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Using real estate records to assess forest land parcelization and development: A Minnesota case study

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ABSTRACT

We measure the extent and location of forest parcelization activity in a heavily forested Minnesota county between 1999 and 2006 and examine both the immediate and extended relationship between parcelization and development activity. We document forest land parcelization and development activity over time utilizing readily available real estate parcel data. Despite widespread perceptions of rapidly increasing rates of parcelization, we observed no significant positive or negative trend in parcelization activity in Itasca County during the study period: an average of only 0.4% of private forest land was parcelized each year. Parcelization was more common near cities, water, and public lands. While the overall rate of parcelization observed in this study may seem meager, closer examination of specific parcels suggest that parcelization is intimately tied to development activity and that this development occurs not long after parcelization.

1. Introduction

Forest parcelization, the division of larger blocks of forest land into smaller blocks with multiple owners, has been shown to lead to a decrease in the economic viability of managing forests for wood products (Greene et al., 1997; Mehmood and Zhang, 2001), a decrease in interest in management and investment of forest management activities on the part of non-industrial private forest landowners (NIPF) (Straka et al., 1984; Romm et al., 1987; Rickenbach and Steele, 2006), as well as adverse impacts on wildlife (Brooks, 2003) and wildlife habitat (Theobold et al., 1997), water quality (Dillon et al., 1994; Hendry and Leggatt, 1982; Wear et al., 1998; LaPierre and Germain, 2005), ecosystem services (Groom et al., 1999), and outdoor recreation opportunities and access (Rickenbach and Gobster, 2003; King and Butler, 2005). Some researchers have hypothesized that *parcelization*, a land ownership measure, may, in turn, lead to *fragmentation*, a land cover measure, which might further affect the management and use of forest land for their many products and amenity values (Gobster and Rickenbach, 2004; Holdt et al., 2004; King and Butler, 2005; LaPierre and Germain, 2005; Germain et al., 2006; Kilgore and MacKay, 2007).

There is little question that forest ownership structure is changing. Between 1994 and 2002, the number of private forest landowners in the United States increased 11% (Zhang et al., 2005). The data also shows an increase in the frequency of small acreage forest land sales. Left unexplained is whether these trends are the result of forest owners subdividing and selling a portion of a larger forest land holding (which indicates that parcelization is occurring), or simply reflecting the fact that smaller forest tracts have become a more dominant share of the forest land sales market.

Parcelization research has largely focused on identifying drivers of parcelization and on implications of parcelization. To a far lesser extent, researchers have sought to empirically quantify rates and trends in parcelization itself. Mehmood and Zhang (2001) examined various factors influencing forest parcelization, finding estate and inheritance taxes, urbanization, income, state death rates, regulatory uncertainty and financial assistance all to have an influence on average forest parcel size in the U.S. Rickenbach and Gobster (2003) identified stakeholders' perceptions of parcelization in northern Wisconsin, and Zhang et al. (2005) identified economic drivers that lead to increased forest land parcelization in the U.S.

Most studies which focus on the quantification of parcelization activity have made use of national or state level statistics to illustrate broad-scale trends in private forestland ownership and parcel size (Birch, 1996; Leatherberry, 2001; Butler and Leatherberry, 2004; Zhang et al., 2005). Greene et al. (1997) used U.S. Forest Service Forest Inventory Analysis (FIA) stand data to track total acreage by stand size, an indicator of fragmentation. However, while changes in FIA stand data can be used to evaluate *forest* fragmentation, FIA data does not provide useful information about *ownership* fragmentation, usually referred to as "parcelization,"

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because forest cover type-based stand delineations are ecological units that may across ownership boundaries.

Largely missing from the literature are smaller scale, empirical estimates that quantify the extent of parcelization occurring within a specific geographic area (i.e., state or county). While national assessments and anecdotal evidence suggest parcelization is occurring (i.e., the number of NIPF owners is increasing and average parcel size is decreasing), this masks parcelization activity occurring at a localized scale. Policy-makers and planners need to know where parcelization is occurring at a finer-scale resolution than average statewide parcel size before being able to fully understand drivers, implications and strategies to address this significant issue.

Two important contributions on land ownership parcelization have been recently been published in this journal. Cumming and Barnes (2007) use property tax records to examine the dynamics of broad ownership categories (public, private, timber, mining) in north central Florida. Donnelly and Evans (2008) use historic plat maps to track ownership changes over time in south central Indiana. In this paper, we suggest that a different perspective on parcelization can be obtained by direct examination of changes in individual property records and real estate transaction records.

