ Sources of information.
➤ Concerns and issues.
➤ Demographics.

The questions in the survey were prepared using a comprehensive questionnaire review process, which included expert reviews, pretesting of the survey instrument at several forestland-owner conferences and professional meetings, input from state forestry agencies, expert opinion, and review by the clearance office of the US Forest Service [3].

Data

The total number of private landowners responding to the NWOS during the survey period for the three states, South Carolina (SC), Georgia (GA), and Alabama (AL) was 1,854 (SC = 751, GA = 813, and AL = 290). Out of all these private owner responses, we discarded forest industry, timber investment management organizations, and real estate investment trusts as we were interested in exploring the diverse set of motivations of the family forest owners. We assumed that the motivations of all forest industry, timber investment management organizations, and real estate investment trusts were to generate profit from timber management. We also excluded all owners with parcel sizes smaller than 10 ha because of the economic inefficiencies associated with managing such smaller parcels for timber production and assumed that a rational owner with the aim of maximizing utility from the forestland had to be motivated mainly by the nontimber amenity values for parcels smaller than 10 ha. These exclusions resulted in reducing the number of respondents included in the analysis from 1,854 to 1,339.

Statistical Methods

The 10 questions in Table 1 (Question 9 in the NWOS) form the basis for developing the landowner typologies, each emphasizing the perceived importance of various benefits that may be important to the forest owners. All questions were rated by the respondents using an ordinal Likert-type scale from 1 to 7 where 1 reveals the strongest motive corresponding to "Very Important" and 7 reveals the weakest motive corresponding to "Not Important" for owning the land. The distribution of answers is given in Table 1. The responses to questions related to nontimber forest products and firewood (9f and 9g) were removed from the analysis because of the small variation in the NWOS responses to these questions (they were not useful for discriminating landowners) and also because very few landowners considered them as important reasons for owning forestland (Table 1). The question related to the perceived importance of having the timberland as part of their home or vacation home (part of question 9) was also not included in the analysis because of dissimilarities in how this question was framed across different versions of the questionnaire used in the three states for the years 2002–2004. In effect then, we used eight attitudinal questions (9a–9j, excluding 9f and 9g) to develop our typology of family forest landowners.

For all of the statistical calculations referenced below we used SAS 9.1 for Windows. Principal components analysis is the most important statistical routine for dimensional reduction and seeks to transform a larger set of correlated variables into a smaller set of uncorrelated variables or factors without losing much information. Principal components analysis with varimax rotation was used to reveal the latent constructs (factors) of forest owner motivations based on the eight questions mentioned above by use of the variance-covariance matrix of landowner responses. Varimax rotation [4] was used to facilitate interpretability of factors by maximizing the variance of loadings (correlation coefficients between the factors and the variables) on each factor for use in the subsequent clustering procedures. Two factors were identified as financial and nonfinancial. Whereas the financial factor reflected landowners' monetary interests related to timber harvest and land investment,

Table 1. Percent responses to survey questions from NWOS used for cluster analysis across all landowners

| Question | Percentage of answers | | | | | | | |
	1 Very Important	2	3	4	5	6	7 Not important	No answer
9. "People own woodland for many reasons: How important are the following as reasons for why you own woodland?"								
a. To enjoy beauty or scenery	46.23	13.97	10.83	10.38	4.18	1.72	4.71	7.99
b. To protect nature or biologic diversity	36.07	14.04	12.47	12.62	5.38	4.78	4.33	10.31
c. For land investment	50.78	11.58	10.75	6.87	3.29	2.02	6.87	7.84
d. For privacy	38.31	9.86	8.14	7.77	4.26	4.26	15.91	11.50
e. To pass land on to my children or other heirs	58.18	12.02	8.14	6.65	2.69	1.27	5.75	5.30
f. For cultivation/collection of non-timber forest products	7.54	4.63	6.35	11.80	7.24	11.95	37.27	13.22
g. For production of firewood or biofuel (energy)	4.41	2.91	6.05	8.66	7.47	14.64	42.94	12.92
h. For production of sawlogs, pulpwood or other timber products	44.51	13.74	10.90	7.84	3.29	2.84	10.31	6.57
i. For hunting or fishing	35.10	14.34	12.77	11.05	3.81	3.36	12.32	7.24
j. For recreation other than hunting or fishing	19.64	9.26	11.13	12.92	6.42	6.87	22.48	11.28

