

NONINDUSTRIAL PRIVATE FOREST OWNERS IN MICHIGAN:
EXAMINATION AT A FINER SCALE

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ABSTRACT

NONINDUSTRIAL PRIVATE FOREST OWNERS IN MICHIGAN: EXAMINATION AT A FINER SCALE

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Non-Industrial Private Forest owners are a diverse group of Michigan's landowners. This study seeks to manage NIPF variation through the creation of groups which characterize landowner behavior and attitudes. This thesis is divided into two papers each examining a different method of grouping Michigan's NIPF landowners. Both papers utilize information from a 2003 survey of 1600 Michigan NIPF landowners.

The first paper utilizes Michigan's four regions: the Southern Lower Peninsula (SLP), Northern Lower Peninsula (NLP), Eastern Upper Peninsula (EUP), and the Western Upper Peninsula (WUP), to place landowners into sub-categories based on location. Distinct differences are found across regions in regards to landowner demographics, parcel characteristics, reasons for owning forestland, and management behavior. These differences suggest the need to take into account the effects of variation of policy success and informational outreach programs.

The second paper utilizes a market-segmentation approach to place landowners in segments based on their reasons for owning forestland. Three segments are developed: Game Wardens, Tenants, and Timber Barons. Each segment differs in relation to demographics, parcel characteristics, reasons for owning forestland, management activities, and preferences for policies or programs. These results suggest the ability to target specific landowner segments to achieve policy goals. Further, policy-makers and outreach extension specialists may wish to account for landowner differences when seeking to develop policies or programs with specific objectives or targets.

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Introduction

Non-Industrial Private Forest (NIPF) owners comprise nearly two thirds of United States' forestland (Butler and Leatherberry, 2004). The NIPF category contains forestlands which are owned by neither government nor forest product industry (Butler and Leatherberry, 2004). Privately owned forests contribute to societal benefits, such as recreation, ecosystem services and timber production (Finley and Kittridge, 2006). In Michigan, 47.3% or 8.8 million acres of the state's 19 million acres of timberland is controlled by NIPF owners (Leatherberry et al., 1998). Michigan's forest product industry contributes as much as \$12 billion in annual revenue and an estimated 10% of the state's manufacturing jobs (Korpi, 2010). Almost half of the state's wood fiber originates from NIPF lands (G.C. and Potter-Witter, in progress). Michigan's forests and recreational opportunities are a draw for tourists both within and outside the state and the tourist industry contributes an additional \$11.5 billion annually in revenue (Stynes, 2002). Considering the importance of Michigan's forests, understanding and influencing the behavior and attitudes of NIPF landowners has been a priority for extension and state forest management organizations.

NIPF owners are facing several challenges to owning forestland. In recent years, pressure has increased on landowners to sell and split their holdings into smaller parcels for development (Egan and Luloff, 2000). Smaller parcels complicate forest management activities, and in some cases, may reduce the financial viability of conducting timber harvests (Cleaves and Bennett, 1995). Further, parcelization reduces recreation access on private lands (Gobster and Rickenbach, 2004). Additionally, the last decade has seen an increase in inter-generational land transfer (Butler and Leatherberry, 2004). Many of the new property owners have a less active interest in their forest property or may not understand the proper care and maintenance of a healthy forest (Egan and Luloff, 2000). A whole new generation of landowners may need education, information, or assistance in managing their forest parcels (Butler and Leatherberry, 2004).

The factors affecting private landowner behavior are quite complex (Dennis, 1989). Non-resident ownership, forest parcel size, and non-timber preferences have all been studied in an effort to predict private landowner behavior (Egan, 1997). However, landowners often have different motivations for owning forested property (Butler and Leatherberry, 2004). The reasons for owning forest property have been shown to directly influence a landowners' forest management decisions (Janota and Broussard, 2008). Different management behavior and attitudes on adjoining parcels can manufacture a patchwork of forest systems (Best, 2002). This patchwork can advance fragmentation and may have unexpected consequences on habitat and opportunities for amenities or benefits from private forestland (Gobster and Rickenbach, 2004).

To ensure the continuity of societal benefits from private forests, policy-makers have examined programs to influence forest management objectives on NIPF lands (Schaff and Broussard, 2006). Often these programs use financial incentives to encourage specific landowner behavior (Serbruyns and Luyssaert, 2006). However, a landowner's motivations for participating in forest management activities are generally not financial (Koontz, 2001; Kendra and Hull, 2005). Instead, recreation or privacy often are primary motivators in forest management decisions (Kluender et al., 1999; Koontz, 2001; Kendra and Hull, 2005). Rather than encouraging management activities, financial incentives often offset personal capital with public funding for those already performing the activities in question (Koontz, 2001).

In Michigan, several incentive programs have been developed to reach the private forest owner. The Commercial Forest Program (CFP) offers tax reductions to those with 40 acres or more of forestland (MiDNRE, 2009). These landowners must have a stewardship plan and be willing to allow non-motorized recreation on their land (MiDNRE, 2009). Additionally, the Qualified Forest Program (QFP) waives certain property taxes for enrolled parcels (MiDNRE, 2009). Enrolled forestland is required to be 20 acres or greater in size and a stewardship plan must be maintained, but no open-

access recreation is required (MiDNRE, 2009). Withdrawal penalties for both programs require repayment of ad-valorem taxes dependent on time enrolled (MiDNRE, 2009). Finally, some opportunities for cost-share are available through the Forest Stewardship Program (FSP). This program provides cost-share assistance for stewardship plans, up to \$200 (Deb Huff, Nov. 5 2010, personal communication). However, funding for this program is on a yearly basis and may fluctuate unpredictably (Potter-Witter, 2005).

NIPF owners are not likely to respond to programs with any consistency (Kline et al., 2000). When they do respond, it often varies across groups of landowners (Potter-Witter, 2005). Oftentimes programs and policies can influence specific sectors of landowners, based on their ownership objectives, while ignoring others (Serbruys and Luyssaert, 2006). Additionally, landowners hold different viewpoints on governmental right or responsibility to influence specific objectives (Finley and Kittridge, 2006). Further, cost share and other financial incentives to forest management tend not to increase the number of landowners performing forest management, but rather increase the intensity of the management performed (Kluender et al., 1999). Educational and informational programs generally attract landowners who are already interested in performing forest management (Serbruyns and Luyssaert, 2006). Reaching out to or providing assistance and information to those who are ill informed or unaware of forestry practices can be far more difficult (Kendra and Hull, 2005). As a result of these challenges, success and participation in various programs and policies across the United States varies (Potter-Witter, 2005; Finley and Kittridge, 2006; Kluender et al., 1999; Kline et al., 2000)

In efforts to improve the effectiveness of future policies or programs, several studies have attempted to identify sub-groups of NIPF owners. In 1998, Karpinnen examined NIPF landowners in Finland grouping them by variables describing forest values. The study identified four groups of NIPF owners: multi-objective owners, recreationists, self-employed owners, and investors. Relationships between groups, values held by owners, silvicultural activities and landowner characteristics were

examined for significant differences. Karpinnen describes variance between groups in harvesting timber as well as the relative importance of non-timber forest management objectives. He concludes a landowner's association with one of the identified groups can be useful in determining landowner behavior or tailoring extension and outreach materials to meet their needs.

Potter-Witter examined four groups of NIPF owners in Michigan (2005). Landowners were surveyed based on their participation in FSP, CFP, Michigan Forest Association (MFA) and the Two-Hearted River Watershed (TRW). She found that landowner demographics and parcel characteristics differ significantly by group. Participants in MFA and CFP were significantly more likely to perform management activities than landowners enrolled in FSP and TRW. Potter-Witter notes that program managers should be cautious in expecting similar results across different programs, as different types of programs are likely to attract landowners interested in different facets of owning forest property.

Investigating concerns over the effects of parcelization and land-transfers, Kendra and Hull (2005) examined the attitudes of new NIPF owners in Virginia. The study used survey data to separate landowners into groups. Cluster analysis produced six segments: investors, professionals, preservationists, young families, forest planners and farmers. No identified segments indicated profit or financial reasons as being important for owning forest property; instead lifestyle concerns predominated. Each segment exhibited different concerns and beliefs towards their forestland. The results indicate the challenges to working with new landowners, especially in regards to traditional approaches of influencing landowners utilizing financial incentives. Kendra and Hull indicate the need for further research to group landowners to provide more useful and defined categories for policy and decision makers.

Massachusetts's NIPF owners have been examined to determine landowner segments and differences in participation in the state's Chapter 61 forest property tax program (Finley and Kittridge, 2006). The study highlights specific barriers to Chapter 61 enrollment based on three different

ownership groups. The groups identified by Finley and Kittridge (2006) are Jane Doe, Thoreau and Muir. Where Thoreau owners may have primary objectives outside timber management, the two goals are not necessarily mutually exclusive. However, Muir owners wish to allow nature to take its course and programs requiring active management are likely to result in failure. The authors believe the segmentation approach offers explanation on otherwise confusing patterns in program participation. They also note the distinct differences in regard to management attitudes, objectives and participation in programs and the necessity to consider this information when crafting and evaluating policies.