A few studies have estimated rates and trends in parcelization at a more localized scale. Drzyga and Brown (1999) digitized historical parcel maps (1970, 1980, 1999) for three counties in Michigan and calculated parcelization as the change in average parcel size between each time period. LaPierre and Germain (2005) documented forest land parcelization in four counties in the New York City Watershed using visual comparisons of GIS coverage and paper maps. Germain et al. (2006) quantified parcelization in one county in central New York using digital tax map sheets. They tracked total number and area of parcels in six different acreage classes. Modern and historic tax rolls, deed books and grantee books were searched manually to create a chain of transactions. The Center for Land Use Education at UW-Stevens Point is in the process of quantifying long-term trends in land subdivision and parcelization at the county-level in Wisconsin (http://www.uwsp.edu/cnr/landcenter/parcelizationstudy/index.html). Ownership maps are being created in a GIS by digitizing plat books and paper maps and utilizing legal descriptions from tax assessment rolls. Changes in ownership will be tracked through time using GIS analysis.

The above-cited studies are map-based investigations of parcelization activity, requiring substantial researcher time and judgment, as well as GIS mapping software and expertise. We are not aware of any research that has attempted to quantify the degree and rate of parcelization using readily available real estate sales data. We are also not aware of research that has formally linked forest land parcelization to development.

In this paper, we use readily available, non-map-based tax records to quantify the extent and location of forest parcelization activity and the relationship between parcelization and development. We focus on a largely forested northern Minnesota county that—anecdotally—is said to have experienced a significant surge in development over the past several years. Specific research objectives were to: (1) describe the extent to which parcelization of forest land is occurring within Itasca County; (2) characterize the nature of parcelization activity by describing prior and subsequent owner and tract characteristics; (3) determine the extent to which this parcelization is related to development; and (4) set forth a methodology for using statewide real estate parcel data for examining parcelization and development activity over time.

2. Data and methods

Itasca County, a large, heavily forested county in northern Minnesota ranks third in total forest area out of the 87 Minnesota counties with 1.36 million acres of forest land (80% of its total land area) (Leatherberry et al., 1995). Of the county's commercial timberland, about 23% is owned by individuals, 20% by the federal government, 19% by the state, 19% by the county or municipalities, and 13% by the forest industry (Leatherberry et al., 1995). The county's population growth from 2000 to 2006 was 1.7%, well below the statewide growth of 5% and its 2000 population density was only 16.5 persons per square mile (U.S. Census Bureau, 2007). At first glance, these figures may suggest that parcelization could not yet be a problem in the study area, but researchers in other areas have shown that private forests have been dividing into smaller parcels at rates well above those attributable to population growth alone (Sampson and DeCoster, 2000). Germain et al. (2006) documented parcelization in upstate New York despite a declining population, citing trends in preferences toward rural homesteads and vacation homes that act as "private green space" for their owners.

We employ a statewide real estate parcel dataset—the annual Market Value Files (MVF) from the Minnesota Department of Revenue—for 1999–2006 to make year-to-year comparisons over this time frame. The dataset is a complete record of all real estate in Minnesota that includes each parcel's location, size (in acres), estimated market values for both land and buildings, and property tax classification. To identify parcelization activity and trends on forest land in Itasca County, several property tax classifications were used. In addition to the "timberland" property tax classification, real estate classified in the agricultural, seasonal, and residential classes were used as predominantly forested land can be classified in these categories for property tax purposes.

Minnesota counties are not required to use a uniform parcel identification numbering (PIN) system, but—fortuitously—that used by Itasca County (and others) is so structured that we could make use of the PIN system to track parcelization over time. Pairing Market Value Files in successive years allowed us to identify two types of parcelization: (1) new parcels in the second year of the data pair (i.e., PINs that only appeared in the second year of a 2-year set), which represented subdivided parcel(s) that did not inherit the original parcel's PIN and (2) parcels with the same PIN in both years of a 2-year set but covering different acreages. Neither would occur without a change in ownership, because land sales are the triggering event in the changing of PINs for parcels 40 acres or smaller (of which we examine only those that were initially 38.5–40 acres). We separately treat the over 40 acre ownership parcels.