the nonfinancial factor represented the importance of non-timber amenity values (biodiversity, esthetics, or recreation) of the forest for the landowner. The overall Kaiser-Meyer-Olkin [5] measure for factor suitability was 0.72, confirming the factorability of the indicator variables (NWOS questions). The two factors together explained 55% of the variance in the responses. Reliability analysis was conducted by computing Cronbach's αs for each factor, which ranged from 0.64 to 0.72, suggesting adequate internal consistency for each of the factors extracted (Hair et al. 1998, p. 118). Finally, a scores matrix of the order $N \times 2$ was computed by multiplying the actual survey responses for each respondent (N) with the estimated factor loadings for each of the two factors (from Table 2) and summing these products. These scores were then used as criterion variables for the cluster analysis. The factor loadings denoting the correlations between the variables (rows) and factors (columns) are given in Table 2.

Cluster Analysis

To get meaningful groups of family forest owners based on their motivations for owning and managing their forestland, NWOS data were subjected to cluster analysis using the factor scores on the two factors extracted for each respondent. Because all of the clustering routines available through various mathematical software packages are biased toward identifying clusters with certain characteristics, once the data are input it is necessary to identify the algorithm that gives the best interpretable results and then validate the clusters. As a first step to clustering, the SAS procedure CLUSTER was used to explore various hierarchical methods such as single linkage, complete linkage, average linkage, centroid, and Ward's method (SAS Institute, Inc. 2004, p. 955) to determine the best method for clustering the data. Hierarchical clustering is exploratory in nature and assumes no a priori information about the number of clusters. To get landowner clusters of reasonable proportions and to exclude the possibility of producing groups that were too small, Ward's minimum variance method was used. This method is based on least-squares criteria and minimizes the within-cluster sum of squares, thus maximizing the within-cluster homogeneity. On the basis of some of the most widely used statistics such as root-mean-square standard deviations, semi-partial R^2, and R^2, a three-cluster solution was found to be most appropriate.

Using a nonhierarchical (K-means) method to sort the observations to the nearest centroid through the proce-

Table 2. Factor loadings representing the correlations between factors and the variables

	Nonfinancial	Financial
Aesthetics	0.76	0.01
Biodiversity	0.62	0.00
Recreation	0.65	0.07
Privacy	0.65	−0.03
Timber	−0.07	0.83
Investment	0.03	0.46
Hunt	0.50	0.31
Legacy	0.26	0.27

dure FASTCLUS [6] in SAS we found results similar to those for the hierarchical method. The results discussed in the next section were obtained by the nonhierarchical clustering routine. We excluded 254 incomplete observations (no response on at least one of the eight questions on reasons for owning forestland from Question 9 of the NWOS) from the cluster analysis; this resulted in reducing the number of observations from 1,339 to 1,085.

Multivariate analysis of variance to test statistical differences between cluster groups confirmed that forest owners were significantly different on the basis of their rankings on the importance of various reasons for owning their land (Question 9 of the NWOS). Analysis of variance using Tukey's studentized range test was performed on owners and forest characteristics to validate the results of the cluster analysis and to facilitate comparisons with other studies.

Clusters of Forest Owners

On the basis of the cluster means for all the variables used in the nonhierarchical cluster analysis, three clusters were identified and named according to how forest owners ranked the different objectives (Figure 2). The cluster analysis model placed most owners (533) in the *multiple-objective* group. Owners belonging to the *timber* cluster included 319 respondents, whereas 233 owners with *nontimber* ownership objectives formed the smallest cluster.