Serbruyns and Luyssaert (2006) examined private forest owner's feelings and likelihood of changing behavior under different policy alternatives. The authors identified four different groups on which their analysis focused: profit-seekers, satisfied recreational, dissatisfied recreational and materialistic. The study examined the differences between policy tools such as "sticks" (regulation), "carrots" (incentives) and "sermons" (information, education or outreach). Different preferences for policy tools were identified by landowner segments. Further, Serbruyns and Luyssaert determined landowners were unlikely to change behavior, but would support programs or policies which reflected current management attitudes and activities. NIPF owners have participated and supported programs which aligned with their objectives and avoided those which are divergent. Thus, it may not be program characteristics which affect group participation, but a landowner's objectives for their forest property.

Finley and Kittridge (2006) highlighted the failure of programs in Massachusetts to reach a large proportion of forest-owners. Much of this failure could be attributed to not taking into account NIPF segment differences. Likewise, differences in participants across programs have been noted (Potter-Witter, 2005). Further, the participation of landowners in government offered programs was affected by a landowner's beliefs and attitudes (Serbruyns and Luyssaert, 2006). Landowner groups have a different set of beliefs and objectives regarding their forested parcel (Butler et al., 2007).

Finally, programs and information are products which are attempting to reach a customer, the landowner. Therefore, understanding the landowner is essential to program and extension success.

This study seeks to examine NIPFs at a finer scale in hope of refining landowner groups for future analysis, outreach development and program creation. The study is organized as a series of two papers, each examining NIPF owners at a different scale. Both papers utilize information obtained from a 2003 survey of Michigan NIPF owners. The survey instrument was designed to determine parcel characteristics, demographics, reasons for owning forest property, past management activities, preferences for policies and programs and the past utilization of extension and outreach materials.

The first paper breaks NIPF owners into categories based on location. The paper identifies regional differences in landowner demographics, parcel characteristics, reasons for owning forestland and management activities. Regional differences may be the result of many different factors and landowner characteristics which are not determinable by this study. However, the presence of these differences indicates the potential of policies to affect regions differently.

The second paper uses market segmentation to identify different sectors of NIPF owners in Michigan. The segments are developed based on survey respondent rankings of 11 reasons for owning forestland. The result is three distinct segments of Michigan NIPF owners based on their reasons for owning forest parcels. Differences between these segments in regards to management activities, demographics, parcel characteristics and perceptions of potential programs are discussed to aid policy-makers in future development.

The information contained within this examination of NIPF owners will be useful to extension and outreach managers, policy-makers and researchers. Extension specialists can utilize this information to create outreach materials and information sources which are targeted to specific landowner groups. Policy-makers will want to examine the issues associated with landowner segments or regional differences where they seek even distribution of incentives or programs. Researchers will

continue to examine NIPF landowners and their behavior, especially in regards to timber production or providing of ecological services. The information contained within this study may help future studies to dissect landowners into more readily manageable categories. Regardless of how this information is utilized, it describes methods in which the issue of heterogeneity associated with the NIPF category may be managed.

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Paper 1.

Regional Variation of Michigan's Non-Industrial Private Forest Owners

1.1 Introduction

The state of Michigan has begun pursuing the development of alternative energy programs, specifically in wood-based bio-energy (Michigan Department of Labor and Economic Growth, 2006). However, wood production from both state and federal lands is currently utilized in Michigan's existing wood products industry (Mueller et al., 2010). Subject to public review and comment, harvest levels on public lands are planned for five to ten year intervals. Consequently, timber output on public land is not expected to change. Private lands, therefore, are receiving renewed attention with respect to their willingness to provide wood fiber for bio-energy uses.

Michigan contains approximately 19.2 million acres of timberland, or forest land “which is producing or capable of producing more than 20 ft³ per acre per year of industrial wood” (FIA, 2008). Leatherberry et al. (1998) estimated that there were 384,700 Non-Industrial Private Forest (NIPF) owners holding an estimated 8.8 million acres, or 47.3% of Michigan timberland. While such a large percentage of Michigan's timberland is owned by private landowners, the NIPF subcategory has been used to categorize a diverse array of forest parcels (Argow, 1996). Therefore, there is large variation among the population of NIPF landowners with respect to their demographic characteristics, forestland attributes and management behavior.

Certain characteristics have been used to predict forest management behavior. Straka et al (1984) described relationships between parcel size and forest management. Specifically, the size of a forest holding was positively related to management intensity. A study by Cleaves and Bennett (1995) in Oregon corroborated these results. Other factors such as length of ownership, presence of existing structures and absenteeism have also been found to be correlated with forest management decisions

(Vokoun et al., 2006). On the other hand, absenteeism and non-hunting recreation were negatively correlated with a landowner's decision to harvest whereas parcel size, landowner debt, stumpage price and landowner age had a positive relationships (Conway et al., 2003). Decidedly, the most important factors for determining a landowners management behavior may be absenteeism and parcel size (Conway et al, 2003; Vokoun et al, 2006).

Opportunities for cost-sharing, technical assistance and property tax reduction have been utilized to encourage timber output and support responsible forest management at both state and federal levels. The effects of these policies have varied by program and group (Potter-Witter, 2005). In Michigan, landowners may receive tax reductions for enrolling forestland as “Commercial Forests”. The program requires a tract of at least 40 contiguous acres on which landowners are willing to allow non-motorized recreation (Natural Resources and Environment Protection Act, 1994). Landowners also have the opportunity to enroll their forestland as a “Qualified Forest Property”. This program requires 20 contiguous acres and an approved management plan. While no public access is required, there can be significant costs to landowners who withdraw lands from the program (Qualified Forest Program, 2006). Considering nearly a quarter of Michigan's landowners hold parcels of less than 50 acres, forest management on a large amount of Michigan's lands may not currently be addressed.

Policy makers are interested in effectively directing conservation and management programs on private forestlands to meet societal objectives (Serbruyns and Luyssaert, 2006). Yet this requires information on factors affecting landowner's willingness to consider enrollment in these programs. Demographic factors alone have been unable to adequately explain forest management behavior on NIPF lands (Potter-Witter, 2005). Other research has suggested that absentee ownership, forest parcel size and non-timber use preferences may be important in predicting management activities (Egan, 1997; Cleaves and Bennett 1995). Furthermore, another large contributing factor is a landowner's reasons for owning forested property (Karpinnen, 1998). Societal, economic and ecological factors

vary across Michigan so it is reasonable to expect NIPF characteristics and landowner behavior to differ as well.

1.2 Study Objectives

The factors affecting private landowner behavior are quite complex (Dennis, 1989). Absentee ownership, forest parcel size, and non-timber preferences have all been studied in efforts to more accurately predict NIPF behavior (Egan, 1997). Various degrees of correlation have been found for a number of characteristics (Peterson and Potter-Witter, 2006; Vokoun et al., 2006; Cleaves and Bennett, 1995; Straka et al., 1984), but many of these have not been examined at regional levels. Many research questions concerning economics and societal impacts on ecosystems are discussed by region; therefore, it is important to examine landowner beliefs and decision processes at the same scale.

This study seeks to test the null hypothesis that Michigan regions – the Southern Lower Peninsula (SLP), Northern Lower Peninsula (NLP), Eastern Upper Peninsula (EUP) and Western Upper Peninsula (WUP) – do not differ in regards to management behavior, reasons for owning forestland, landowner demographics or parcel characteristics. The analysis focuses on seven forest management activities and eleven reasons for owning forested parcels. The examination of regional differences could aid policy makers in developing programs and incentives which more adequately target their private forest goals in Michigan.

1.3 Study Methods

In 2003, a survey of Michigan nonindustrial private landowners was conducted. The survey instrument was based on a review of similar studies in the United States, especially those conducted by the USDA Forest Service (Birch, 1996; Leatherberry et al., 1998) and an earlier examination of Michigan landowner assistance programs (Potter-Witter, 2005). The instrument included questions on

demographics, parcel characteristics, reasons for owning forested property, assistance programs and management activities.

The sample consisted of 1,600 randomly selected Michigan landowners stratified by number of NIPF parcels in each region. Since no database of Michigan forest owners was available, parcels were randomly selected for inclusion in the survey. First, a legal section of township was randomly selected. If aerial photography determined at least 50% of the section was forested, it was included in the sample frame. County and township tax rolls were consulted to obtain mailing addresses for all landowners within the specified section. Based upon Leatherberry's (1998) estimates of the number of NIPFs in Michigan and in each region, the target sample size was set at 0.05% of forest parcels and was stratified such that 204, 235, 706 and 455 owners of WUP, EUP, NLP and SLP properties comprised the mailing list. Using Dillman's (2009) Total Response Method, follow up postcards were sent to remind those who had failed to respond. In total, 457 usable surveys were returned for a total response rate of 28.25% (Table 1.1). Adjusted for each region, response rates were 26.1% in the SLP, 30.4% in the NLP, 28.5% in the EUP and 27.9% in the WUP.

Table 1.1 Survey response rate by region.

	Mailed	Returned	Response
Statewide	1600	457	28.25%
SLP	455	119	26.2%
NLP	706	214	30.3%
EUP	235	67	28.5%
WUP	204	57	27.90%

To corroborate this survey, it was compared against results obtained by the National Woodland Owner Survey (2009). Age, income, gender, primary residence location and parcel size were extracted and compared to the earlier results. For the tested factors, no significant differences were detected.

