The Use of Amenity Indicators in Anticipating Private Forestland Parcelization: A Look at the Lake States' Northwoods

By: Paul H. Gobster, Research Social Scientist, USDA Forest Service, North Central Research Station, 845 Chicago Ave., #225, Evanston, IL 60202-2357, Phone: 847-866-9311 ext. 16, pgobster@fs.fed.us , and **Thomas L. Schmidt,** Research Forester, North Central Research Station.

Abstract: The subdivision of privately owned parcels of forestland is increasing across the country, but little is known about the rate and magnitude of this change. In trying to better understand how such change is distributed spatially and temporally across the landscape, we examined private forestlands in the nonmetropolitan counties of the Northwoods of Minnesota, Wisconsin, and Michigan. We hypothesized that parcelization would be greater where lands were associated with amenity attributes identified through forest inventory and other methods. Study results show that such attributes may be of some use as indicators for detecting patterns of landscape change, but that additional research and perhaps other indicators are needed to better understand the parcelization process. Implications for policy, planning, and research are discussed.

Introduction

Forest parcelization and fragmentation are of concern across the United States and globally because they affect plant and animal diversity, the efficiency and viability of timber industries, the opportunity to realize certain kinds of recreational opportunities and experiences, and other forest resources and amenities (e.g., Barlow et al. 1998, Sauer 1997). Parcelization is the subdivision of larger forest holdings into smaller tracts or parcels. The total area of forest does not necessarily decrease with parcelization. Fragmentation is the conversion of predominantly forested tracts into a mixture of forested and non-forested tracts. Fragmentation reduces forest area, leads to smaller tract sizes, creates more edge, and reduces connectivity among tracts.

In the Eastern U.S., where private ownership accounts for nearly two-thirds of all unreserved forest acreage, the parcelization of private forestlands is thought to play an important role in the fragmentation process (Gobster et al. 2000). What happens when a timber producer subdivides and sells a 640-acre section of land as 16, 40-acre "hunting camp" properties? When a hunting camp owner subdivides and sells his or her 40-acre parcel as 16, 2.5-acre "vacation home" properties? When viewed from the air little change may be apparent, but what happens beneath the canopy may have a substantial effect on how that forest is used and how it functions biologically, economically, recreationally, and aesthetically.

While the impacts of fragmentation have received considerable attention by researchers in recent years, we also need to know more about parcelization, especially where and why it is occurring. In a recent paper, Schmidt and Raile (1998) examined trends in private forestland parcelization in the Lake States region of the United States over a 13-year period. They compared data generated during the two most recent forest inventories conducted by the USDA Forest Service, North Central Research Station's Forest Inventory and Analysis (FIA) unit for Michigan (Raile and Smith 1983, Schmidt et al. 1997), Wisconsin (Raile 1985, Schmidt 1998), and Minnesota (Jakes 1980, Leatherberry et al. 1995). They found that between the late 1970s and early 1980s (previous inventories) and the early-to-mid 1990s (current inventories), the average size of forestland ownership by private individuals decreased across the three states. Acreage of private forestland in parcels less than 100 acres in size increased from 14 to 16 million acres, a 14 percent gain, while acreage in parcels 100 acres and larger decreased from 7 to 6 million acres, an 11 percent drop. In reporting their findings, the researchers also pointed out that the rate of parcelization was not occurring evenly across the Lake States, but that certain parcel attributes such as forest type seemed to be associated with variations in the average size of ownership.

In this paper we build on the results of Schmidt and Raile (1998) by examining a set of factors that may help anticipate whether private forestlands will be subdivided. We were particularly interested in indicators that might signal whether forestlands are considered "amenity properties." Because many people are attracted to forests for recreational and aesthetic reasons, properties that have amenity attributes may be more desirable to own, either as undeveloped properties or with the eye toward developing them for a seasonal or retirement home. Likewise, woodland owners or developers might look at the amenity attributes of land in choosing where to purchase and/or subdivide lands to maximize profits from prospective buyers. Because of such reasons, we hypothesized that lands that have attributes that make them amenity properties will be more susceptible to parcelization and ensuing fragmentation (Wisconsin Department of Natural Resources 1996).

In the following sections we define the study area and set of amenity indicators taken from the FIA database and from a county-level recreational classification developed by Beale and Johnson (1998). Using these variables, we examine current (early-to-mid 1990s) forest inventories on each indicator to see if they help to detect patterns in parcelization. When possible, we also compare the current inventories with the previous ones (late 1970s-early 1980s) to see if the indicators might help predict increases in parcelization over time. We conclude with a discussion of our findings and recommendations for policy, planning, and future research.

Study Background and Methods

The Lake States' Northwoods

In defining our study area we attempted to isolate amenity influences from other factors that may affect parcel size, such as urban expansion. Thus, we narrowed our study area to a set of nonmetropolitan counties (i.e., counties without a population center of 50,000 or more persons) in the northern portion of the Lake States, an area collectively called the Lake States' "Northwoods." This area has no exact definition among the many individuals and groups who use the term, though it generally refers to an area of northern Minnesota, Wisconsin, and Michigan that is predominantly forested as opposed to more southerly portions of those states that are of mixed forest and agriculture or more urban in nature. The forests of the Northwoods generally fall above a vegetative and climatic "tension zone" that separates northern hardwood stands of maple-beech-birch, aspen-birch, white-red-jack pine, and spruce-fir from central hardwood stands of oak-hickory (Powell et al. 1993). This tension zone also tends to be a psychological one, and many residents of the Lake States look to the Northwoods for high quality outdoor recreation experiences in the numerous public and private forests and lakes.