Most owners placed high importance on "Legacy" and low importance on production of firewood/or biofuel ("Firewood") and cultivation/collection of nontimber forest products ("NTFP") such that these factors had little influence on segregating the clusters (Figure 2). The nontimber owners were not motivated by financial objectives and placed higher importance on all the nonfinancial amenity objectives. The timber owners, on the other hand, were primarily motivated by monetary objectives and gave high scores to timber production and land investment reasons. The multiple-objective owners indicated all the objectives were important.

Characteristics of Clusters
Cluster 1: Multiple-Objective

A plurality of family forest owners (49.1%) in the sample formed the multiple-objective group. It is evident that this owner group is strongly motivated by both consumptive (hunting and timber harvest) use values and nonconsumptive (aesthetic beauty and biodiversity) use values equally. Most multiple-objective owners owned large tracts of land, were older than 60 years, and owned their land for approximately 29 years, and approximately half of them had inherited their land (Table 3). Approximately 57% of the group lived within 1 mile of their timberland and approximately one-quarter had vacation/second homes within a mile of their timberland. Approximately one-quarter of the multiple-objective owners expected their children to take over their timberland in the next 5 years. On average, half had harvested trees in the past 5 years and slightly less than 60% had the assistance of a professional forester for their
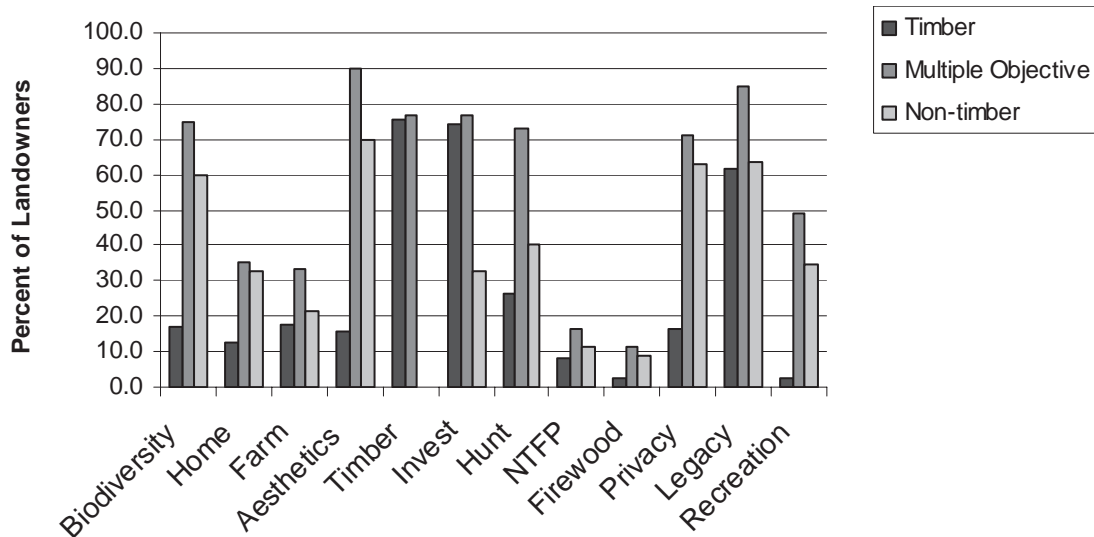
Figure 2. Proportion of landowners for each group and their importance (those who responded 1 or 2 to the NWOS question) ranking for ownership objectives.