The data was examined for measures of central tendency, frequency and distribution. Exploration revealed possible regional variations to examine statistically. Missing or extreme values identified in exploratory analysis were corrected, where possible, by consulting the original surveys. Where a response could not be determined with certainty, it was omitted. Extreme values corroborated by the original survey were retained.

Statistical tests were performed in R (R Project: <http://www.r-project.org>). Exploratory analysis revealed age and tenure as normal, continuous variables. For this case, a student's t-test was used to compare regions. The remainder of the variables of interest were found to be non-normal. More often than not, responses were bi-modal. A Chi-squared test was used for gender, education, income, employment and management activities, as these are all either binary or categorical. The Wilcoxon-ranked-sum test was used for variables such as importance of reasons for owning forested property, distance from nearest forested parcel and forest parcel size categories. While these are not continuous, they are measured on a scale and therefore such a test is more sensitive to deviations from normality.

1.4 Results

1.4.1 Characteristics of Michigan NIPF lands

The average age for all respondents was 58 and 82.3% were male. Most respondents reported acquiring “some college” education and nearly all (96.6%) had obtained a high school diploma. The majority (51.0%) of respondents were employed full time and the remaining 37.1% were retired. The median income for Michigan forest owners was \$40,000-59,999 and 45.5% resided on their forested parcel.

Across all regions, 56.6% Michigan landowners considered “to enjoy beauty or scenery” as a “very important” reason for owning forestland. Additionally, “for land investment” and “to pass land on to my children or other heirs” were seen as “somewhat important.” Respondents were neutral on “for production of firewood or biofuel (energy).” Finally, “for recreation other than hunting or fishing” was “somewhat important” across all regions. While this information can be useful in determining characteristics of Michigan landowners, this analysis focuses on differences among Michigan's geographic regions.

1.4.2 Regional demographic comparison

Landowners in the WUP tended to have a higher formal education than those in the NLP or EUP (Table 1.2). Educational differences between the EUP and NLP were exhibited in a slightly higher amount of formal education obtained in the NLP. In regards to employment, more EUP respondents were employed part time or seasonally compared to those in the SLP who were more often retired or employed full-time. It is important to note, terms such as “NLP landowners,” “landowners in the WUP” or “EUP respondents” refer to where the parcel is located, and the landowner in question may not live in the same region, or even the same state.

Table 1.2 Median demographic and parcel characteristics by Michigan region.*

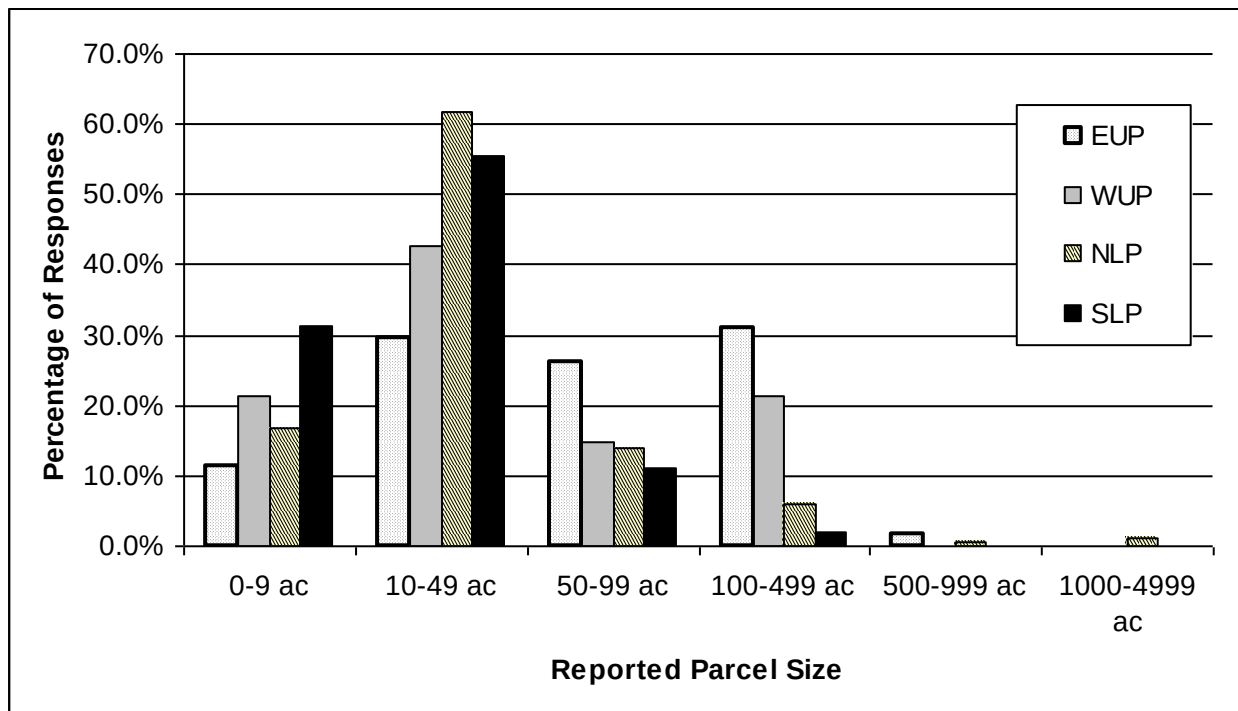
Variable	SLP	NLP	EUP	WUP
Landowner age**	59 ^a	57 ^a	57 ^a	57 ^a
Gender (percent male)	84.8% ^a	80.2% ^a	83.3% ^a	83.9% ^a
Education	Some college ^{abc}	Some college ^a	Some college ^b	Bachelors degree or equivalent ^c
Income	\$40,000-59,999 ^a	\$40,000-59,999 ^{ab}	\$40,000-59,999 ^{ab}	\$60,000-74,999 ^b
Employment [^]	Employed full time ^a	Employed full time ^{ab}	Employed full time ^b	Employed full time ^{ab}
Tenure**	30 years ^a	25 years ^b	28 years ^{ab}	26 years ^{ab}
Forest size category	10-49 acres	10-49 acres	50-99 acres	10-49 acres
Permanent residence (percentage)	67.9%	35.7% ^a	44.8% ^a	40% ^a
Distance	15 miles ^a	82.5 miles ^{bc}	25.5 miles ^{ab}	101.5 miles ^c

*Like superscripts denote no significant difference between regions. ** Mean was used to report average response. ^ Mode was used to report average response.

SLP respondents held their forest parcel longer than those in the NLP (Table 1.2). Additionally, more SLP landowners resided on their forested parcel than did those in other regions. Further, SLP landowners lived closer to their nearest parcel than those in the NLP or WUP, while WUP respondents lived furthest. A higher incidence of agricultural land was reported by SLP respondents compared to those in other regions. Considering that many farms tend to be residences, this may explain the higher percentage of permanent residences and close proximity to owned forest land found in the SLP.

All regions were significantly different regarding forest parcel size (Table 1.2). The NLP contained the largest parcels sampled with 1.1% in the 1000-4999 acre category (Figure 1.1). However, the EUP contained the largest median forest parcels with 32.7% of parcels larger than 100 acres. Conversely, the SLP contained the most small parcels with 86.9% less than 50 acres in size. In general, the Upper Peninsula contained more parcels in the 50-99 acre and 100-499 acre categories whereas the Lower Peninsula was comprised of more parcels in the 10-49 acre category. This difference was obtained since the parcel size categories are not normally distributed, and in fact are distributed quite differently from each other. Wilcoxon Ranked Sum takes distribution into account when determining whether two samples are from the same population.

Figure 1.1 Histogram of parcel size category by region.*



**For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation.*

1.4.3 Importance of reasons for owning forestland

SLP respondents ranked “to protect nature and biologic diversity” as a more important reason for owning forestland than those in the EUP (Table 1.3). In the SLP, 74.0% of respondents considered “as part of my home, vacation home, farm, or ranch” as a “very important” reason for owning forested property compared to 56.0% in the WUP and 58.2% in the NLP. Additionally, NLP respondents indicated “for cultivation/collection of non timber forest products” as more important than SLP landowners. EUP respondents reported “for production of sawlogs, pulpwood, or other timber products” as more important than other regions. Where 44.4% of EUP respondents claimed this factor as important, only 26.9% of those in the WUP, 29.7% in the NLP and 31.2% in the SLP provided

similar responses. Further, NLP respondents reported “for hunting or fishing” was a more important reason for owning forested property than those in the SLP or WUP. Likewise, EUP respondents considered the same reason as more important than those in the WUP. Finally, all regions felt “for recreation, other than hunting or fishing” was “somewhat important”.