For the purposes of this study we defined the Northwoods to comprise the 89 northernmost nonmetropolitan counties in Minnesota, Wisconsin, and Michigan (Figure 1). This area includes 34 counties in the Minnesota Department of Natural Resources' planning regions I-III, 19 counties in Wisconsin identified by Voss et al. (2000), and all 15 counties in the Upper Peninsula along with 21 counties in the northern Lower Peninsula of Michigan above Oceana to Bay Counties (Spotts 1991). According to the current forest inventories, this land area of about 55 million acres is 65 percent forested; this is higher than the 42 percent forest cover for the entire three states combined. While publicly owned forest resources in the Northwoods comprise the majority of all forest lands, private forest lands remain an important component in the supply of a myriad of forest values. In total, all privately owned forestlands in the 89 Northwoods nonmetropolitan counties currently amount to 20.1 million acres.

Recreational counties

The recreational attractiveness of an area is a likely contributor to forestland parcelization, as it may fuel the desire for people to purchase homes there for vacation or retirement purposes (Stynes et al. 1997). Demographers Beale and Johnson (1998) developed a classification of rural counties where recreation industry is concentrated that we felt might also be useful for examining patterns of parcelization in the Northwoods. Their classification of "nonmetropolitan recreational counties" is based on statistics of: 1) employment in

recreation-related businesses, 2) earnings from recreation-related businesses, 3) percentage of seasonal housing units, and 4) per capita spending on motels, resorts, and campgrounds. Final inclusion as a recreational county was based on verification of the recreational nature of the county from travel guides and other recreation literature.

Although the researchers developed the classification primarily for economic purposes, they also found that the 285 nonmetropolitan recreational counties they identified across the United States grew in population during the period 1990-1998 at a faster rate than other nonmetropolitan counties. They found that much of the growth of these counties could be attributed to population in-migration rather than a local increase of births over deaths, and hypothesized that the same amenities that support a strong recreation industry also attract migrants to the areas.

Using Johnson and Beale's (1999) listing of nonmetropolitan recreational counties, we identified 37 recreational counties in the 89 nonmetropolitan county Northwoods region, comprising 7.7 million acres or 38 percent of the privately owned forestlands in the study area. Comparing these counties with nonrecreational nonmetropolitan Northwoods counties, we expected to find a greater proportion of private forestland in recreational counties in the smaller ownership classes (40 acres and under). We also expected to find a higher percent increase in the acreage of private forestlands in smaller ownership classes between inventory periods in the set of recreational counties than in the nonrecreational ones.

FIA amenity indicators

Assessments of the forest resources of each state are periodically conducted by the FIA units of the Forest Service based on an extensive system of sample plots. These plots are assessed through aerial photo interpretation and field visits that focus on a variety of variables important to forest resource management. The North Central Research Station has inventory records going back to the 1930s, but computerized inventories in the last two inventory cycles (late 1970s – early 1980s and early-to-mid 1990s) permit relatively easy statistical manipulation of the databases by location and attributes.[1] For the Northwoods, FIA statistics are based on more than 29,000 field-measured plots.

In the present study we were interested in how different amenity-related FIA forest attributes might help anticipate the parcelization of private forestlands. Forest **stand size class** may be one such variable, reflecting the average size of trees within a stand. Many studies of people's perceptions of forest landscapes have shown a strong correlation between large trees and high preference ratings (Ribe 1989). **Forest type** is a classification of forestland based on the predominant tree species on a site, and might also indicate the desirability of land for aesthetics, recreation, and seasonal home development. Upland forest types such as maple-beech-birch and oak-hickory are two such forest types that were observed by Schmidt and Raile (1998) to be prominent in small ownership classes and are given further scrutiny here. Elm-ash-cottonwood is a lowland forest type common in riparian areas, and thus may also be associated with parcelization around lakes and rivers. **Stand history and disturbance** is a classification of the history of the stand including if it has been disturbed by natural or human activity between inventories. Again, preference research shows high scenic ratings for forests that appear undisturbed and low ratings for forests with clearcuts and other signs of human or natural disturbance (Ribe 1989). Finally, **distance to water** and **distance to road** are two site-related variables that are associated with landscape preferences (Herzog 1985) and suitability for site development (Brown and Vasievich 1996). Both distances are measured from the sample plot location to the feature, and include the smallest identifiable permanent feature (i.e., unimproved forest roads and perennial streams) on upward.

For these reasons, we expected to find that forestlands with large trees, upland and lowland riparian forest types, undisturbed conditions, or those close to water or roads would have a greater proportion of acreage in smaller parcel classes than forestlands with smaller trees, early successional forest types, recent clearcuts, or those further from water or roads.

Stand area class was our primary variable of interest in examining the effects of these various amenity indicators. Stand area is differentiated on the ground by differences in ownership as well as stand-size class, forest type, or stand origin. To examine patterns of ownership parcelization, we grouped average stand areas into the following classes: 0-10 acres, 11-20 acres 21-40 acres, 41-80 acres, 81-160 acres, 161-640 acres, and more than 640 acres. In discussing the results we most often concentrate on the small (1-40 acres) and large (161+ acres) area classes, and present our tables in these aggregated stand classes.