Fig. 1 illustrates these possible parcel changes from 1 year's MVF to the next. For example, Fig. 1a, the lower parcel in the year 2 column represents the first condition described above where a new PIN appears in the second, but not the first year. The upper parcel in the year 2 column represents the second condition, namely the parcel existed in year 1 but has a change in the number of acres. In this study, both types of parcels created in the second year of a 2-year set are referred to as "child parcels," while the original parcel from the first year is referred to as a "parent parcel." A "split" occurs when one parcel is divided into two or more parcels, each with a separate PIN, as in Fig. 1a. A "consolidation" occurs when two or more parcels are consolidated into one parcel, as in Fig. 1b. A "split and consolidation" (Fig. 1c) can also occur.

Some researchers have used 50 acres as the minimum threshold at which forest management becomes a viable land management activity (Thorne and Sundquist, 2001; Sampson, 2004). We felt, however, that a 40-acre threshold was most appropriate given Itasca's parcel identification scheme and that 40 acres reflects a reasonable cutoff for viable forest management activities. This threshold has the additional advantage that it corresponds to the basic building blocks of the American Public Land Survey, on which is based most of Minnesota's (and many other states') land records

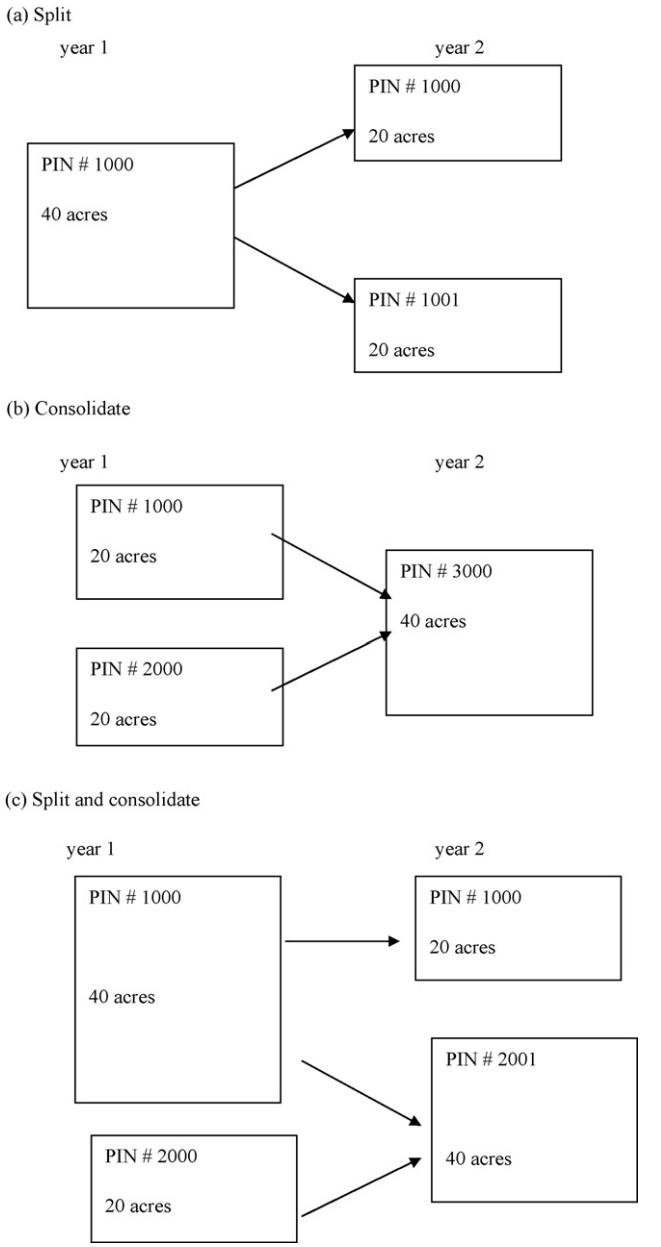

Fig. 1. Possible property ownership changes. (a) Split, (b) consolidate, and (c) split and consolidate.

systems. Consequently, parent parcels smaller than 40 acres (technically, 38.5 acres, to deal with possible rounding issues and survey errors) were not included in this analysis. Because the maximum area assigned an individual PIN in Itasca County is 40 acres, contiguous ownership parcels larger than 40 acres, are assigned multiple PINs—one for each 40 acre block. We deal with these larger parcels below.