Table 1.3 Median response of importance of reason for owning forestland by region.*

Reason for owning forestland	SLP	NLP	EUP	WUP
To enjoy beauty or scenery	Very important	Very important ^a	Very important ^a	Very important ^a
To protect nature and biologic diversity	Very important ^a	Very important ^{ab}	Somewhat important ^b	Very important ^{ab}
For land investment	Somewhat important ^a	Somewhat important ^a	Somewhat important ^a	Somewhat important ^a
As part of my home, vacation home, farm, or ranch	Very important ^a	Very important ^b	Very important ^{ab}	Very important ^b
For privacy	Very important ^a	Very important ^a	Very important ^a	Very important ^a
To pass land on to my children or other heirs	Somewhat important ^a	Somewhat important ^a	Somewhat important ^a	Somewhat important ^a
For cultivation/collection of non timber forest products	Neutral ^a	Somewhat unimportant ^b	Neutral ^{ab}	Neutral ^{ab}
For production of firewood or biofuel (energy)	Neutral ^a	Neutral ^a	Neutral ^a	Somewhat Unimportant ^a
For production of sawlogs, pulpwood or other timber products	Somewhat unimportant ^a	Somewhat unimportant ^a	Neutral	Somewhat unimportant ^a
For hunting or fishing	Somewhat important ^{ac}	Very important ^b	Very important ^{ab}	Somewhat important ^c
For recreation, other than hunting or fishing	Somewhat important ^a	Somewhat important ^a	Somewhat important ^a	Somewhat important ⁻

*Like superscripts denote no significant difference.

1.4.4 Performance of management activities

Finally, the regional differences in management activities were compared. Few significant differences were found among regions except for those activities generally performed in conjunction with timber production. A greater number of EUP landowners cited “improved an existing stand for timber” than those in any other region (Table 4) and was significantly different from SLP landowners. Additionally, more EUP landowners had “built or improved access road or trail” than those in the NLP. Moreover, a greater number of EUP and WUP respondents have harvested timber than those in the SLP. No differences were detected among other management activities.

Table 1.4 Percentage of respondents performing management activities by region. *

Management activity	SLP	NLP	EUP	WUP
Planted trees for timber, wildlife, or environmental protection	47.8% ^a	53.6% ^a	42.5% ^a	42.9% ^a
Harvested firewood	58.7% ^a	53.6% ^a	51.1% ^a	48.6% ^a
Improved an existing stand for timber	37.9% ^a	48.9% ^{ab}	61.5% ^b	48.6% ^{ab}
Fenced livestock or deer out of forested land	15.1% ^a	5.1% ^a	17.9% ^a	11.1% ^a
Built or restored a wetland or pond	10.7% ^a	11.7% ^a	5.4% ^a	7.7% ^a
Built or improved access road or trail	22.2% ^{ab}	16.5% ^a	37.0% ^b	23.7% ^{ab}
Harvested timber	37.7% ^a	49.6% ^{ab}	73.2% ^b	52.6% ^b

**Like superscripts denote no significant difference.*

1.5 Discussion and Conclusion

This analysis highlights differences in NIPF forest owners across Michigan's regions. Specifically, the SLP had a higher degree of agriculture as well as a majority of non-absentee

landowners, suggesting many of the forest parcels may be influenced by agricultural uses. Additionally, the higher population density in southern Michigan (Michigan Information Center, 2001) may influence forest property and landowner characteristics in this part of the state. The lack of participation in forest management activities is consistent with our findings that SLP landowners find non-consumptive uses of their forest property as more important factors for ownership.

Northern Michigan is known for its many summer cottage retreats and vacation homes (Stewart and Styne, 2006). The amount of absentee landowners and greater distance from nearest forest parcel corroborate these findings. The ranking of reasons such as “for hunting or fishing” and “for recreation other than hunting or fishing” further indicate the potential leisure usage of these properties. The relative proximity to SLP population centers and low population densities make the NLP ideal for summer retreats.

In contrast, the incidence of management activities and the higher rating of “for the production of sawlogs, pulpwood, or other forest products” separate the EUP as one of the more unique regions. The high occurrence of absentee landowners suggested some of the same dynamics as the NLP, however the EUP tends to be further from metro-Detroit than convenient for weekend cottage use. Considering 50% of EUP landowners live 25.5 miles or closer to their forest property, it is far more likely many of these landowners live elsewhere in the region. While interesting, further research is needed to pinpoint the cause of differences compared to other regions.

Finally, the WUP was very similar to the NLP regarding private forest owners. However, WUP landowners obtained more formal education than those in the NLP and these landowners considered hunting and fishing was more important for owning forest property. Other similarities suggested many of the same factors which drove NLP ownership may have influenced NLP properties in the WUP. Specifically, the degree of absentee ownership and distance to forest parcel suggest many WUP landowners may have traveled from other mid-west population centers in the pursuit of vacation or

cottage properties.

The regional differences tended to be centered around specific categories of ownership factors. For example, where all regions consider bequeathing their land to their heirs and non-hunting recreation as equally important, regions can be more adequately distinguished based on the importance of consumptive reasons for owning forest property such as timber production, hunting or fishing, or biologic protection. These results indicated the possibility of a “spectrum” of forest ownership with consumptive uses on one end and biologic protection on the other. Considering that preservation and consumptive uses of forest parcels may be seen by landowners as exclusive or contrary to other objectives, this can be expected. Future research could create useful indicators or predictor variables for determining where on the spectrum landowners may fall.

This analysis is limited to reasons for owning forested parcels, basic parcel and landowner characteristics and past performance of management activities. Regarding NIPF landowners, chief interest has been in determining their willingness to produce timber (Egan, 1997). While a statement can be made regarding past management activities, past management decisions do not have a clear effect on future ones. Interesting future analyses could attempt to determine exogenous factors relating to a landowners willingness to harvest on a regional scale. Since stumpage price and other harvest factors vary geographically, such a study could present useful information in further determining, at a finer scale, a landowners decision process regarding forest management.

1.5.1 Policy Implications

In a state as diverse as Michigan, it is not surprising that factors describing private landowners and their parcels differ geographically. Where past research and policies have described an entire state, this study reports unique differences and motivations by region. While the driving forces behind this variation require further examination, it retains important implications for forest policies and programs.

NIPF owner's personal beliefs and objectives have been shown to influence participation in a variety of forest management programs (Serbruyns and Luyssaert, 2006). Ownership objectives greatly influence a landowners willingness to participate in government sponsored programs (Janota and Broussard, 2008). Erickson et al. (2002) point that modern forest policies must strive to target wide bases of forest owners by offering assistance or incentives consistent with a landowner's reasons for owning forestland. Such reasons are not often financial (Erickson et al., 2002; Beach et al., 2003). Therefore, where landowners' objectives and forest parcel characteristics differ geographically, we can expect behaviors, including participation in management and conservation programs, to vary as well.

Considering Michigan's recent investigation of wood-based alternative energy, we can anticipate increased pressure on private lands to produce wood fiber. Since financial incentives are ineffective motivations for conducting forest management (Erickson et al., 2002; Beach et al., 2003), policy makers may wish to examine new methods of encouraging participation in government programs. Where we have illustrated geographic variation among NIPF lands, past researchers have examined the relationships between landowners and participation in activities. These factors suggest Michigan policy-makers must seek to develop policies which take into account regional variation if they hope to produce more effective participation in forest management incentives and programs.

Since policy objectives are not often regional in nature, these differences could have profound implications for their effects and success. Where one region may be likely to participate in a proposed program or incentive, another may fail to actively enroll. Such disconnects in forest management can only contribute to differences in forest management patterns and practices. Therefore, policy-makers will wish to carefully consider regional differences when developing policies across large geographic areas to avoid problems of inequality or potential forest fragmentation.

Knowing differences in regional forest management, policy makers could craft programs specifically designed to utilize this variation to their advantage. Performance of management activities

could be influenced by utilizing landowner characteristics endogenous to specific regions. For example, where landowners consider “for biologic protection” as an important reason for owning property, programs could be designed that utilize a landowners interest in bio-diversity or wildlife habitat to stimulate specific objectives. Programs which are more aligned with a landowner's value of land might go a long way in increasing participation in these regions.

Regardless of objectives, policy-makers should strive to understand all possible effects of their programs to avoid unintended consequences. While this study presents one way of looking at NIPF landowners, some questions remain unanswered. For instance, perhaps there is potential for participating in various policies or government programs based on reasons for owning forested land. Further, since financial incentives are not always effective at influencing landowners, what policy methods may be more attractive to certain landowner groups? Or, based on reasons for owning forest property, how have landowners viewed management activities which they have performed? Would they conduct them again? Future research could shed light on these issues and provide further information to guide policy analysis and creation.

As our world continues to change, we can expect society to place increased demand for multiple uses on our nation's forestland. Considering the extent of private land control of our forests, it is ever more important we continue to seek to understand the NIPF owner. While NIPF landowners have proven to be quite complex, certain factors can help facilitate in the further clarification of their motivations. Regardless of whether we wish to encourage NIPF landowners to harvest timber, or provide further recreation services, it may be time to dissect the category and look at this unique sector of forestland at a finer scale. Perhaps then, we will begin to understand the elusive NIPF owner.

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Paper 2.