Results and Discussion

Before discussing particular amenity indicators it is useful to characterize private forestland ownership within the Northwoods area as a whole and compare it with Schmidt and Raile's (1998) analysis of the entire three Great Lakes states of Minnesota, Wisconsin, and Michigan. The first thing to note is that, regardless of any particular amenity attribute, private forestland ownership in the Northwoods is highly parcelized. In the current inventories, we found that 40 percent of the total area of private forestland in the Northwoods was in parcels of 10 acres or less and 71 percent was in parcels of 40 acres or less; this compares with 42 percent and 77 percent, respectively, for 0-10 and 0-40 acres parcels of private forestland in the rest of the 3-state region. Thus despite its reputation as the woodbasket of the Great Lakes, the private forestlands of the Northwoods are only slightly less parcelized than those in the more urban and agricultural counties in the southern part of the region.

A second thing to note is that the overall area of private forest landownership has increased between inventories. Across all stand area classes, there was a change in acreage of private forestland in the Northwoods from 19.5 million to 20.1 million acres between inventories, an increase of more than 600,000 acres. This is likely due in major part to the reforestation and restocking of lands in the wake of changing agricultural practices in the region (Schmidt et al. 1997). This change in the base number of acres between inventories makes interpreting the influence of amenity variables a little less straightforward for comparisons over time, and requires looking at percentages as well as actual acreage.

Recreational counties

We had expected greater parcelization in the nonmetropolitan recreational counties of the Northwoods as defined by Beale and Johnson (1999), and our hypothesis was partly supported. In examining statistics on stand area classes of private forestlands for the current inventories, we found that 73 percent of lands in recreational counties were in small stand classes of 40 acres or less, compared with 70 percent of lands in non-recreational counties (Table 1). Consistent with this pattern, we also found a smaller percentage of lands in recreational counties in larger stand area classes of 161 acres or more, 7 percent compared with 12 percent of lands in nonrecreational counties. However, this relationship was not entirely consistent across the individual stand area classes. In looking at the smallest stand area class, 0-10 acres, the proportion of private forestlands in nonrecreational counties in this class slightly exceeded that of recreational counties, 41 percent versus 37 percent, respectively.

This deviation from the expected pattern is especially significant, not only because this smallest stand area class comprises a large proportion of private forestlands in the Northwoods but also because the relationship reversed itself in comparison with data from the previous inventory. In that inventory, private lands in recreational counties were proportionately more parcelized than lands in nonrecreational counties in the smallest stand area class. In fact, between the previous and current inventories there appeared to be an overall decrease in the percent of lands in recreational counties in stand area classes 40 acres and less (79% previous vs. 73% current) and a substantial increase in the percent of lands in classes between 41 and 160 acres (13% previous vs. 20% current). Thus our hypothesis about the increasing parcelization of recreational counties over time was not supported. Perhaps most surprisingly in this respect, actual acreage in the largest stand area class, 640 acres and larger, nearly doubled in the recreational counties between inventories, from 91,000 to 163,000 acres. While this

gain is in an area class that currently represents only about 2 percent of the total acreage of private forestlands in the Northwoods, such a trend deserves further investigation.

Forest-related indicators

Stand size class. We expected that smaller parcels would have a greater proportion of large trees, but instead we found that trees on all private lands in the Northwoods are getting larger, regardless of the stand area class they are in (Table 2). Over all forest stand classes, the proportion of the forest base of Northwoods' private forestlands with large diameter trees increased from 28 percent (5.6 million acres) to 36 percent (7.1 million acres) between inventory periods, an increase of more than 1.5 million acres.

We detected a small shifting of the proportion of stands toward large diameter trees between inventory periods for the smallest stand area class (0-10 acres), but this change washes out when the small area classes are aggregated as shown in the table. In fact, one of the biggest shifts is in the largest class (641+ acres), where the percent of large diameter trees nearly tripled, from 133,000 acres to 505,000 acres. Thus our hypothesis is not supported.

Forest type. FIA uses 16 categories (including "non-stocked") to classify the forest types of the Northwoods. Of these, 5 forest types accounted for more than three-fourths of all privately owned forestland assessed in the current inventory: maple-beech birch (32%, 6.4 million acres), aspen (26%, 5.2 million acres), elm-ash-cottonwood (8%, 1.6 million acres), oak-hickory (7%, 1.3 million acres), and northern white-cedar (6%, 1.1 million acres). Data on these 5 types are presented in Table 3.

We expected to see greater landownership parcelization in high amenity oak-hickory and maple-beech-birch forest types than in early successional forest types like aspen that are often preferred by the local timber industries, but comparison of forest types by stand area classes did not bear this out. In fact, in the current inventory aspen was nearly as likely or more likely to be in small ownership classes (38% within 0-10 ac., 74% within 0-40 ac.) as was oak-hickory (40% 0-10 ac., 71% 0-40 ac.) and maple-beech-birch (35% 0-10 ac., 62% 0-40 ac.). We did, however, find that a relatively high proportion of the elm-ash-cottonwood forest type was in small stand area classes (49% 0-10 ac., 80% 0-40 ac.). This could indicate a tendency toward parcelization of riparian areas consistent with our hypothesis.

