

The Effects of Forestland Parcelization and Ownership Transfers on Nonindustrial Private Forestland Forest Stocking in New York

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ABSTRACT

Nonindustrial private forestland (NIPF) owners control a large percentage of the working forest east of the Mississippi River and supply the forest products industry with the majority of its roundwood requirements. Many of these forests are subject to increasingly frequent parcelization and ownership transfers. Such transfers often are associated with liquidation cuts. This study completed forest inventories on a sample of 137 NIPF woodlots to examine the relationship between parcelization and ownership changes and 23 forest stocking and quality variables. The results indicate that organized subdivisions are associated with lower forest stocking and poorer-quality residual stems. We found no relationship between land tenure and forest stocking and quality. Nonparcelized woodlots with long ownership tenure did not differ in forest stocking and quality.

Keywords: family forests, ownership fragmentation, silviculture, forest management, northern hardwoods, real estate cuts, liquidation cuts

Forestlands account for nearly two-thirds of the land cover throughout the Northeast. Approximately 70% of these forestlands are owned by nonindustrial private forestland (NIPF) owners or what Butler and Leatherberry (2004) refer to as family forest owners, leaving 18% in public hands and 12% owned by timber invest-

ment management organizations and the forest products industry (Smith et al. 2004). In New York State, forests cover 18.4 million ac of land, or 62% of the state's terrain (Smith et al. 2004). Of these forestlands, 15.4 million ac, or 83%, are classified as timberland, which is capable of growing at least 20 ft³/ac per year. In 2005, an estimated 757

mmbf of logs and 1.9 million green tons of pulpwood and chips were harvested from New York timberland. Over three-quarters of the state's log harvest was in five high-value hardwood species (sugar maple [*Acer saccharum*], red oak [*Quercus rubra*], red maple [*Acer rubrum*], black cherry [*Prunus serotina*], white ash [*Fraxinus americana*], and white pine [*Pinus strobus*]; Crawford [2006]). The majority of these high-value logs originate from 13 million ac of timberland controlled by an estimated one-half million NIPF owners (Canham and King 1998, Smith et al. 2004). Germain (1998) reported that New York NIPF owners provide an estimated 90% of the roundwood supply required to sustain the state's primary wood manufacturing industry. Most forest products companies located in states east of the Mississippi River have a similar reliance on NIPF for wood supply (Sampson and DeCoster 2000).

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Continued reliance on NIPF as the primary source for wood fiber is at risk. A variety of impacts associated with parcelization and ownership transfers of NIPF are placing both the quantity and the quality of the wood supply in jeopardy (Barlow et al. 1998, Munn et al. 2002). The effects of parcelization and urban expansion on forestry are well documented in the literature. Nearly 30 years ago, Row (1978) reported on diminishing economies of scale in timber production on smaller forest tracts, particularly those below 25 ac. Parcelization directly affects the potential for forest management by reducing the size of the management unit, often resulting in declining economies of scale, thereby reducing the likelihood of sustainable forest management (Row 1978, Cubbage 1983, Zipperer and Birch 1993, Sampson and DeCoster 2000, Thorne and Sundquist 2001).

Anecdotal evidence suggests that when forest property is conveyed to a new owner, whether intact or subdivided, large or small, it often is subjected to a liquidation cut. The phenomenon occurs when landowners conduct a harvest to capture the stumpage value before selling, often leaving behind wooded, but high-graded parcels with reduced potential for sustained yield management. The degree of cutting intensity varies from full-scale liquidation cuts in which all the merchantable timber is extracted from the parcel, to commercial thinnings that leave a respectable residual stand to the next owner. In many instances, the recent harvest does not impact the selling price of the parcel, particularly when the next owner does not place a high priority on forest management. In fact, some buyers may perceive the harvesting activity, regardless of cutting intensity, as an improvement to the property, particularly if it is a land conversion for future residential development.

In New York, recent baseline NIPF parcelization studies established that the average parcel size of NIPF is declining. Specifically, from 1984 to 2000, an estimated 8,000 new parcels were added to the five-county Catskill Region, resulting in the decline of the mean NIPF parcel size from 19 to 16 ac (Lapierre and Germain 2005). A similar study, completed in Oneida County established that from 1975 to 2000, the mean area of NIPF parcels decreased from 38 to 24 ac (Germain et al. 2006). Together, declining tract size and property conveyance may be conspiring to reduce the ability of NIPF to supply timber, particularly if land-

owners liquidate their timber assets before selling. Although this practice is perceived as commonplace, this is the first study to go beyond the anecdotal and analyze the differences in forest stocking and quality as they relate to parcelization and land transfers. The objective of the study was to examine forest stocking variables as they relate to parcel size, the frequency of property conveyance, and the occurrence and type of parcelization occurring on NIPF.