A market segment approach to identifying Michigan nonindustrial private forest owners

2.1 Introduction

The state of Michigan contains 19.2 million acres of timberland, or forestland which is “capable of producing 20 ft³ of wood fiber annually” (FIA, 2008). Michigan's forestland plays an important role in sustaining the timber industry, outdoor recreation and tourism industries as well as in developing the state's natural character (Leatherberry et al., 1998). In fact, the Michigan timber industry accounts for approximately 10% of the state's manufacturing jobs and an estimated \$12 billion in annual revenue (Korpi, 2010). Michigan's tourist industry is estimated to contribute an additional \$11.5 billion in annual revenue (Stynes, 2002) and much of this is centered on the state's bountiful natural resources. Approximately 47.3%, or 8.8 million acres, of Michigan's timberland is controlled by an estimated 384,800 nonindustrial private forest (NIPF) owners and as much as 49% of Michigan's timber products originate from private lands (GC and Potter-Witter, in press). Each landowner may have different objectives and goals for his or her timberland, which can lead to a patchwork of forest management (Best, 2002). Considering this variation, much interest has been dedicated to understanding and influencing Michigan's NIPF owners.

Currently, Michigan has several programs designed to target private forest owners. The Commercial Forest Program (CFP) allows property tax reductions on forested tracts of at least 40 acres which allow open-access to non-motorized forms of recreation (Natural Resources and Environment Protection Act, 1994). Only 2.2 million acres and 1,600 private landowners (nonindustrial and industrial) are currently enrolled in this program (MiDNRE, 2009). Another opportunity for property tax reduction is available through the “Qualified Forest Program” (QFP). This program does not

mandate open-access recreation and requires 20 acres of undeveloped forestland (Potter-Witter, 2008). The potential recapture tax upon withdrawal of land from the QFP can be up to 14 times the *current ad valorem* tax for the property and statewide enrollment is capped at 900,000 acres for the 2010 tax year (MiDNRE, 2009). For CFP, withdrawal penalties may total a maximum of 15 years of *ad valorem* tax (MiDNRE, 1993). While programs differ on some factors including forest parcel size, they both require commitment to a forest management plan (Potter-Witter, 2005). Finally, Michigan offers federal assistance through the Forest Stewardship Program (FSP). This program offers cost-share assistance for the development of a forest management plan (MiDNRE, 2009). However, the FSP does not require management activities and continuation of funding is year-to-year (Potter-Witter, 2005). Regardless of the differences between available programs, enrollment remains a small minority of NIPF landowners.

Participation in programs often varies depending on landowner characteristics (Potter-Witter, 2005). The factors that influence a landowner's performance of management activities can be complex and difficult to pinpoint (Dennis, 1989). Research has shown that financial incentives often have little impact on NIPF lands (Beach et al., 2003; Serbruyns and Luyssaert, 2006). A wide variety of attitudes and beliefs factor into a landowner's decision to perform forest management (Erickson et al., 2002). Lifestyle and amenity choice are often of higher consideration than are financial reasons for owning forested land (Koontz, 2001; Kendra and Hull, 2005). While a landowner may have a variety of reasons for owning forestland, these do not always exclude wood production (Karpinnen, 1998). Instead, landowners may be more selective when choosing management activities, including timber production, which will not affect and can occur along with those objectives he or she deems more important (Karpinnen, 1998). In other words, a landowner seeks compatibility between management activities and their primary land ownership objectives.

The primary objectives of a landowner for his or her parcel are paramount in influencing forest management program participation (Janota and Broussard, 2008). By and large, landowners will adopt

programs which fit with the current usage of their land (Serbruyns and Luyssaert, 2005). NIPF owners are often unwilling to compromise the current objectives for financial incentives or other program benefits (Kline et al., 2000). If policies seek to achieve equal distribution and maximum effectiveness, they must strive to target wide bases of NIPF landowners by offering programs consistent with reasons for owning forest property and management objectives (Erickson et al, 2002). The first step in creating such policies is to identify target landowner groups for inclusion in incentives, programs, or policies.

Cluster analysis regularly is used in marketing research and analysis to identify and describe unique market sectors to facilitate effective product marketing (Hair et al., 2006). Considering that forest management policies are essentially a “product” and policy-makers seek a “customer” to utilize them, this analysis could be useful in identifying potential NIPF landowner sectors. Once identified, future policies or outreach programs could be constructed to meet the demands of each unique landowner sector. Cluster analysis is a relatively new approach to identifying sub-groups of NIPF landowners (See: Karpinnen, 1998; Finley and Kittridge, 2006) and it has yet to be used in defining policy targets in Michigan.

2.2 Study Objectives

Considering low participation rates in Michigan's current forest management programs, identifying key sectors may help in crafting policies with greater reach, accessibility, or influence. This study attempts to identify landowner segments in Michigan for this purpose. Survey data from 2003 was used to identify clusters (alternatively: segments or sectors) of Michigan NIPF landowners based on their reasons for owning forested property. Once identified, these clusters were defined and tested for significant differences in order to provide information for future program construction and administration. The information generated from this study can then be utilized to understand difference in participation rates across programs, or create and alter policies which seek to utilize landowner

segments to achieve specific objectives.

2.3 Methods

This analysis used data obtained from a 2003 survey of Michigan NIPF landowners. The survey instrument was designed to obtain information on landowner and parcel characteristics, reason for owning forest property, management activities and perceptions of management incentives and extension materials (Peterson and Potter-Witter, 2006; Mueller and Potter-Witter, in progress). The survey also sought to determine a landowners' motivation for refraining from conducting harvesting timber. The instrument was mailed to a stratified random sample of 1,600 private forest owners in Michigan. Since no database of Michigan landowners exist, one had to be constructed. First, legal sections were randomly selected. Aerial photographs were then consulted to determine if the section contained at least 50% forest cover. If so, all landowners with more than ten acres of land were added to the database. Stratification was done by region such that 204, 235, 706, 455 surveys were sent to the Western Upper Peninsula (WUP), Eastern Upper Peninsula (EUP), Northern Lower Peninsula (NLP) and Southern Lower Peninsula (SLP) respectively. The construction and distribution of the survey followed the Total Design Method as outlined in Dillman (2009).

This analysis followed a three phase approach to identify specific NIPF owner segments. Segments were constructed based on responses to eleven, five-point Likert scale, questions regarding the importance of reasons for owning forestland. First, principal component analysis (PCA) was performed to reduce the number of variables where correlation existed. PCA is used to examine the underlying structure among variables included in an analysis (Hair et al., 2006). It uses the correlation between variables to make combinations which reduce the number of independent variables in a model but seeks to retain the variance structure of the dataset (Hair et al., 2006). In other words, the number of independent variables is reduced based on correlation with each another. This can help to increase the

interpretability of a dataset without losing substantial amounts of information. Once principal components, representing original variables, were created, PCA was used to generate factor scores for each observation. The scores are a normalized representation of the component based on how a respondent scored the variables associated with the component in question (Hair et al., 2006). The number of components needed to adequately explain data is dependent on the complexity of the dataset. Scree tests, latent root criterion, or prior research knowledge can be utilized to base judgment on component retention (Hair et al., 2006). A Scree test relies on finding a point where no marginal increase in the amount of explained variation is found between one set of components and another (Hair et al., 2006). Latent root criterion seeks to retain the amount of components where the eigenvalue is greater than one (Hair et al., 2006). An eigenvalue of one indicates the component is explaining as much variation as an original variable. As the analysis seeks to combine variables into better representations, the set of component solutions with an eigenvalue greater than one would be retained (Hair et al., 2006).

Second, cluster analysis (CA) was used to create NIPF owner segments based on the reduced independent variables from the PCA. CA is a statistical approach often used in market analysis to identify specific segments (Hair et al., 2006). CA seeks to create “clusters” in which members of one cluster are more similar to each other than they are to members of other clusters (Hair et al., 2006). Segment means are used to group responses which are closest to the center of that “cluster” (Hair et al., 2006). CA analysis attempts to reduce variability of members within a cluster, and increase variability between clusters (Hair et al., 2006). Researchers using CA are searching for natural structures which have descriptive significance, rather than creating artificial structures with statistical power (Hair et al., 2006). To determine the number of clusters, prior information is used or researchers should carefully consider the implications and meaning of potential solutions (Hair et al., 2006).

Once clusters were identified, multiple discriminant analysis (MDA) was used to determine

which factors were most effective in distinguishing each cluster. MDA is a common technique used in the biological sciences to help explain the differences between two or more groups being sampled (McGarigal et al., 2000). MDA utilizes methods similar to regression analysis to create functions which predict an observation's group membership based on utilized measurement scales (Hair et al., 2006). The number of functions developed is one less than the number of groups defined (McGarigal et al., 2000). The first function seeks to explain the greatest amount of variance, where the subsequent functions seek to explain the remainder (McGarigal et al., 2000). As in regression analysis, the function creates coefficients which measure the effects of each variable within that specific function (Hair et al., 2006). These functions are essentially linear combinations of the variables which are used to predict group assignment (McGarigal et al., 2000). The form, is thus:

$$v_j = \beta_{0j} + \beta_{1j}x_{1j} + \beta_{2j}x_{2j} + \beta_{3j}x_{3j} + \dots + \beta_{ij}x_{ij} \quad \text{equation 1.1}$$

Where β_{ij} represents the coefficient of the i^{th} variable for function j , v_j represents the score for function j , and x_{ij} represents the value of that variable for that observation (McGarigal et al., 2000). In this case, the factor scores from PCA can be used as the variables to determine factor effects on group outcome (McGarigal et al., 2000). MDA means can be computed which aid in further explaining the average landowner from that specific segment (Hair et al., 2006). Essentially, this is similar to the “group means” described in CA relative to the discriminant functions.