In looking at the change in proportion of forest types between the two inventories, we found a substantial transformation of private forestlands in the Northwoods from forest types that have been traditionally preferred by local industry to those that have been traditionally considered more amenity oriented. Between the previous and current inventories, acreage of aspen declined 7 percent (from 5.6 to 5.2 million acres) while acreage of oak-hickory increased by 12 percent (from 1.2 to 1.3 million acres) and acreage of maple-beech-birch increased by 11 percent (from 5.7 to 6.4 million acres). This change has probably been driven more by forest succession than by landowner management activities. However, that this succession was allowed to occur may exhibit landowner preference for such changes, and is consistent with increases in stand size class reported above.

While changes in private forestland parcelization for oak-hickory and maple-beech-birch forest types between inventory periods do not appear significant when ownership is grouped at the broad stand area classes shown in Table 3, a look at smaller class divisions shows that significant parcelization within these amenity forest types may in fact be occurring. For oak-hickory, while the proportion of stands 40 acres or less changed less than 1 percent between inventory periods, stands 0-10 acres increased by 8 percent while stands 11-20 and 21-40 acres each decreased by 4 percent. For maple-beech-birch, the proportion of stands 40 acres or less changed by 8 percent between inventory periods; within this division stands 0-10 acres increased by 6 percent while stands 11-20 and 21-40 acres decreased by 7 percent and 6 percent, respectively. While further research is needed to explain this pattern, it may indicate that for these high amenity forest types, parcelization is most active on parcels that are already relatively small rather than on the medium and large private forest tracts.

Stand history and disturbance. A final forest-related FIA variable we examined as a potential amenity indicator of land parcelization was stand history and disturbance. For this we expected that smaller stand area classes would be proportionately less disturbed and less clearcut than larger ones. But in examining these categories, we did not find support for our hypotheses. To the contrary, we found a slightly smaller percentage of stands in the 0-40 acre stand area classes were classified as undisturbed (81%) as compared with the 161+ acre stand classes (84%), and that the same percent of small and large stand classes exhibited signs of clearcutting (4%) (Table 4). By the same token, a comparison between inventories generally showed a decrease in percents and acreage of undisturbed land in the smaller stand area classes and an increase in clearcutting, implying that more rather than less disturbance is occurring in smaller stands.

Proximity-related indicators

We cannot report temporal changes in the distribution patterns of private landownership as a function of proximity to water and roads because a considerable number of survey points were not measured on these attributes during the previous inventory period and the missing data do not seem to be randomly distributed across the stand area classes. Therefore, presentation and discussion of findings on these amenity attributes will be limited to data from the most recent inventory.

Water. A large part of the popularity of the Northwoods is its dense network of lakes and rivers. This is reflected in the current inventory data, where nearly half (47 percent) of private forestlands, some 9.3 million acres, are within ¼ mile of a water body (Table 5). Of these 9.3 million acres, 45 percent (4.4 million acres) are within the 0-10 acre stand area class and 76 percent (7.1 million acres) are within stand area classes of 40 acres or less. The highest parcelization occurs in the smallest stand area class, where 52 percent of parcels are within ¼ miles of water. This proportion generally declines as stand area class increases, to where only 36 percent of parcels in between 160-640 acres and 40 percent of parcels 641 acres or larger were within ¼ mile of water. These findings help support our hypothesis that private lands nearest water may be more susceptible to parcelization.

Roads. Data from the current inventory also show that the road network surrounding private forestlands in the Northwoods is quite dense, with more than half of the acreage, some 10.5 million acres, within ¼ mile of a road (Table 6). Of these 10.5 million acres, 44 percent or 4.7 million acres is in parcels 0-10 acres in size and 76 percent or 8 million acres is in parcels 0-40 acres in size. The highest parcelization occurs in the 0-10 acre stand area class, where 58 percent of lands are within ¼ mile of a road. Parcelization steadily decreases with increasing stand size, to where 39 percent of parcels 161-640 acres and 641 acres or larger were within ¼ mile of a road. These findings also help to support our hypothesis that private lands nearest roads may be more susceptible to parcelization.

Conclusions and Future Research Directions

While results from our investigation are far from being clear cut, we did find evidence to suggest that the recreational nature of counties, the forest-related attributes of stand size class, forest type, and stand history and disturbance, and the proximity-related attributes of water bodies and roads may help to detect differences in the proportion of private lands within different stand area classes and changes in these proportions over time. Although the magnitudes of these differences and changes were rarely dramatic and in some cases happened in different ways than we had expected, we feel that such amenity attributes deserve closer attention in future policy, planning, and research on forest parcelization and fragmentation.

The proximity-related variables showed the most consistent results with our hypotheses, suggesting that water and road access may be important indicators of parcelization. Also, the fact that the lowland riparian forest type was the only forest type that supported our hypothesis further serves to strengthen the case that water plays a key role in understanding the subdivision of forestlands. Further work needs to be done to examine how

different types of water bodies relate to parcelization, for there is increasing concern in the water-rich Northwoods that smaller and smaller lakes and streams will come under pressure for development since undeveloped private lands on larger water bodies are becoming rare (Wisconsin Department of Natural Resources 1996).