Methods

The study built on the work of LaPierre and Germain (2005), who quantified the parcelization of private forestlands in four counties (Greene, Schoharie, Sullivan, and Ulster) within the Catskill Region of New York from 1984, the year of oldest available tax maps across the region, through 2000. Caron (2008) replicated that study in neighboring Delaware County.

To investigate the effect of property size and parcelization on forest stocking and quality, an observational study based on a randomized, complete block, factorial design was conducted. Using the combined sample of approximately 6,200 parcels and real property centroid files from the New York State Office of Real Property Services, we selected a stratified random sample of parcelized and nonparcelized forested parcels from each of four acreage classes, using county as a blocking variable. Parcels in Delaware County were blocked together and parcels in the remaining contiguous four counties were blocked together based on the higher prevalence of agricultural land use in Delaware County. Attribute data included in the centroid files provided the means of identifying the experimental factor levels for each property and contacting landowners. For this study, properties were considered parcelized if they were split from a larger ownership sometime between 1984 and 2005, which is the year of the field survey. Properties that were the same size at the time of the field survey as they were in 1984 were considered nonparcelized. This design allowed for testing the main effects of property size and parcelization on the quantity and quality of forest stocking, as well as any interaction between the two factors. A total of 1,267 NIPF owners received a request to participate in the study, which involved both a field assessment of their property and a completion of a follow-up landowner interview (not addressed in this article). Specifically, the letter requested their participa-

Table 1. Frequency distribution of visited NIPF forest properties and sample plots according to parcelization type and property size class.

Property size class (ac)	Parcelization type		Total
	Nonparcelized	Parcelized	
5–9.9	19 (140)	29 (261)	48 (401)
10–49.9	24 (295)	20 (239)	44 (534)
50–99.9	15 (283)	6 (111)	21 (394)
>100	16 (350)	8 (163)	24 (513)
Total	74 (1,068)	63 (774)	137 (1,842)

The total number of properties surveyed in each group is followed by the total number of plots shown in parentheses.

tion in a study looking at forest quality and land-use changes on private forestlands. One hundred eighty-seven landowners or 15% percent of those contacted agreed to participate by returning a card with their contact information. Of the 187 parcels, we randomly selected 137 parcels for field measurements. Given the low response rate, participation bias was a concern. Consequently, we addressed the issue of nonrespondent bias by comparing our average basal area (105 ft²) across the 137 parcels with other regional assessments of NIPF to confirm that our sample was representative. Munsell and Germain (2007) reported an average basal area of 115 ft² on 50 sampled parcels in the Catskill Region; Vickory (2007) reported a similar level of 113 ft² on 50 NIPF parcels in neighboring Oneida County, while 105 US Forest Service forest inventory analysis plots on private land in the region averaged 92 ft² (Miles 2007). With respect to basal area, our sample appears to be representative; nonetheless, results should be viewed accordingly.

During the summer of 2005 we were able to conduct field assessments on 137 parcels, including 63 properties that had been parcelized between 1984 and 2000 and 74 properties that had remained intact since 1984 (Table 1). For each of the visited NIPF properties, we systematically sampled the parcel using basal area factor 10-point samples on a rectangular sampling grid with a randomized start to quantify 23 different variables describing forest stocking and quality, including basal area, species composition, sawtimber volume, and other forest characteristics (see Table 2 for complete list of variables measured). To facilitate ongoing analysis of land use and land cover classification, the sampling grid covered the entire property, including nonforestland. How-

ever, the distance between points along the major grid lines was calculated based on the total forest area and shape of each property to meet or exceed the minimum number of forested point samples established for each of the four different acreage classes. Overall, sampling intensity averaged 13 forested points per property, representing 0.78 points/ac. We completed a total of 1,842 forested points on 137 properties. Measurements taken on each tree at each sampling point included species, dbh, acceptable growing stock (AGS)/unacceptable growing stock (UGS) quality designation, crown position, live crown ratio, and length of sawlogs or pulpwood bolts. The quality of the growing stock was based on whether individual stems had the ability to produce a sawlog in the present or future, with UGS characterized by visible signs of low vigor and poor health, including but not limited to major decay, fungal fruiting bodies, crown dieback, and unacceptable crown damage. Trees of unmarketable species, such as ironwood (*Ostrya virginiana*), striped maple (*Acer pensylvanicum*), and pin cherry (*Prunus pensylvanica*), regardless of vigor and health, were always designated as UGS.