After MDA was performed and groups were identified, the groups were compared for significant differences. In this study, the comparisons centered on parcel and ownership characteristics as well as on the performance of specific forest management activities. Further, MDA was used to determine the primary ownership reasons which indicate landowner’s association with a specific NIPF

owner segment. The comparison of these factors helped to establish the similarities and differences among NIPF landowners.

After PCA, CA, and MDA were performed, the data were separated into landowner segments. Exploratory analysis was performed on the variables of residency, forest parcel size, management activities, age, education, income and employment to look for measures of central tendency, deviation, average values and normality. Age exhibited a normal distribution, where other variables such as management activities, income, education, employment and absenteeism were either binary or nonparametric. Forest parcel size, due to its non-normal distribution as a larger number of smaller parcels are owned than are large ones, was broken into forest size categories as used in previous research (Birch, 1996; Leatherberry et al., 1998). Significant tests were set at $\alpha = 0.05$. Wilcoxon-ranked-sum was used to test differences in parcel size category between groups where chi-squared was used for all other nonparametric tests. The single normally distributed variable, age, was tested using the Student's t-test. All statistical methods and analyses were performed in R (R project: <http://www.r-project.org>)

2.4 Analysis

2.4.1 Variable reduction using principal component analysis

The 2003 survey asked respondents to report their ratings of importance of eleven reasons for owning forestland. These reasons were “to enjoy beauty or scenery,” “to protect nature and biologic diversity,” “for land investment,” “as part of my home, vacation home, farm, or ranch,” “for privacy,” “to pass land on to my children or other heirs,” “for cultivation/collection of non-timber forest products,” “for production of firewood or biofuel (energy),” “for production of sawlogs, pulpwood, or other timber products,” “for hunting or fishing” and “for recreation, other than hunting or fishing.” Respondents were asked to rank the importance of these reasons on a Likert scale of “very important”

to “not important.”

Often, some Likert-scale variables can be “linked” with one another. This may be the result of questions which measure similar variables, such as core reasons for owning forest property. To reduce the number of variables and simplify the dataset, an exploratory PCA was used to determine the number of components necessary to retain explanatory variance. A Scree test was unable to determine the number of necessary components. Using the latent root criterion, which suggests utilizing the number of components which have an eigenvalue greater than one (Hair et al., 2006), four components were retained. “To pass on land to my children or other heirs” and “for land investment” did not adequately load (<0.50) or cross-loaded on several components (>0.30) and were retained as unique identifiers.

The PCA was performed again, with those variables which inadequately loaded, or cross loaded removed and examined utilizing a varimax rotation. This method rotates the data axis to achieve a greater degree of interpretability (McGarigal et al., 2000). The rotation moves the data axes in order to maximize the similarities within components, and maximize the differences between components. The axes may not necessarily remain at 90 degrees to one another. This allows researchers to more readily determine which variables should be included in each component. Important loadings for each component are represented as numbers closer to one and less important characteristics are represented as numbers closer to zero. A loading of 0.50 generally indicates significance and loadings of 0.20 to 0.50 may signify cross-loading between several components (Hair et al., 2006).

The rotated factor loadings indicate how each variable is represented by the newly created component. These components are generally given names based on the original variables they represent (Hair et al., 2006). The reasons for owning forest property of “as part of my home, vacation home, farm or ranch” and “for privacy” both loaded on principal component one (PC 1) (Table 1). For this reason, PC 1 was named “homestead.” PC 2 held responses related to utilitarian reasons for owning

forestland and was thus named “consumptive enjoyment.” These variables related to utilitarian uses were “for cultivation/collection of non-timber forest products,” “for production of firewood or biofuel (energy)” and “for production of sawlogs, pulpwood or other timber products.” “For hunting or fishing” and “for recreation other than hunting or fishing” loaded on PC 3 which was named “personal recreation.” PC 4 provides the information related to the reasons for ownership “to enjoy beauty or scenery” and “to protect nature and biologic diversity,” therefore it was referred to as the component explaining “preservation.”

Table 2.1 Rotated component loadings and Cronbach's alpha for Principal Components.

Items	Reasons for owning forestland	Rotated principle component scores				Cronbach's Alpha
		Homestead	Consumptive Enjoyment	Personal Recreation	Preservation	
1	As part of my home, vacation home, farm or ranch	0.86	0.05	0.00	0.14	0.64
2	For privacy	0.80	0.08	0.16	0.16	
3	For cultivation/collection of non-timber forest products.	0.22	0.75	0.12	0.05	0.76
4	For production of firewood or biofuel (energy)	0.05	0.84	0.17	0.02	
5	For production of sawlogs, pulpwood or other timber products.	-0.09	0.86	0.05	-0.01	
6	For hunting or fishing	0.00	0.21	0.84	0.00	0.55
7	For recreation other than hunting or fishing.	0.18	0.08	0.75	0.24	
8	To enjoy beauty or scenery	0.36	-0.05	0.09	0.79	0.72
9	To protect nature and biologic diversity	0.04	0.09	0.14	0.90	
10	To pass land to my children or other heirs			Retained as unique variable		
11	For land investment			Retained as unique variable		

Finally, Cronbach's alpha was computed for each PC. Cronbach's Alpha is a measure of reliability which addresses the consistency of a measurement scale (Hair et al., 2006). Based on the Cronbach's alpha, which suggests measures of 0.70 or greater are reliable (Hair et al., 2006), PC 2 and PC 4 were reliable estimates of their combination variables. Due to the low alpha of PC 1 caution was taken when interpreting results associated with this component. Finally, the low alpha associated with PC 3 indicated the need to develop and refine indicators for testing factors representing recreational importance of owning forestland. Regardless, this component was retained for further analysis as it represents an important factor regarding forest ownership that was otherwise unincorporated.

2.4.2 Identifying NIPF owner segments

CA seeks to analyze the heterogeneity of subgroups within a larger NIPF population (Hair et al., 2006). While many studies seek to generalize across NIPF landowners (Egan, 1997; Leatherberry et al., 1998; Conway et al., 2003) only a few have sought to identify specific segments within the NIPF group (Karpinnen, 1998; Finley and Kittredge, 2006).

Based on the six factors (four generated from PCA and two unique variables), the k-means algorithm was used to assign landowners to clusters. In this method, NIPF landowners who exhibited similar characteristics in their reasons for owning forestland were grouped together to form a segment. Note that these “segments” were based on reasons for owning forestland and not on other endogenous or exogenous factors which might influence their characteristics. However, as reasons for owning forestland often influence a landowner's decision process (Conway et al., 2003), these factors do play an important explanatory role in the developed segments. To ensure best results, two-member, three-member, four-member, five-member and six-member clusters were analyzed. Following MDA in the last phase of this analysis, the three-member solution provided results which were consistent with

earlier studies and most easily interpreted in regard to significant differences and unique distinguishing characteristics of the generated segments.

2.4.3 Segment differentiation using discriminant analysis

CA created three segments based on their clustering around six variables (four generated from PCA and two retained as unique variables) which represented the importance of reasons for owning forestland. MDA was used to determine the unique profiles of each segment. This is by the discriminant function which is a linear combination of the descriptive variables which seeks to describe group membership (McGarigal et al., 2000). The first discriminant function explains the most variance, while the second function seeks to explain remaining variance between the included variables and groups. Specifically, MDA was used to examine the impact of each of the six variables on segment membership.

Both discriminant functions (DF) were significant ($p < 0.01$) by their approximate F-value. All included variables were significant in aiding to create the discriminant functions. Associated standardized canonical loadings and rotated discriminant loadings are contained in table 2.2.

Table 2.2 Summary of discriminant analysis and explanatory power of variables used to create clusters.

Discriminant variables	Standardized Coefficients		Discriminant Loadings		Univariate F	
	DF 1	DF 2	DF 1	DF 2	Ratio	Prob.
PC 1 Homestead	0.149	-0.023	0.071	0.065	176.15	< 0.01
PC 2 Consumptive enjoyment	0.656	-0.728	0.905	-0.083	433.96	< 0.01
PC 3 Personal recreation	0.351	0.550	-0.033	0.438	231.56	< 0.01
PC 4 Preservation	0.375	0.330	0.051	0.249	193.54	< 0.01
Item 10 To pass on land to children or other heirs	0.575	0.623	0.180	0.674	329.40	< 0.01
Item 11 For investment	0.265	-0.226	0.265	0.074	198.20	< 0.01

2.5 NIPF owner segments

Discriminant function one, which was dominated by consumptive enjoyment, distinguished among all three segments (Table 2.3). Discriminant function two, which had emphasis placed on recreational uses for forestland and bequeathing land, distinguished between segment one and the other two segments. As a result of the importance of personal recreation exhibited in group 1, illustrated by the group mean and discriminant function, this group was labeled “Game Wardens.” These landowners represented 29.8% of respondents. As illustrated by the discriminant functions, the Game Wardens considered consumptive enjoyment of their forestland as less important than did those in segment three. Due to the relative higher importance of consumptive enjoyment, segment three landowners were labeled “Timber Barons.” Timber Barons represented 46.4% of respondents. Finally, segment two was

distinguished by the lack of relative importance of the factors illustrated in the MDA. From this standpoint, segment two landowners may feel the same towards the importance for owning forestland as do the others, with the exception of the strongly discriminating factors (personal recreation and consumptive enjoyment). These landowners were labeled “Tenants” and comprised 23.8% of respondents.