Other information with regard to forest type showed that some of the greatest changes were happening within in the smallest ownership class, 0-10 acres. We suspect that the bulk of this parcelization may be coming from lands that are already relatively small in acreage (i.e. 40 acres or less). More work is needed to confirm these suspicions and, if so, assess what implications such shifts may have in the fragmentation of local and regional forestlands.

While it is generally well known that forestlands in the Northwoods and Eastern U.S. as whole are getting more extensive, older, and are decreasing in the acreage of early successional types like aspen, it is not clear from this study how these factors might related to parcelization of the forest. The literature upon which our hypotheses are based show good reasons to associate these trends with an increase in amenity value, but it may be that economics, social values, or other factors are acting in conjunction with parcelization or development of amenity areas. The policy implications of such landscape change extends far beyond issues of parcelization and fragmentation, though further work should continue to monitor these potential relationships.

In these and other aspects of planning, policy, and research we need to improve our methods and skills in anticipating when, where, and how much private forestland parcelization will occur. We feel the use of amenity indicators such as those examined here are a promising direction, but more work needs to be done in refining measures, examining both more extensive and smaller scale regions, and looking at changes over longer intervals of time. Forest Inventory and Assessment data provide a promising avenue for such investigations, as do U.S. Census (e.g. Hammer et al. 1999), GIS-based land analyses (e.g., Brown and Vasievich 1996), and social surveys (e.g., Leatherberry 1999). Coupled with studies looking at the impacts of ownership parcelization and analyses of policies and other strategies to prevent or ameliorate the negative effects of these trends, we can provide useful information to planners dealing with issues of forest fragmentation (Gobster et al. 2000).

Endnote

1. The latest forest inventory data are retrievable on the World Wide Web at: http://www.srsfia.usfs.msstate.edu/scripts/ew.htm

Literature Cited

BARLOW, S.A., I.A. MUNN, D.A. CLEAVES, and D.L. EVANS. 1998. The effect of urban sprawl on timber harvesting: a look at two southern states. *Journal of Forestry* 96(12):10-14.

BEALE, C.L., and K.M. JOHNSON. 1998. The identification of recreational counties in nonmetropolitan areas of the USA. *Population Research and Policy Review* 17:35-53.

BROWN, D.G., and J.M. VASIEVICH. 1996. A study of land ownership fragmentation in the Upper Midwest. In *GIS/LIS '96: Annual conference and exposition proceedings*, 199-1209.

GOBSTER, P.H., R.G. HAIGHT, and D. SHRINER. 2000. Landscape change in the Midwest: an integrated research and development program. *Journal of Forestry* 98(3):9-14.

HAMMER, R.B., P.R. VOSS, and A.E. HAGEN. 2000. Approximating geographic patterns of residential development during the past half century and projecting future trends: are Wisconsin's North Woods Disappearing? Draft manuscript available at http://www.ssc.wisc.edu/poplab/north/home.html

HERZOG, T.R. 1985. A cognitive analysis of preferences for waterscapes. *Journal of Environmental Psychology* 5:225-241.

JAKES, P.J. 1980. *The fourth Minnesota forest inventory: Area.* Resource Bulletin NC-54. St. Paul, MN: USDA Forest Service, North Central Forest Experiment Station.

JOHNSON, K.M., and C.L. BEALE. 1999. Recreational counties in nonmetropolitan America. Available online at www.luc.edu/depts/sociology/johnson/p99webr.html

LEATHERBERRY, E.C. 1999. Trends in forest ownership fragmentation in the Lake States, 1980s-1990s. In *Proceedings of the Society of American Foresters 1998 National Convention*, 116-122. Bethesda, MD: Society of American Foresters.

LEATHERBERRY, E.C., J.S. SPENCER, T.L. SCHMIDT, and M.R. CARROLL. 1995. *An analysis of Minnesota's fifth forest resources inventory.* Resource Bulletin NC-94. St. Paul: USDA Forest Service, North Central Forest Experiment Station.

POWELL, D.S., J.L. FAULKNER, D.R. DARR, Z. ZHU, and D.W. MAC CLEERY. 1994. *Forest resources of the United States, 1992.* General Technical Report RM-234 (Revised). Ft. Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station.

RAILE, G.K., and W.B. SMITH. 1983. *Michigan forest statistics, 1980.* Resource Bulletin NC-67. St. Paul: USDA Forest Service, North Central Forest Experiment Station.

RIBE, R.G. 1989. The aesthetics of forestry: what has empirical preference research taught us? *Environmental Management* 13:55-74.

SAUER, L.J. 1998. *The once and future forest: a guide to forest restoration strategies* Washington, D.C.: Island Press.

SCHMIDT, T.L. 1998. *Wisconsin forest statistics, 1996.* Resource Bulletin NC-183. St. Paul: USDA Forest Service, North Central Research Station.

SCHMIDT, T.L., and G.K. RAILE. 1998. Forest fragmentation in the Lake States. In *Proceedings of the Society of American Foresters 1998 National Convention*, 107-115. Bethesda, MD: Society of American Foresters.

SCHMIDT, T.L., J.S. SPENCER, and R. BERTSCH. 1997. *Michigan's forests 1993: an analysis.* Resource Bulletin NC-179. St. Paul: USDA Forest Service, North Central Forest Experiment Station.