In addition, properties in the parcelized group were further categorized post hoc based on the type of parcelization that had occurred since 1984. Properties resulting from the division of a single parcel into three or more properties of roughly equal size ($\pm 15\%$ of the mean residual property size) were categorized as “organized,” while properties resulting from the division of a single parcel that was divided in half or divided into properties of unequal size (i.e., more than $\pm 15\%$ of the mean residual property size) were categorized as “unorganized.” For example, a 40-ac parcel divided into four parcels of 9.0, 9.5, 10.0, and 11.5 ac was considered part of an organized parcelization. In many cases, properties classified as “organized” also were long and narrow, maximizing road frontage, and were adjacent to the rights-of-way and cul-de-sacs characteristic of organized subdivisions. This designation is intended to capture potential differences between the piecemeal parcelization associated with long-term family ownership and the organized subdivision of property for residential development.

Two additional confounding variables, the frequency of ownership conveyance and the length of ownership tenure, were examined based on property tax information, which was collected in county offices by

Table 2. Summary statistics for all the dependent variables used to quantify the level of forest stocking and quality examined in this study.

Variable	Mean	Standard deviation	Minimum	Maximum
Merchantable mean dbh (in.)	13.5	2.72	7.1	30.0
Quadratic mean DBH (in.)	7.9	1.81	3.4	14.1
Basal area (ft ² /ac)	105.4	25.33	10.0	164.6
Basal area of AGS (ft ² /ac)	57.6	19.36	10.0	110.0
Basal area of high-value species (ft ² /acre)	26.8	18.91	0.0	90.0
Basal area of all hardwood species (ft ² /ac)	80.0	21.99	4.17	100.1
Basal area in AGS (%)	54.6	12.19	23.4	100.0
Basal area in high-value species (%)	26.9	18.62	0.0	80.0
Basal area in NHW component species (%)	48.7	22.22	0.0	96.8
Basal area in NHW-associated species (%)	34.5	17.13	0.0	74.3
Basal area in conifers (%)	19.6	21.84	0.0	95.8
Basal area in saplings (%)	13.3	8.30	0.0	41.6
Basal area in poles (%)	24.6	10.42	0.0	55.2
Basal area in small sawtimber (%)	33.2	10.78	0.0	59.4
Basal area in medium sawtimber (%)	16.8	8.05	0.0	38.1
Basal area in large sawtimber (%)	12.3	12.54	0.0	100.0
Sawlog volume (mbf/ac)	3.08	2.008	0.00	12.06
Volume of high-value species (mbf/ac)	0.88	0.829	0.00	3.64
Pulp volume (tons/ac)	3.91	2.018	0.00	13.03
Relative density ^a	77.4	16.49	28.6	139.0
Relative density of AGS	41.0	12.84	10.4	115.2
Trees per acre	623	373.2	113	2,544
Saplings per acre	480	382.8	13	2,514

^aRelative density describes the degree of crowding in even-aged stands and is used to judge the timing of thinnings; 100% relative density represents the A-line in the stocking guide (Nyland 2002).

linking forest property tax map numbers with deed book and page references. Three levels of the conveyance factor were based on the number of ownership transfers between 1984 and 2005, with parcels grouped by zero, one, and two or more transfers over that period. In addition, the total duration of ownership for the 2005 landowner for each parcel was used to characterize ownership as far back as 1937, allowing us to examine the effects of ownership tenure. Parcels were grouped into three tenure levels: less than 10 years, 10–20 years, and greater than 20 years. Complete property conveyance and tenure data were not available for 14 of the 137 properties in the sample.