Table 3. Results of tests of difference in owner and forest characteristics between three groups of landowner clusters

Characteristic	C1 Multiple-objective	C2 Timber	C3 Non-timber
Mean age (years)	61.5[C2]	64.2[C1]	62.2
Men (%)	74.1[C2]	66.1[C1,C3]	75.9[C2]
Mean duration of ownership (years)	28.6[C3]	31.2[C3]	22.4[C1,C2]
Income (1000$)	79.4	78.3	71.4
Education	4.2[C3]	4.3[C3]	3.8[C1,C2]
Retired (%)	36.7	42.9	45.5
Inherit (%)	49.3[C2,C3]	56.7[C1,C3]	27.5[C1,C2]
Leased (%)	44.1[C2,C3]	52.3[C1,C3]	19.7[C1,C2]
Leased in the past 5 years (%)	30.0	36.1	11.6
Primary residence (%)	56.8[C2]	30.7[C1,C3]	58.4[C2]
Secondary/vacation home (%)	23.8[C2,C3]	14.1[C1]	12.9[C1]
Mean forest area (ha)	544.4 (141.6)[C3]	751.9 (134.8)[C3]	155.6 (39.2)[C1,C2]
Farm area (ha)	180 (64.7)	166.6 (60.7)	92.9 (40.5)
Management plan (%)	32.1[C3]	25.7[C3]	10.3[C1,C2]
Site preparation (%)	47.8[C3]	43.3[C3]	12.9[C1,C2]
Harvest (%)	89.3[C3]	86.2[C3]	56.6[C1,C2]
Harvest (%) in the past 5 years	51.2[C3]	48.3[C3]	22.7[C1,C2]
Harvest (%) most recent with consultation from a forester	57.6[C2]	62.1[C1,C3]	29.6[C2]
Future heir (%)	23.8	19.4	19.3
Easements (%)	19.7	14.4	14.2
Land certified (%)	8.4	5.0	1.3
Cost share program participation (%) in the past 5 years	25.0	22.3	6.0

All tests were conducted using a 5% level of significance. Values in parentheses are medians.
[C1, C2, C3] Significantly different landowner clusters.

most recent harvest operations. Thirty percent of the owners had leased their land in the past 5 years. Approximately one-fifth of the owners had conservation easements on their forestland, and one-quarter had also participated in cost share programs such as the Conservation Reserve Program, Stewardship Incentive Program, and Forestry Incentives Program in the last 5 years. These owners were found to be most active in terms of their silvicultural and harvesting activities, similar to Karpinnen's (1998) multiobjective owners in Finland. The multiple-objective owners share characteristics with the timber agriculturists of Kurtz and Lewis (1981), and the multiobjective owners of Kuulu-vainen et al. (1996) and Kline et al. (2000).

Cluster 2: Timber

The timber motivated owners owned the largest tracts of land and were also the oldest and most educated and had the longest duration of ownership, averaging approximately 32 years. The longer tenure of forestland ownership for these owners may indicate the fact that timber management is a long-term decision and thus timber managers are generally associated with their land for a longer duration relative to owners who value forest for recreational and aesthetic purposes. Approximately 57% of these owners had inherited their forestland and slightly more than 19% expected to pass it to their heirs in the next 5 years. More than one-third had

leased their land, approximately 14% had conservation easements, and 22% had participated in government assistance programs in the last 5 years. Only 5% of owners had their land certified. These owners are similar to the investors of Karpinnen (1998) and timber producers of Kline et al. (2000).

Cluster 3: Nontimber

The nontimber owners formed the smallest cluster (21.4%) and owned the smallest parcels with a median holding size of 39 ha (Table 3). They were more than 60 years of age, were the least educated, belonged to the lowest income category, and were also least likely to have inherited their land relative to all other owners. The nontimber owners were the least active forest managers with only 10% having a forest management plan. A mere 6% of them had participated in cost share programs in the last 5 years and less than 2% had their land certified. Twenty-three percent of owners harvested trees in the last 5 years. Less than 30% consulted a professional forester for their most recent harvest. The nontimber owners are comparable to timber conservationists of Kurtz and Lewis (1981) and recreationists of Karpinnen (1998) and Kline et al. (2000).