This procedure allowed us to create a data set that identified every forest land parcel split and consolidation that occurred in Itasca County from 1999 to 2006. A "split" occurs when one parcel is divided into two or more parcels, each with a separate PIN. A "consolidation" occurs when two or more parcels are combined into one parcel. For each split parcel, we recorded the township in which the sale occurred, number of child parcels, property tax classification of each parcel before and after a split, changes in building value following a split, owners of parent and child parcels, and whether a child parcel is adjacent to water (lakes, streams, rivers) or public land (federal, state or county).

Table 1
Parcel splits and consolidations, 1999–2006.

	Regular parents		Over 40 acre parents	
	Splits	Consolidations	Splits	Consolidations
1999–2000	56	0	0	3
2000–2001	38	0	2	4
2001–2002	80	1	2	1
2002–2003	48	0	4	7
2003–2004	49	0	9	7
2004–2005	50	1	8	6
2005–2006	45	0	3	10
Total	366	2	28	38

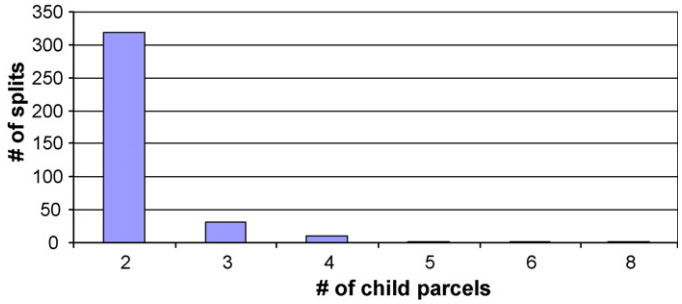

Fig. 2. Number of child parcels, 1999–2006.

3. Results

From 1999 to 2006, there were a total of 366 parcel splits and two parcel consolidations in Itasca County (listed under the heading "regular parents" in Table 1). Except for a slight spike in 2001–2002, parcelization was fairly constant over the years: there was no noticeable positive or negative trend in the number of splits countywide.

3.1. Characteristics of splits

While there were occasional splits with up to eight child parcels, the vast majority of parcel splits (87%) produced two child parcels (Fig. 2). Of the 366 parcel splits, approximately 11% had the same owner(s) for both the parent and any child parcels (Fig. 3). These "splits," which we discovered upon examination of current parcel maps, are usually an artifact of the way in which tax parcels are classified for property tax purposes. For example, due to a timber harvest, a 40-acre parcel classified as timberland might be divided into two 20 acre parcels, one classified timberland and one classified agricultural undeveloped. Both child parcels are still held by the same owner, but the property tax classification has changed for one or both. While these splits do not reflect an immediate change in ownership, we argue that they can be properly considered one type of parcelization because the reassignment of boundaries in the

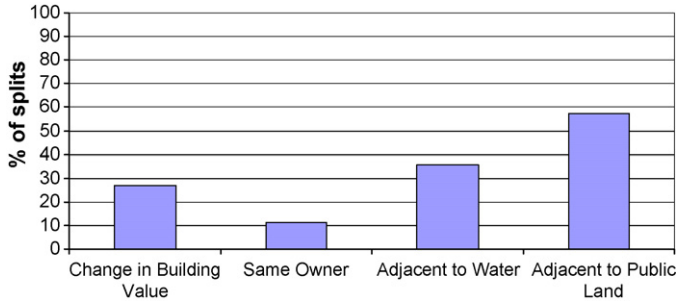

Fig. 3. Characteristics of parcel splits, 1999–2006.

tax records makes it easier for one or both of the child parcels to be sold later.

The Market Value Files contain "location" information to the extent of the civil township in which the property is located. To supplement the acreage, price, building value, and other MVF data with lake proximity, public land proximity, etc., we used the PIN numbers from our findings of splits and consolidations, applying the PIN to the county's on-line GIS system, which enabled us to visually determine the appropriate proximity information.

About a third of the splits resulted in at least one child parcel that was adjacent to water, and 57% had at least one child parcel that was adjacent to public land (Fig. 3). Snyder et al. (2007) found that adjacency to lakes or rivers had a significant positive influence on private forest land prices in northern Minnesota, an indication of the value that owners place on such amenity features. This finding might help explain the large percentage of parcelization activity occurring near water. However, the Snyder et al. (2007) study also found a negative influence of adjacency to public land on forest land prices. The large percentage of parcel splits occurring near public land may simply be a reflection of the large amount of public land in forested areas of Itasca County, rather than an indication that owners find parcels adjoining public land to have higher value or desirability than those which do not. Nearly 60% of timberland in Itasca is owned by federal, state or county government (Leatherberry et al., 1995).