Statistical Analysis. The effects of parcelization and property size on the 23 variables used to quantify forest stocking and quality were analyzed using a multiple analysis of variance (MANOVA) procedure with SAS version 9.1 (SAS 2004), with *F* approximations based on Wilks’ lambda used to determine significance. In addition, each response variable was analyzed individually within an ANOVA model. The analyses were based on a randomized, complete block design (with two county groups as the blocking factor), with an unbalanced two-way factorial treatment arrangement. For some cells of the factorial arrangement of our parcel distribution, there were few replications. As

such, inferences on interactions were problematic and for the most part, not significant. Therefore, data were analyzed using an additive model rather than a full factorial model so that the main effects still could be investigated while excluding the possible interactions. Because of the unbalanced design, type III sums of squares and least-squares means were used for individual response variables, with Fisher’s protected least significant difference test used for the means comparison differences among groups based on parcelization and acreage class, with experiment-wise error rate held at $\alpha = 0.10$. These methods also were used to examine the effects of conveyance and ownership tenure.

Overall, we compared 74 nonparcelized properties to 63 parcelized properties, including 36 that resulted from organized subdivisions and 27 that resulted from unorganized parcelization (Table 1). Our sample had approximately 76% of basal area in hardwoods, with the remaining basal area composed primarily of red (*Pinus resinosa*) and white pine and eastern hemlock (*Tsuga canadensis*). Given the dominance of northern hardwoods in the sample, we improved the resolution of our analysis by focusing on plot data from northern hardwood stands within each parcel. The analysis was repeated using the 956 plots that met the cri-

teria for the maple-birch-beech northern hardwood assemblage outlined by Leak et al. (1987). Plots were included in the analysis if they contained at least 65% of basal area in a combination of 4 component species—sugar maple, red maple, yellow birch (*Betula alleghaniensis*), and American beech (*Fagus grandifolia*)—and 12 associated species, with at least 50% of basal area in the component species. Seventeen parcels in the sample did not have any plots that met these criteria. Overall, 52% of the plots in the sample are represented by this maple-birch-beech mix, with the remaining plots dominated by a variety of other species, including oaks and the northern pine-hemlock assemblage.

Results

The entire sample of 137 NIPF woodlots averaged just over 105 ft²/ac of basal area, 3 mbf/ac of volume, and 77% relative density (Table 2). The mean percentage of basal area in AGS was 55%, indicating that just over one-half of the basal area has merchantable sawtimber or has pole-sized stocking with the potential to generate merchantable sawtimber in the future. Approximately one-quarter of the basal area and nearly 30% of the volume was in black cherry, sugar maple, and northern red oak combined.

When comparing the 63 NIPF parcels that had been subdivided since 1984 with 74 parcels that had remained intact, only the mean percentage of basal area in AGS yielded a significant difference, with non-parcelized properties showing a slightly higher percentage of basal area in AGS (55%) compared with parcelized properties (50%; $P = 0.0624$). However, the basal area of AGS was not significantly higher in non-parcelized properties ($P = 0.7386$).

When all 23 forest stocking and quality variables were examined simultaneously in MANOVA, treatment effects were generally weak. However, the type of parcelization had the strongest effect of any of the treatments ($P = 0.0335$), while the number of ownership transfers had the weakest effect ($P = 0.9974$). Interaction between parcel size and type of parcelization was not significant ($P = 0.8095$). ANOVA analyses based on specific, individual forest stocking and quality variables, however, showed significant differences in forest stocking as a result of type of parcelization and parcel size.

When the 63 parcelized properties were further classified based on whether or not they were part of an organized subdivision,

Table 3. Mean values for forest stocking variables among the three different types of parcelization.

Type of parcelization	Forest stocking variable			
	Basal area (ft ² /ac)	Basal area in high-value species (ft ² /ac)	Percent basal area in high-value species	Volume in high-value species (mbf/ac)
Nonparcelized ($n = 74$)	103.1 (2.4) ^{a,b}	29.0 (2.2) ^a	29.7 (2.1) ^a	0.981 (0.097) ^a
Parcelized, unorganized ($n = 34$)	112.2 (3.7) ^a	31.3 (3.3) ^a	30.6 (3.2) ^a	1.068 (0.145) ^a
Parcelized, organized ($n = 29$)	102.8 (4.3) ^b	17.5 (3.9) ^b	19.1 (3.7) ^b	0.557 (0.172) ^b

Means with the same letter in each column are not significantly different ($\alpha = 0.10$). The standard error of the mean is in parentheses.

results appear to support the conventional wisdom regarding liquidation cuts before parcelization, although mean values are generally close to one another. Parcelized properties that were part of an organized subdivision showed significantly lower values for basal area, basal area in high-value species, percent of basal area in high-value species, and volume in high-value species (Table 3).