Table 2.3 Group means at center for NIPF segments on each discriminant function.

NIPF segments	n	Discriminant Function Means	
		DF 1	DF 2
Game Wardens (Segment 1)	104 (29.8%)	-16.53	61.81
Tenants (Segment 2)	83 (23.8%)	-101.16	-34.96
Timber Barons (Segment 3)	162 (46.4%)	51.83	-20.07

It is important to note that the MDA analyzed differences between groups. Where Timber Barons may have been “less interested” in personal recreational uses of their forestland, this does not mean they were altogether uninterested, only that their ranking was different than was that of Game Wardens. Likewise, MDA only measures the ability of the measurement scales to distinguish among groups. Where a specific scale may be unimportant in MDA (ex: homestead or for investment), it could still be a very important reason for owning forest property. Rather than the said factor distinguishing among groups, the importance could be held in common among all groups.

2.5.1 Demographic differences between segments

At 52.9 years old, Game Wardens were the youngest of the landowner segments (Table 2.4). No significant differences existed between landowner segments in regard to education, income or employment. However, Game Wardens were less often permanent residents of their forest property than were the other segments. Tenants resided on their parcel as permanent residents more often than did those in other groups.

Table 2.4 Demographic characteristics of NIPF landowner segments.

Item	NIPF segments		
	Game Wardens (Segment 1)	Tenants (Segment 2)	Timber Barons (Segment 3)
Respondent Age	52.9	57.2 ^a	55.4 ^a
Education	Some college ^a	Some college ^a	Some college ^a
Income	\$60,000-74,999 ^a	\$60,000-74,999 ^a	\$40,000-59,999 ^a
Employment	Employed full time ^a	Employed full time ^a	Employed full time ^a
Absent Ownership	34.6%	54.2%	43.8%

Like superscripts denote no significant difference.

Additionally, Game Wardens tended to hold smaller forest parcels than did Timber Barons, where Timber Barons held the largest forest parcels (Table 2.5). Game Wardens held no parcels greater than 500 acres in size, while both of the other segments did so. Considering that recreation values can be achieved on relatively small parcels (Zhang et al., 2005), there may not be a strong incentive to own large parcels when recreation is the prime reason for owning forestland. Conversely, utilitarian uses of forest property often require large parcels (Cleaves and Bennett, 1995). Timber Barons also held significantly larger parcels than did Tenants. Again, this could be an indication towards the necessity of Timber Barons to own larger parcels to meet their objectives, than a statement regarding Tenant behavior.

Table 2.5 Forest parcel size by NIPF owner segment.

NIPF segments	Forest Parcel Size					
	0-9 acres	10-49 acres	50-99 acres	100-499 acres	500-999 acres	1000-4999 acres
Game Wardens ^a (Segment 1)	25.3%	53.8%	12.1%	8.8%	0.0%	0.0%
Tenants ^a (Segment 2)	28.8%	49.3%	12.3%	6.8%	2.7%	0.0%
Timber Barons (Segment 3)	11.6%	52.1%	19.2%	15.8%	0.0%	1.4%

Like superscripts denote no significant difference.

2.5.2 Participation in management activities

All management activities except “fenced livestock or deer out of forested land” were significantly different by NIPF owner segment. Game Wardens had “planted trees for timber, wildlife, or environmental protection” more than had Tenants, but less than Timber Barons (Table 2.6). Conversely, fewer Game Warden respondents that they had harvested firewood than did other segments. More Timber Barons had harvested timber and conducted a timber stand improvement than had other landowner segments. However, where more Game Wardens had conducted timber stand improvements than Tenants, fewer Game Wardens had harvested timber.

The disconnect between managing for timber, as illustrated by performance of timber stand improvement, versus actual timber production is perplexing. It is possible that the survey question measuring responses was unclear, or that Game Wardens were considering habitat management or firewood collection a form of “timber improvement.” Finally, current Game Warden property owners may have the desire to produce timber, but have not yet conducted a harvest. The survey instrument did not require information on intentions; as such, we can only speculate on the reasons for this result.

Additionally, Game Wardens had “built or restored a wetland or pond” and “built or improved access road or trail” more than had Tenants, but less than had Timber Barons. Tenant respondents

reported having “harvested firewood” and “harvested timber” more than did Game Wardens. This may indicate a stronger inclination to “preserve” forestland in the Game Warden segment than that in Tenants. Where Game Wardens tended to participate in restoration activities more than did Tenants, Tenant NIPF owners seemed to participate more often in management activities which were centered on utilization of their forestland.

This result contradicts that of the MDA where Tenants placed less emphasis on consumptive enjoyment of their forestland than did other segments. However, while Tenants may have considered “consumptive enjoyment” as less important than did other segments, this does not mean that they did not partake in active management. Where these activities may not have been important reasons for owning forestland, at least relative to other segments, “Tenants” could have viewed it as an active part of owning forestland

Table 2.6 Performance of management activities (percent) by NIPF owner segment.

Management Activity	NIPF segments			χ^2 , prob
	Game Wardens (Segment 1)	Tenants (Segment 2)	Timber Barons (Segment 3)	
Planted trees for timber, wildlife, or environmental protection	65.1%	54.0%	78.8%	10.9, < .01
Harvested firewood	50.7%	55.8%	82.6%	25.1, < .01
Improved an existing stand for timber	44.7%	23.3%	68.3%	26.8, < .01
Fenced livestock or deer out of forested land	12.1%	2.5%	16.2%	4.7, 0.09
Built or restored a wetland or pond	20.3%	15.9%	43.7%	14.8, < .01
Built or improved access road or trail	51.4%	36.7%	66.1%	12.4, < .01
Harvested timber	36.8%	40.4%	68.6%	30.4, < .01

2.5.3 Reasons for owning forestland

While MDA illustrates the relative differences of the measures among segments, it does not report the overall importance of the measures. An examination of the absolute ranking of importance for reasons for owning forestland by landowner segment provides more insight into the importance of the measures for each group. The median responses to each of the original 11 measures are reported in Table 2.7.

Table 2.7 Median importance of reasons for owning forestland by NIPF owner segment.

Reasons for owning forestland	NIPF owner segments		
	Game Wardens (Segment 1)	Tenants (Segment 2)	Timber Barons (Segment 3)
As part of my home, vacation home, farm or ranch	Very important	Somewhat important	Very important
For privacy	Very important ^{ab}	Somewhat important ^a	Very important ^b
For cultivation/collection of non-timber forest products	Not important ^a	Not important ^a	Neutral
For production of firewood or biofuel (energy)	Not important ^a	Somewhat unimportant ^a	Somewhat important
For production of sawlogs, pulpwood or other timber products	Not important	Not Important	Somewhat important
For hunting or fishing	Very important ^a	Neutral	Very important ^a
For recreation, other than hunting or fishing	Very important ^a	Neutral	Somewhat important ^a
To enjoy beauty or scenery	Very important ^a	Very important	Very important ^a
To protect nature and biologic diversity	Very important ^a	Somewhat important	Very important ^a
To pass on land to my children or other heirs	Very important ^a	Somewhat unimportant	Somewhat important ^a
For land investment	Somewhat important ^a	Neutral ^a	Somewhat important

Like superscripts denote no significant difference.

Game Wardens considered all measures of reasons for owning forested property as important

with the exception of those factors within Consumptive Enjoyment. Conversely, only “to protect beauty or scenery,” “to protect nature and biologic diversity,” “for privacy” and “as part of my home, vacation home, farm or ranch,” factors which loaded on the homestead and preservation components, were important to Tenant landowners. The reasons for owning forestland which fell into the consumptive enjoyment component, “for cultivation/collection of nontimber forest products,” “for production of firewood or biofuel (energy),” and “for the production of sawlogs, pulpwood or other timber products,” were more important for Timber Barons than they were for other segments. These results reinforced that of the MDA. Note, factors which were not important in distinguishing Timber Barons were cited as being more important than were utilitarian reasons for owning forest property. Again, recall that MDA only showed which factors were influential in distinguishing between clusters, but made no claims on the absolute importance of these variables to landowners. As such, table 2.7 shows factors which did not show strongly in MDA, but were considered “Very Important” to landowners.

2.5.4 Landowner segment perception of policy tools

To determine potential policy effects across landowner groups in Michigan, and to provide information to aid in future policy creation, differences among landowner desires for incentives or programs were examined (Table 2.8). Those landowners most actively interested in managing their forestland (Game Wardens and Timber Barons) liked the idea of “free or low-cost management assistance or professional advice” and “free or low cost educational materials” more than did the Tenants who expressed less interest in forest management activities. Financial incentives were more largely supported by Timber Barons than they were by other landowner groups. Tenants did not consider financial reasons as important in aiding to meet their management goals with the exception of “cost-share.” However, other financial incentives measured in the survey were tailored towards timber management, where Tenants could be more interested in habitat management or improving

biodiversity. All landowners were supportive of “property tax reductions for management forest lands,” however the meaning of “management” likely differed by landowner group.