Cluster Validation

Although classification procedures using cluster analysis have been applied to family forest owners in a number of studies, few studies have reported results of any empirical cluster validity test. Based on the five-step cluster validation technique (Lattin et al. 2002, p. 299) we performed a validation test on the NWOS clustering results. Following this technique the data were randomly split in the ratio 1:1 to get the calibration and the validation samples. Next the calibration sample was used for hierarchical cluster analysis, and the appropriate number of clusters and their centroids were determined. Further the cluster centroid from the last step was used to assign each observation from the validation sample to the nearest centroid using nonhierarchical cluster analysis, and the cluster solution was saved. In the next exercise the complete validation sample was used to perform hierarchical cluster analysis, and the cluster solutions thus obtained were cross-tabulated with the results of calibration data to form a confusion matrix (Table 4), depicting the percentage of observations in each of the three cluster groups incorrectly classified into another group.

As can be seen in Table 4, errors in classification were low, and most of the observations that were clustered at both step 3 and 4 of the validation routine were found to be in the same cluster group for each of the three types of landowner. Percent misclassification estimates for owners belonging to the multiple-objective, timber, and nontimber groups were

2.4, 2.7, and 1.05, respectively (Table 4). Cluster validation is extremely important as estimating consistent groups with the same members in subsamples in the data set is crucial and indispensable for any clustering applications.

Summary and Discussion

Previous studies have shown that family forest owners are a heterogeneous group, but no attempt was made in previously published studies to develop an empirical categorization scheme that covers family forest owners at scales larger than a state or substate level. Our study supports the presence of three groups of family forest owners in the southeastern states of Alabama, Georgia, and South Carolina as discussed previously in the theoretical model (Figure 1) on landowner behavior. Butler (2005) identified similar groups of family forest owners and analyzed their harvest behavior. Our results serve as an empirical confirmation of the presence of such groups of landowners and emphasize the need to differentiate family forest owners into smaller homogeneous entities to better tailor policy instruments consistent with underlying objectives for their forests and to have an influence on their forest management activities. Kendra and Hull's (2005) recent study on new owners in Virginia revealed that the majority of owners were motivated by lifestyle, naturalism, and transcendental (nonfinancial) concerns, whereas from an earlier study by Kluender and Walkingstick (2000), Arkansas forest owners were found to be motivated primarily by profit. Results show that the bulk of respondents in our study are not motivated strongly by either the profit motive or by amenities, but instead are genuinely driven by favorable attitudes toward the complex mix of both financial and nonconsumptive benefits similar to the results of Karpinnen (1998) and Kline et al. (2000). As reported above, landowners have different objectives and motivations for managing their forestland and identification of those may be critical to developing better informed policy prescriptions. Policies can be targeted to each owner group according to their needs and interests and thus policy implementation can be made more efficient. For example, timber harvests for owners within the nontimber group may be conducted primarily to improve wildlife habitat or to maintain a healthy forest, which is quite different than harvests for purely economic reasons. Similarly the timber owners will probably be more receptive to policies that are consistent with their financial objectives whereas the multiple-objective owners may be receptive to several types of policy instruments and are likely to be most influenced by a wider array of policy instruments.

The multiple-objective ownership type was found to be the largest group with almost one of every two family forest owners in the sample population belonging to this category.

Table 4. Confusion matrix for cluster validation

	Multiple-objective	Timber	Nontimber	% misclassification
Multiple-objective	322	—	8	2.4
Timber	5	181	—	2.7
Nontimber	—	2	189	1.05

—, null or 0 number of observations.

These owners derive utility from both financial and nonfinancial uses of the forest and were found to be the most active forest managers. This result indicates that sole emphasis on monetary benefits (timber owners) does not lead to the most active silvicultural and harvest behavior. We also found that the nontimber owners did not exclude themselves from harvesting timber, although the majority of them did not have a forest management plan or did not use the assistance of professional foresters.