In comparing the four acreage classes, several significant differences are apparent. The smallest acreage class (5.0–9.9 ac) shows the lowest basal area (99 ft²/ac) and volume (2.4 mbf/ac) of the four classes (Table 4). However, it is worth noting that the trend across the means for the four classes is nonlinear, with parcels larger than 100 ac exhibiting lower basal area and volume than the 10- to 49.9-ac class. The largest acreage class also has the lowest relative density of AGS (36%), with the 10- to 49.9-ac class showing the highest relative density of AGS (46%).

When we examined the effects of parcelization on northern hardwood stands alone, focusing on the 956 plots in this classification, the results were very similar to those using the entire sample of 1,842 plots (Table 5). Overall, the mean basal area for northern hardwood stands across the entire sample was 101 ft²/ac, with approximately 50% of the basal area in AGS. Total sawlog volume was 2.56 mbf/ac. Parcelized properties, including organized and unorganized combined, showed significantly lower percent of basal area in AGS (47% versus 53%; $P = 0.0349$) and lower percent of basal area in high-value species (30% versus 38%; $P = 0.00699$) when compared with nonparcelized properties, although these differences are relatively subtle. Organized parcelization appears to result in lower percent of basal area in both high-value species and AGS, as

well as lower overall sawlog volume in northern hardwood stands (Table 5). Most striking, based on the northern hardwood plots, organized parcelization has a nearly 50% lower volume of high-value species than the nonparcelized properties and properties resulting from unorganized parcelization (Table 5). Again, this result lends support to the perception of liquidation cuts preceding subdivision for residential housing. Regarding parcel size, the smallest acreage class exhibited the lowest volume, with a mean volume of 1.93 mbf/ac in northern hardwood stands, which is consistent with results from the analysis using all plots.

Twenty-four parcels in the sample did not change ownership between 1984 and 2005, 59 were transferred once during that period, and 40 were transferred twice or more. Of the 125 landowners for whom tenure data were available, 38 owned the parcel less than 10 years, 52 owned the parcel between 10 and 20 years, and 35 owned the parcel for more than 20 years at the time of the field survey. The average tenure across the entire sample was 17 years, but we found no effect of the length of ownership tenure. Examining the effect of the number of ownership transfers, we found no relationship between the number of conveyances over the study period and the forest stocking and quality variables. Similarly, when comparing the NIPF parcels that had not been conveyed or parcelized during the study period with those that had been parcelized and/or sold once or more, we found no significant differences among these variables.

Discussion

Entering the study there was strong anecdotal evidence suggesting that parcelization and property transfers lead to liquidation cuts. During his career with the forest

Table 4. Mean values for forest stocking variables among the different property size classes.

Parcel size class	Forest stocking variable				
	Basal area (ft ² /ac)	Sawlog volume (mbf/ac)	Pulp volume (tons/ac)	Relative density of AGS	Trees per acre
5–9.9 ac (<i>n</i> = 49)	98.8 (3.4) ^b	2.40 (0.26) ^b	3.12 (0.28) ^b	39.1 (2.1) ^b	905 (137) ^{a,b}
10–49.9 ac (<i>n</i> = 44)	111.5 (3.4) ^a	3.51 (0.25) ^a	4.33 (0.28) ^a	45.5 (2.1) ^a	893 (134) ^{a,b}
50–99.9 ac (<i>n</i> = 21)	107.0 (5.3) ^{a,b}	2.79 (0.40) ^{a,b}	4.07 (0.44) ^{a,b}	41.0 (3.3) ^{a,b}	1,146 (213) ^a
>100 ac (<i>n</i> = 23)	110.9 (4.9) ^{a,b}	3.27 (0.37) ^{a,b}	4.32 (0.41) ^a	35.7 (3.1) ^b	824 (197) ^b

Means with the same letter in each column are not significantly different ($\alpha = 0.10$). The standard error of the mean is in parentheses.

products industry, the first author witnessed numerous examples of this phenomenon. Although we found subtle differences across a handful of variables, particularly when we examined the type of parcelization (i.e., organized versus unorganized), this study does not provide a “smoking gun” in support of the general perception that liquidation cuts before parcelization and property transfers result in lower-quality residual stands when compared with management practices under more static ownership regimes. Before attempting to discern why our findings are less than dramatic, there are important results worth highlighting.