Table 2.8 Importance of incentives and programs to aid landowners in meeting forestland ownership objectives.

Incentives to encourage forest management	NIPF Owner Segments		
	Game Wardens (Segment 1)	Tenants (Segment 2)	Timber Barons (Segment 3)
Free or low-cost management assistance or advice from a natural resource professional	56.2%	35.2%	55.6%
Free or low-cost educational materials or events on forest management	54.8%	45.9%	57.7%
Income tax deductions or credits for management expenses	58.5% ^{ab}	30.6% ^a	63.2% ^b
Property tax reductions for managed forest lands	66.3% ^a	61.0% ^a	72.6%
Low interest loans to help pay for management expenses until forestry income is achieved	20.1% ^a	9.8% ^a	26.6%
Cost-sharing assistance to help pay for forest management	20.1% ^a	24.2% ^a	44.4%
Annual rental payments to provide income while trees mature	26.9% ^a	15.8% ^a	36.1%
Higher payments for my timber	25.3% ^a	24.5% ^a	58.9%

Like superscripts denote no significant difference.

2.6 Discussion

The NIPF category of U.S. landowners has always been the target of research and policies since colonial times (Binkley, 1981). Much of this can be attributed to the difficulty in understanding or characterizing private landowners due to the diversity contained within the group. This analysis, however, indicates that it is possible to combine NIPF landowners into segments for which the variability within the group is less than that between groups. Statistical analysis indicates that some landowners may have specific traits in common with one another, and thus these land owners can be

grouped into identifiable segments. This brings into question the wisdom of utilizing one “catch-all” group to describe NIPF landowners. Perhaps, instead, policy-makers and researchers should consider analyzing NIPF ownership at a finer scale in order to effectively understand this ownership group.

A few specific factors seem to be key in distinguishing among private landowners. Identifying these factors is integral to understanding NIPF ownership in Michigan. Where traits such as homestead and preservation are held in common across Michigan NIPF owners, consumptive enjoyment, recreation, and bequeathing land are quite polarizing and aid in distinguishing among particular ownership groups. While these differences do not illustrate the absolute importance of these factors to particular landowners, they do illustrate relative differences between each segment; differences which may be important in understanding landowner behavior. While Timber Barons found consumptive enjoyment of their forestland to be more important than did other NIPF subgroups, it was still relatively unimportant compared to other ownership factors. “For privacy”, “as part of my home, vacation home, farm or ranch” and other characteristics were cited as more important than were the factors which comprise “consumptive enjoyment.”

Timber Barons reported being the most active in managing their forestland (Table 2.6). This was consistent with the higher importance they placed on consumptive enjoyment of their forestland. These landowners may have similar objectives to other segments, but understand the potential of stewardship to meet their objectives and retain the health of their forest system. Perhaps Timber Barons saw compatibility between consumptive enjoyment and other reasons for owning forest property where other segments saw such as divergent. While the absolute reason for such differences is not known, the characteristics of this group can aid in understanding their motivations and behavior.

Game Wardens also tended to take an active role in managing their land. More of these landowners had performed all activities, with the exception of “harvested timber” and “harvested firewood” than had Tenants. The high importance placed on recreational value of their timberland may

influence Game Wardens to actively manage their land for such purposes. The enjoyment of wildlife and nature may have driven these landowners to create nature trails, restore wildlife habitat, or perform other activities related to forest recreation.

Finally, Tenants actively managed their land less than did other NIPF owner segments. Conversely, these landowners performed activities that can be related to consumptive enjoyment (“harvested firewood” and “harvested timber”) more often than did Game Wardens. Perhaps these activities offer a direct tangible benefit and were thus preferred. However, as a group, these landowners seemed uninterested in active forest management. It may be that latent ownership factors contained on components such as Preservation may have been the primary objectives of these landowners. Another possibility is that the factors most importantly held by these landowners, such as intrinsic values associated with owning land, were not measured in the survey instrument.

This study focused on the importance of reasons for owning forestland and performance of management activities as a means to distinguish among NIPF owner segments. While the NIPF results show distinct groups which are significantly different from one another, some caution is necessary in interpreting the conclusions. Factors unmeasured in this study may be more important in influencing and separating NIPF owners. These could include intrinsic value in owning land, holding land for development or later home development. The ability to distinguish segments based on the traits, however, determines that there is a significant result which aids in characterizing NIPF landowners. Therefore, while factors not studied here might help to further categorize or characterize NIPF landowners, the results reported in this study still report specific and important differences between segments.

Cluster analysis can be open to interpretation (Hair et al., 2006). There is no absolute established way to determine how many clusters to utilize in a final solution (Hair et al., 2006). Several clusters were tested before determining a result which was based on the interpretability of the

multiple discriminant analysis. This solution to the cluster problem has been used regularly before (Finley and Kittridge, 2006). Further, the results based on the importance of consumptive enjoyment, recreational values and bequeathing land is consistent with other studies (Karpinnen, 1998; Kendra and Hull, 2005; Finley and Kittridge, 2006). The three-cluster solution, therefore, seems to offer the most easily interpreted analysis which is also consistent with past examinations.

This and similar analyses open the door for future research into NIPF owner segments. Much research has been dedicated to attempting to understand NIPF landowner motivations, specifically in regard to timber harvests (Egan, 1997). However, few studies also seek to determine the informational and support needs of landowner groups. Such studies could aid extension program managers and policy makers in reaching out to forest landowners. Likewise, testing different informational sources or programs across the different segments would help to craft effective policies for targeting specific groups of landowners. More importantly, these could help determine programs which have greatest potential for effect across all segments. Either way, the generally dismal performance of policies and programs aimed at NIPF owners may be improved by further examination of NIPF segments.

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Conclusion

Influencing private lands has been a significant source of interest for researchers and policy-makers alike. Policies and programs have tended to center on encouraging the maintenance of an intact and ecologically healthy forest landscape or on encouraging forest management activities. Many programs have sought to retain forestland from development for recreation and ecological purposes. However, past policies and programs have had a variety of effects depending on the characteristics of the landowner (Potter-Witter, 2005; Serbruyns and Luyssaert, 2006; Tyrell, 2010). This effect has been seen in Michigan (Potter-Witter, 2005), as well as other locations around the world (Finley and Kittridge, 2006; Serbruyns and Luyssaert, 2006).

This study highlighted diversity in Michigan private landowners with regard to reasons for forest ownership, parcel characteristics, management activities and other factors. Recent efforts indicate that landowners are willing to utilize various programs, policies, or financial incentives to different degrees based on a myriad of factors including their parcel size and reasons for owning forestland (Serbruyns and Luyssaert, 2006). Due to differences in landowner characteristics and behavior, therefore, current policy and outreach efforts may target specific sectors of landowners while neglecting others.

The first paper examined Michigan's NIPF owners based on the region in which the owner's forest parcel was located. SLP respondents placed an emphasis on owning forestland for nature and biologic protection. Additionally, fewer SLP respondents harvested timber and more resided on their forested parcel. In contrast, NLP respondents owned their land primarily for recreation, as part of their home, or for privacy. EUP landowners placed importance on hunting and fishing as reasons for owning forestland, and many said they were open to timber-harvesting or other management activities. Finally, WUP landowners placed an emphasis on owning forestland as part of their home or vacation home, for biological protection and for privacy. For the most part, WUP landowners had conducted timber

harvests. These results indicate the large variation between Michigan regions, specifically in regard to reasons for owning forestland.

The second paper explored specific sectors of NIPF owners based on their reasons for owning forestland. Game Wardens represented 29.8% of respondents and were more interested in recreational reasons for owning forestland compared to other groups. Timber Barons comprised 46.4% of Michigan NIPF owners and were distinguished by the higher importance they placed on consumptive reasons for owning forest property, such as producing timber or wood for energy. Finally, the last group was 23.8% of Michigan NIPF owners and was represented by Tenants, who did not exhibit strong distinguishing factors in regard to reasons for owning forestland. Each of these groups expressed different attitudes towards various policies and incentives and performed management activities to varying degrees, further illustrating the differences among Michigan NIPF owners.

As society continues to desire benefits from private forestland, we must continue to understand the private forest owner in order to meet societal objectives. This study provided information which should be useful to professionals who seek to influence private landowners. Where even distribution of a policy or program participation is desired, the information in this study suggests common traits among all ownership groups can be utilized to influence landowner response. Perhaps incentives or programs which correspond with ownership reasons such as beauty or privacy (which are held by all ownership groups) could be utilized to influence the greatest number of landowners. On the other hand, where responsible timber harvesting is the goal, it may be more prudent to target only those who hold land for “consumptive enjoyment”. Providing programs or incentives to all landowners might not be the most effective use of limited public resources.

When we fail to understand those targeted by any policy, we are likely to be disappointed. Only by seeking to understand the motivations behind NIPF owner behavior can we craft programs which will pique interest and encourage enrollment or participation in management programs. As we begin

the second decade of the 21st century and seek to provide more ecosystem services from our state and national forestland, from timber to carbon, more and more we will need to examine those private landowners who control and manage forestland. Only when we seek to help NIPF landowners meet their objectives, can we aid them in meeting ours.

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