3.2. Does parcelization cause development?

For this study, development is defined as the presence of structures such as houses on the property. In order to determine if development was occurring on the child parcels that were created when a parcel split, the building value in the first year of a 2-year set was compared with the building value of all the resulting child parcels in the second year of the 2-year set. If the total building value (of all resulting child parcels) in the second year exceeded the original building value of the parent parcel (from the first year) by at least 15%, then the split was coded as having a change in building value. However, if there was a 15% change in building value, but the total building value for each resulting child parcel remained under $5000, then the split was coded as not having a change in building value. The $5000 threshold was used for parcel splits with no building value in the first year. If there existed no building for the parent parcel in the first year, but was at least $5000 building value on any one of the child parcels in the second year, then the split was coded as having a change in building value. (The $5000 threshold was used to account for the construction or existence of small structures such as sheds, which we felt did not constitute noteworthy development activity.)

Using this approach, we found that 38 of the 56 (68%) parcel splits from 1999 to 2000 had building value added by 2006. Of the 38 splits that resulted in a change in building value, 20 had building value added immediately in 2000. Another 10 splits had building value added by 2002, and one to three splits had building value added each year for the remainder of the study period (Fig. 4).

Our procedure also enables us to examine property transactions in great detail, especially with respect to the temporal relationship between parcelization and development. As a single example, in 2000, a 40-acre parcel located in Trout Lake Township was split into three parcels of equal acreage, each with a new owner. The parent parcel was adjacent both to the Swan River and to county-owned land. While the parent parcel was classified timberland (for property tax purposes), the three resulting child parcels were classified Seasonal Recreation. None of these child parcels had a building value in 2000. The first child parcel gained $2900 in building value in 2004, but remained classified as Seasonal Recreation (bare land) until 2007, when its property type changed to residential (1 Unit). In the same year, its building value increased to $4200. (This is under this study's $5000 threshold, so the parcel is not considered "developed" yet.) The second child parcel remained classified as Seasonal Recreation (bare land) through 2006, and had no building value during this time. In 2007, its property classification changed to residential (1 Unit), and it gained $10,600 of building value. The third child parcel gained $6400 of building value in 2001, and was classified as residential (1 Unit) at this time. This parcel steadily gained building value until 2007, when its building value was changed to $24,600. (None of these valuations is adjusted for inflation.) Over the 7 years following this parcel split, all three of the child parcels both gained building value and changed in property tax classification.

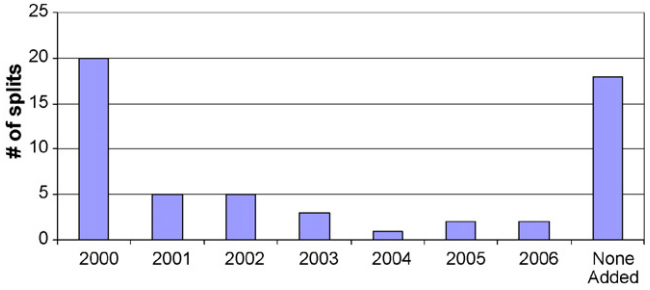

Fig. 4. Year building value was added to child parcels.

3.3. Parcelization of large ownership tracts

The PIN assignment scheme used in Itasca County complicated the identification of splits of large forest parcels (i.e., contiguous ownership tracts greater than 40 acres). For example, a 160-acre tract with one owner might be recorded with four PINs—one for each 40 acre block. The sale of one of the four 40 acre blocks would not be identified using the methodology employed in this study—no new PINs would be created nor would the acreage for each existing PIN change in the second year of our year-to-year comparisons. To deal with this shortcoming, we undertook the supplemental analysis described below.

To assess parcelization activity on contiguous ownership blocks 40 acres or larger, a separate database containing all real estate transactions in the county during the study period was examined. Because this database includes the names of the buyers and sellers of each land sale, it could be used to identify the sale of all 40 acre tracts (i.e., one tract for each unique PIN). Once all 40 acre tracts were identified, we used Itasca County ownership maps (i.e., plat books and digital ownership maps) and determined whether or not the sale was part of a larger contiguous holding. If it was, the sale was considered a split. Additionally, the plat books were used to determine whether the buyer was adding forest land to an existing holding adjacent to the purchased tract. If so, the sale was considered a consolidation.