SPOTTS, D.M. 1991. *Travel and tourism in Michigan: a statistical profile.* East Lansing, MI: Michigan State University Travel, Tourism, and Recreation Resource Center.

STYNES, D.J., J.J. ZHENG, and S.I. STEWART. 1997. *Seasonal homes and natural resources: patterns of use and impact in Michigan.* General Technical Report NC-194. St. Paul: USDA Forest Service, North Central Forest Experiment Station.

Table 1. Area of privately owned forestland in the Lake States' Northwoods by county type and stand area class, for previous and current inventory periods.
(Row Percents)*

County type	Stand area class							
	0-40 acres		41-160 acres		161+ acres		Total	
	acres	%	acres	%	acres	%	acres	%
	Previous Inventory (thousands of acres)							
Nonrecreational	8,893	74	1,955	16	1,115	9	11,962	99
Recreational	5,869	79	985	13	622	8	7,476	99
Total	14,762	76	2,940	15	1,736	9	19,439	100
	Current Inventory (thousands of acres)							
Nonrecreational	8,681	70	2,218	18	1,544	12	12,443	100
Recreational	5,605	73	1,537	20	517	7	7,659	100
Total	14,286	71	3,755	19	2,061	10	20,101	100

* Row percents may not add to 100 because of rounding.

Table 2. Area of privately owned forestland in the Lake States' Northwoods by stand-size class and stand area class, for previous and current inventory periods. (Row Percents)*

Stand-size class	Stand area class							
	0-40 acres		41-160 acres		161+ acres		Total	
	acres	%	acres	%	acres	%	acres	%
	Previous Inventory (thousands of acres)							
Large diameter	4,134	74	803	14	585	11	5,561	99
Medium diameter	6,838	73	1,604	17	912	10	9,422	100
Small diameter	3,693	83	517	12	234	5	4,443	100
Nonstocked	99	83	16	13	6	5	120	101
Total	14,763	76	2,940	15	1,736	9	19,546	100
	Current Inventory (thousands of acres)							
Large diameter	4,884	68	1,341	19	919	13	7,146	99
Medium diameter	5,157	70	1,402	19	767	11	7,327	100
Small diameter	4,192	75	1,005	18	371	7	5,568	100
Nonstocked	56	84	7	10	5	7	68	100
Total	14,287	71	3,755	19	2,061	10	20,103	100

* Row percents may not add to 100 because of rounding.

Table 3. Area of privately owned forestland in the Lake States' Northwoods by forest type and stand area class, for previous and current inventory periods. (Row Percents)*

Forest type	Stand area class							
	0-40 acres		41-160 acres		161+ acres		Total	
	acres	%	acres	%	acres	%	acres	%
	Previous Inventory (thousands of acres)							
Northern white-cedar	766	71	134	12	177	16	1,080	100
Oak-hickory	844	71	261	22	78	7	1,185	100
Elm-ash-cottonwood	1,120	81	178	13	80	6	1,389	99
Maple-beech-birch	3,960	69	886	16	845	15	5,700	100
Aspen	4,316	77	953	17	320	6	5,637	99
Other and non-stocked	3,756	82	528	12	235	5	4,556	99
Total	14,762	76	2,940	15	1,736	9	19,546	99
	Current Inventory (thousands of acres)							
Northern white-cedar	835	75	188	17	88	8	1,112	100
Oak-hickory	957	71	301	22	90	7	1,347	100
Elm-ash-cottonwood	1,239	80	189	12	122	8	1,550	100
Maple-beech-birch	3,982	62	1,342	21	1,095	17	6,418	100
Aspen	3,860	74	1,017	19	354	7	5,230	100
Other and non-stocked	3,413	77	718	16	312	7	4,444	100
Total	14,286	71	3,755	19	2,061	10	20,101	100

* Row percents may not add to 100 because of rounding.

Table 4. Area of privately owned forestland in the Lake States' Northwoods by stand history-disturbance and stand area class, for previous and current inventory periods.
(Row Percents)*

Stand history	Stand area class							
	0-40 acres		41-160 acres		161+ acres		Total	
And disturbance	acres	%	acres	%	acres	%	acres	%
	Previous Inventory (thousands of acres)							
No disturbance	12,009	75	2,436	15	1,456	9	15,999	99
Natural disturbance	365	80	67	15	25	6	457	100
Clearcut	374	79	77	16	26	5	476	100
Other human caused	2,017	77	360	14	230	9	2,614	100
Total	14,763	76	2,940	15	1,736	9	19,546	99
	Current Inventory (thousands of acres)							
No disturbance	10,629	72	2,648	18	1,536	10	14,814	100
Natural disturbance	1,242	77	257	16	120	7	1,619	100
Clearcut	580	66	217	25	80	9	877	100
Other human caused	1,838	66	633	23	325	12	2,797	100
Total	14,287	71	3,755	19	2,061	10	20,103	100

* Row percents may not add to 100 because of rounding.