Regarding the specific type of parcelization occurring since 1984, these data do appear to support the hypothesis that organized subdivision for rural residential development results in lower basal area and volume of high-value species when compared with unorganized or piecemeal parcelization. One interpretation rests on the fact that real estate developers planning a subdivision customarily conduct a liquidation cut on the larger parcel before moving forward with the land surveying process. In general, parcels in the 5.0- to 9.9-ac acreage class showed the lowest stocking and quality, regardless of ownership history. Because organized subdivisions in this region tend to feature 5- to 10-ac parcels, the negative effects are further compounded. We consider subdivisions of this nature as land conversions to rural residential developments with minimal opportunities for forest management. It is interesting to note that our highest mean basal area (112 ft²) and volume (3.6 mbf) per acre occurred in the 10- to 50-ac rather than the 100-plus ac acreage class (Table 4). Larger woodlots provide economies of scale that should encourage sustained yield management (Row 1978, Cubbage 1983); however, acreage alone does not appear to guarantee forest stocking that is consistent with long-term forest management.

Approximately 16% of the forestland parcels in our sample met the perceived gold

Table 5. Mean values for forest stocking variables among the three different types of parcelization considering only those plots that meet the criteria to be considered a northern hardwood plot.

Type of parcelization	Forest stocking variable			
	Percent basal area in high-value species	Sawlog volume (mbf/ac)	Volume in high-value species (mbf/ac)	Percent basal area in AGS
Nonparcelized (<i>n</i> = 66)	38.2 (2.5) ^a	3.01 (0.32) ^a	1.16 (0.12) ^a	52.4 (1.6) ^a
Parcelized, unorganized (<i>n</i> = 24)	36.2 (3.7) ^{a,b}	2.55 (0.18) ^b	1.12 (0.12) ^a	49.1 (2.4) ^a
Parcelized, organized (<i>n</i> = 30)	25.4 (4.6) ^b	1.83 (0.26) ^c	0.58 (0.13) ^b	49.2 (2.9) ^a

Means with the same letter in each column are not significantly different ($\alpha = 0.10$). The standard error of the mean is in parentheses.

standard of forest stewardship—nonparcelized woodlots greater than 50 ac with a single owner with long tenure. The perceived gold standard landowners, some with tenure of 50 years or longer, generally shared the same quantity and quality of stocking with parcelized woodlots and short tenure ownerships. As discussed earlier, large tracts do support economies of scale in management, treatment, and harvesting operations; however, it does not appear that this fact is translating into superior stocking of high-quality timber on large ownerships.

We suspect the subtle nature of our results lie partly in the timing of the study. With the exception of the 28 long-tenure ownerships, the stage could have been set by liquidation cuts before this study’s 1984 threshold. A single ownership transfer before 1984 could have instigated a liquidation event with long-term effects on forest stocking decades into the future (Kenefic and Nyland 2005). Considering the average rotation age of a northern hardwood stand is 80–100 years, a parcel may be conveyed an average of five times during a rotation (assuming a 17-year tenure) and may be parcelized to some extent at each turn. Although this study generally shows weak or nonexistent effects of parcelization and ownership history on forest stocking quantity and quality (with the exception of organized parcelization for development), observed effects

may be weak because we are already well above the thresholds for parcelization and conveyance that result in impacts on forest stand conditions. The initial liquidations cuts likely occurred in the late 1970s and early 1980s when these stands were entering into the sawtimber size class.

Given our reliance on NIPF for wood products, what does this mean for the ability of NIPF to supply wood products into the future? As parcelization and land conversions continue, fewer NIPF acres will be available as working forest. Although the forest products industry is adapting to the realities of smaller woodlots, eventually, parcels become too small to justify forest management or even a one-time harvest. The volume per acre can greatly influence this acreage threshold (Row 1978). Minimum volumes for operable timber sales can vary widely depending on the region, but a common minimum standard in the Northeast is 1,500 bd ft and 5 cords/ac (Marquis et al. 1992). Using this threshold of forest operability, the majority of NIPF parcels represented in this study—large and small, parcelized or intact, short or long tenure—can support one more harvest entry in the coming decade. Thereafter, strong consideration should be given to the process of regeneration. Those industries relying on NIPF for wood fiber, whether traditional forest

products companies or the burgeoning woody biomass sector, should consider these forest stocking issues when planning for long-term wood supply.

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