This supplementary analysis of larger parcels revealed an additional 28 splits and 38 consolidations (Table 1). Several of these parcelization transactions involved the sale of that portion of the holding containing water frontage. On balance, more ownership consolidation than parcelization activity took place on these larger forested tracts. An additional eight sales were both a split and consolidation—the buyer increased existing acreage and the seller decreased existing acreage.

4. Conclusions

We measured the extent and location of forest parcelization activity in a heavily forested Minnesota county between 1999 and

2006 and examined both the immediate and extended relationship between parcelization and development activity. Unique to this study is that we documented forest land parcelization and development activity over time utilizing readily available real estate parcel data.

It is possible that our methodology could be replicated in other geographic areas depending on data availability. Our PIN-based identification of parcel splits is dependent upon Itasca County's parcel numbering conventions. This might need to be altered to fit another area's identification scheme. Moreover, we used Minnesota Market Value Files, which provided a great deal of readily available parcel data that might not be so accessible in other states with other record-keeping systems. Finally, some of our supplementary analysis (adjacency measures, large parcel analysis) made use of Itasca County's parcel-level GIS data. The availability and quality of this data source surely varies across counties and states.

That said, from our analysis we draw five major conclusions about forest land parcelization in Itasca County.

No time trend in parcelization activity. During the 1999–2006 study period, except for a spike in 2001–2002 (which resulted from an administrative change in the property tax record-keeping system), parcelization was fairly constant at a county level. Despite widespread perceptions of rapidly increasing rates of parcelization, we observed no significant positive or negative trend in parcelization activity in Itasca County during the study period. It is possible that our study period falls after a previous stage of increasing activity. Future parcelization studies should strive for longer study periods in order to obtain a better understanding of local parcelization trends over time.

Small rates of forest land parcelization. Given the 366 parcel splits observed, during the study period, only 0.4% of private forest land in Itasca County was parcelized each year. It is important to note that the method of tracking parcelization activity used in this study utilizes a 40-acre threshold, and does not capture parcelization activity below this threshold. Certainly, over an extended period of time, parcelization activity at this rate could have an impact on the economic viability of managing forests for timber, and could prove harmful to water quality, wildlife habitat and recreational interests. A study tracking parcelization with either a higher or lower threshold, or with no threshold at all, would yield different results, and this must be considered both when designing and interpreting a parcelization study.

Parcelization was more common near cities, water, and public lands. The characteristics of the parcel splits observed can provide important clues as to areas within Itasca County that are of the most immediate concern in regards to parcelization. For example, with 36% of splits occurring adjacent to water and 57% adjacent to public land, areas directly bordering water or public land may need to be a priority for protection. Overall, individual circumstances and local concerns need to be considered when setting protection priorities. In Itasca County, the heaviest parcelization activity occurred in the southern half of the county near cities. These areas may provide a good starting point for protective measures, such as zoning regulations and conservation easements, taken by local and state legislators and conservation organizations.

Parcelization often led to development. While the overall rate of parcelization observed in this study may seem meager, and while there was no positive or negative trend observed, the effects of the parcelization should not be viewed as inconsequential. For instance, 54% of the splits observed occurred on previously undeveloped land, and 68% of the splits from 1999 to 2000 alone had building value added within 7 years after division. These numbers suggest that parcelization is intimately tied to development activity, and that this development occurs not long after parcelization. This development activity can change the face of a landscape or a community, and can result in substantial ecological, economic and social ramifications.

Consolidation was more frequent among large acreage parcels. While parcelization is less common on larger (those overt 40 acres in size) forest ownerships, 38 of the 74 sales on such lands were actually consolidations whereby the adjacent landowner was the buyer of these tracts. For several of these sales, the portion of the ownership parcel sold was adjacent to water.

While additional research is clearly required to further quantify the extent and location of parcelization and development activity in other geographic areas of interest, the methodology set forth in this study provides a starting point. Future research should also seek to understand the types of development that affect timber availability, recreational access and ecosystem services, and should examine the net effects of development on local communities, economies, and local units of government.

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