Table 5. Area of privately owned forestland in the Lake States' Northwoods by distance to water and stand area class, for current inventory period.
(Row Percents)

Distance	Stand area class							
	0 to 40 acres		41 to 160 acres		161+ acres		Total	
to water	acres	%	acres	%	acres	%	acres	%
	Current Inventory (thousands of acres)							
< 1/4 mile	7,101	76	1,458	16	778	8	9,337	100
1/4 - ½ mile	3,167	67	1,004	21	559	12	4,729	100
> 1/2 mile	4,015	67	1,293	21	724	12	6,033	100
Total	14,286	71	3,755	19	2,061	10	20,102	100

Table 6. Area of privately owned forestland in the Lake States' Northwoods by distance to road and stand area class, for current inventory period.
(Row Percents)*

Distance	Stand area class							
	0 to 40 acres		41 to 160 acres		161+ acres		Total	
to road	acres	%	acres	%	acres	%	acres	%
	Current Inventory (thousands of acres)							
< ¼ mile	7,994	76	1,722	16	810	8	10,527	100
1/4 – 1/2 mile	3,556	69	1,074	21	544	11	5,174	101
> ½ mile	2,734	62	959	22	708	16	4,402	100
Total	14,287	71	3,755	19	2,061	10	20,103	100

* Row percents may not add to 100 because of rounding.