Extrapolating the sample estimates of forestland acres to three-state region totals (see Butler et al. 2005, p. 14–15) for each of the landowner types, we find that of the 12.8 million ha of family forestland, 6.6 million ha were owned by the multiple-objective owners, 5.4 million ha by the timber-only objective owners and 0.8 million ha by the nontimber-motivated ownership category. This suggests that close to 1 million ha of timberland in the three states will not be available for timber production owing to the nonfinancial amenity objectives of the nontimber owners. Timber supply models have typically ignored landowner psyche about owning and managing their forestland with the assumption that all forests are available for timber production. This assumption in reality could be totally inappropriate given our analysis. Results from broad area-based studies on landowner objectives and attitudes could be used by researchers to evaluate the availability of timber from existing family forestland (Kuuluvainen et al. 1996).

Substantial expansion of the cooperative forestry assistance funding under the Farm Bill indicates concern for maintenance of family forests as healthy forests. Identifying landowner objectives could help the Forest Service fight the four major threats [7] to the nation's forests and rangelands by communicating with different types of landowners in language they understand. For example, an owner interested in timber is less likely to relate to the objectives of the Wildlife Habitat Incentives Program compared with the perceived benefits from Forestry Incentives Program, whereas a multiple-objective owner is likely to be influenced by both programs.

The overarching goal of private forest policies is to promote better management of forests and almost always entails monetary investment on the part of the landowner. As discussed above, the management goals of landowners are diverse and may not be aligned with existing policies or their objectives. Information that can help to distinguish the likely active managers (timber and multiple-objective owners) from the inactive (nontimber owners) ones can help in successful outreach to family forest owners. For example, in Broderick et al. (1996), intenders and nonintenders of stewardship planning were chosen as the priority target audiences and a marketing campaign was designed to help promote stewardship planning by family forest owners.

Further analyses of the data by integrating the detailed forest characteristics along with linkages to the socioeconomic census data could produce important information on family forest owner behavior. A large number of observations (254) excluded from the analysis due to incomplete responses warrants a closer look to check whether there are enough similarities among them to be classified as a separate cluster or not. This group could represent owners who are undecided or who do not fully understand their reasons for owning forestland. Similar owners were identified and termed as passive owners in a study of NIPF owners in western Oregon and western Washington by Kline et al. in 2000. Finally, the average age of family forest owners is the 60s, and it remains to be seen if the future change of ownership will be associated with changing owner attitudes and motivations.

This study highlights the diversity in family forest owners, which we believe has enormous implications for design of extension and educational services tailored to the needs of landowners. Our results indicate that an increasing share of forest owners associate "nontraditional" (nontimber amenity) goals, such as recreation and nature conservation, with their properties instead of timber production. Professional foresters working with family forest owners can use the results from this study to identify different landowner types for more effective, targeted communication efforts.

Endnotes

[1] For a review of literature on NIPF studies, see Beach et al. (2005).

[2] Family forest owners are defined as "family forests include lands that are at least 1acre in size, 10% stocked, and owned by individuals, married couples, family estates and trusts, or other groups of individuals who are not incorporated or otherwise associated as a legal entity" (Butler and Leatherberry 2004)

[3] For a detailed description of the development and implementation of the survey instrument (NWOS) see *Design, Implementation, and Analysis Methods for the National Woodland Owner Survey* (Butler et al. 2005).

[4] Varimax is an orthogonal rotation of the factor axes to maximize the variance of squared loadings of a factor (column) and all the variables (rows) in a factor matrix (see Table 2).

[5] Kaiser-Meyer-Olkin is a measure of sampling adequacy and evaluates the appropriateness of the correlation matrix for factoring. Kaiser-Meyer-Olkin values should be >0.6 for a satisfactory factor analysis (Tabachnick and Fidell 2001, p. 589).

[6] FASTCLUS in SAS uses a nearest centroid sorting iterative method, in which a set of points known as cluster seeds is selected as the first guess of the mean of the clusters and each observation is assigned to the nearest seed to form temporary clusters; the seeds are then replaced by the seeds of the temporary clusters in an iterative manner until no further changes occur in the clusters (for details, see SAS Institute, Inc. 2004).

[7] The four threats noted are fire and fuels, invasive species, loss of open space, and unmanaged recreation (US Forest Service 2006).

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