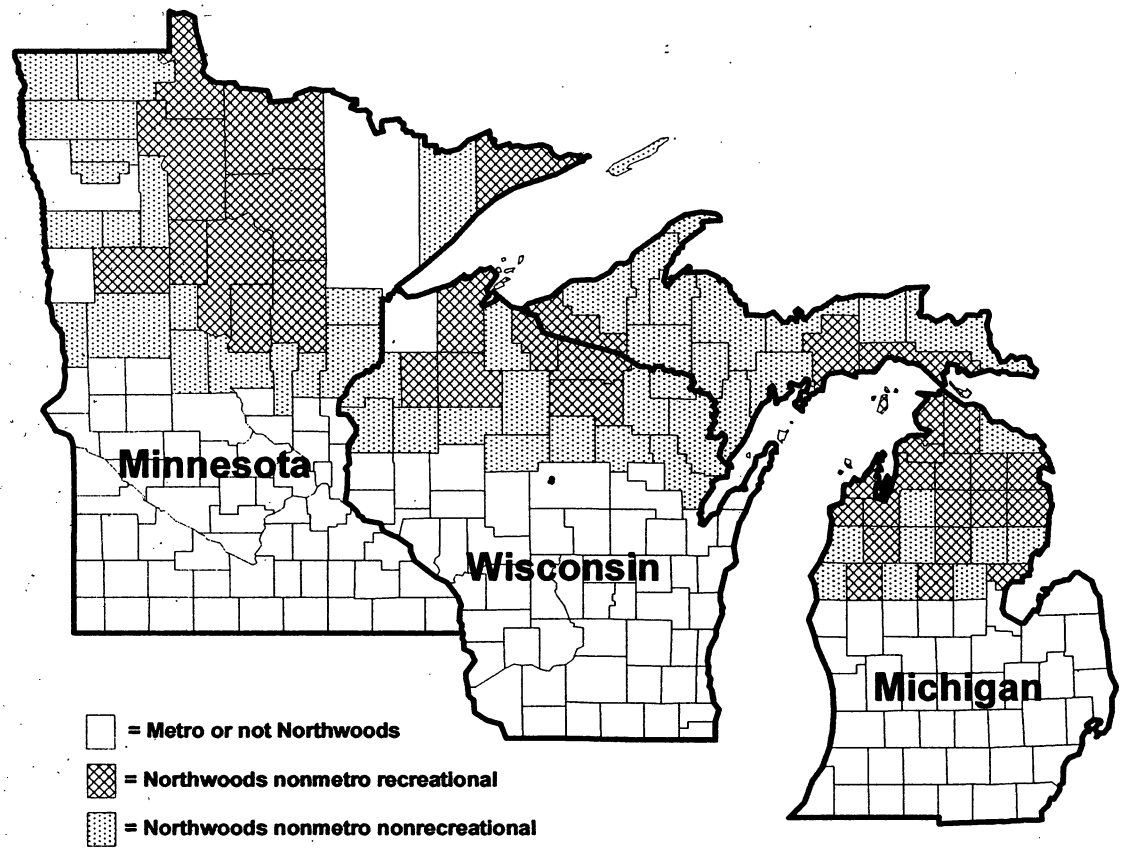


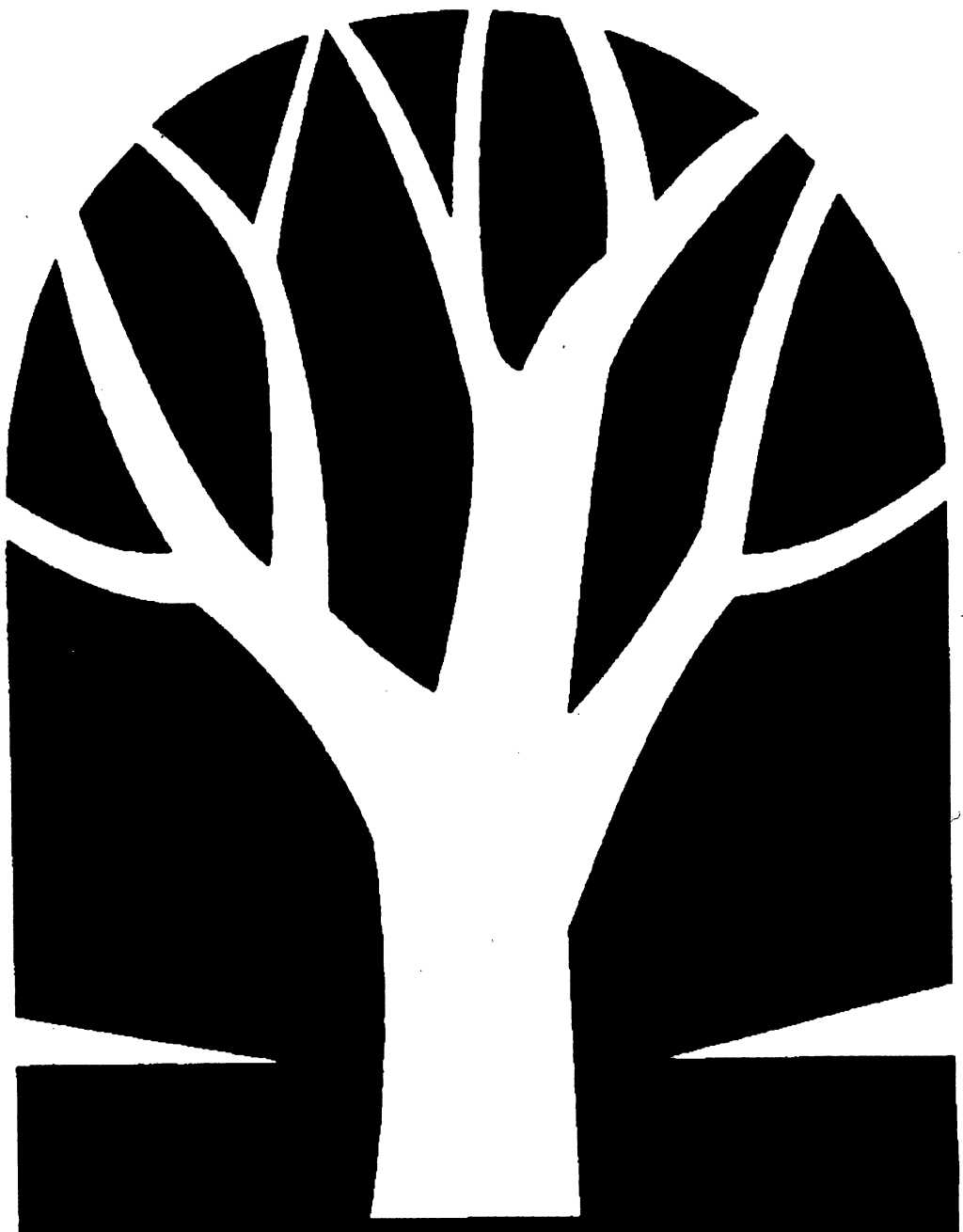
Figure 1. Map of the Lake States study region, with the shaded areas showing Northwoods nonmetropolitan recreational (Johnson and Beale 1999) and nonrecreational counties included in the analysis.

FOREST FRAGMENTATION 2000

Sustaining Private Forests in the 21st Century

Radisson
Hotel

Annapolis
Maryland
September
17-20, 2000



PROCEEDINGS

PROCEEDINGS

FOREST FRAGMENTATION 2000

Sustaining Private Forests in the 21st Century

September 17-20, Annapolis, Maryland

Lester A. DeCoster, Editor
The DeCoster Group, Inc., 11322 French Horn Lane, Reston, VA 20191
Phone: 703-860-2513, Email: lesdecoster@worldnet.att.net

R. Neil Sampson, Publisher
The Sampson Group, Inc., 5209 York Road, Alexandria, VA 22310
Phone: 703-924-0773, Fax: 703-924-0588
Email:rneilsampson@cs.com, Web-site: www.sampsongroup.com

December, 2000

Citation
Proceedings of the Forest Fragmentation 2000 Conference. 2000. Sampson Group, Inc., Alexandria, VA. www.sampsongroup.com

Additional copies of these proceeding can be ordered from The Sampson Group (Contact information above)
$50 per copy for conference attendees; $75 per copy for non-attendees
Make checks payable to: Sampson Group-Fragmentation2000

ACKNOWLEDGMENTS

Conference Organizer: Neil Sampson, The Sampson Group
Conference Coordinator: Terri Bates, Bates Associates
Proceedings Editor: Lester DeCoster, The DeCoster Group

Planning Committee
Ted Beauvais, USDA Forest Service; Larry Biles, USDA CREES
Lester DeCoster, The DeCoster Group; Suzanne Fleek, American Farmland Trust
Bill Horvath, NACD; Michael Jacobson, The Pennsylvania State Univ.
Neil Sampson, The Sampson Group;Tim Warman, American Farmland Trust
Larry Wiseman, American Forest Foundation

Administration and Arrangements
Linda Neel, Terry Lynott: National Association of Conservation Districts (NACD)

Financial Support Provided by

American Forest Foundation
American Forest and Paper Association
Bradley Murphy Forestry & Natural Resources Extension Trust*
Forest Resources Association, Inc.
National Association of State Foresters
USDA Cooperative State Research Education and Extension Service (CREES)
USDA Forest Service
USDA Natural Resources Conservation Service

* The mission of the Bradley Murphy Forestry & Natural Resources Extension Trust is to encourage and promote the stewardship of forests and natural resources through education and the free market system