Parcelization and Land Use: A Case Study in the New York City Watershed

Jennifer A. Caron, Rene H. Germain, and Nathaniel M. Anderson

ABSTRACT

Over 75% of the New York City Watershed is forested, and the majority of the land is owned by family forest owners. Ownership fragmentation and development may impact both the working forested landscape and water quality. We surveyed the owners of intact and subdivided family forest parcels across various parcel sizes to gauge their awareness of forest management practices and to assess the potential property-level impacts of their activities on water quality. To support the landowner survey, we used field data on forest stocking and timber quality gathered at each property. Results indicate that owners of large parcels (>50 ac) had significantly higher water quality awareness scores than did owners of small parcels and were more likely to have a written forest management plan. Full-time resident owners were more likely to engage in practices that may negatively impact water quality more directly, such as adding structures and a driveway, which increases impervious surface area and associated runoff, and using additives on their lawns, which can add nutrients and chemicals to surface water.

Keywords: watershed management, ownership fragmentation, family forests, forest management

Family forest owners play an important role in maintaining forest cover and overall forest health in some of the critical watersheds that provide drinking water supplies. Their understanding of sustainable management can impact forests and water resources. Well-managed forests provide an ideal source of water supply. Fifty percent of the freshwater flow in the lower 48 United States originates in forests, and 180 million residents rely on forested watersheds for their drinking water (Stein and Butler 2004). Forty-two percent of the 620 million ac of forestland in the lower 48 United States are privately owned by an estimated 10.4 million family forest owners (Butler 2008).

Parcelization, the division of large parcels into smaller parcels, can make it challenging for land managers to manage forest and water resources effectively (Germain et al. 2006, Vickery et al. 2009). A property that is subdivided before it is sold can create opportunities for second homeowners, retirees, or other new, full-time landowners to purchase a rural residential parcel in a forested area. The process of parcelization on an individual property scale has minimal impact but in aggregate can have significant negative consequences for forested watersheds. It leads to smaller average parcel size, which can reduce the resources available for wood products and negatively impact water quality by reducing economies of scale in forest management and increasing nonpoint source pollution, particularly erosion intensified by impervious surface area. Additionally, the values of and intended land uses for newly created parcels vary with the increased diversity of landowners.

New York City is a high-profile example of a city that must preserve the rural character of its water source to maintain high water quality. The Catskill and Delaware watersheds (henceforth, the Watershed), which provide approximately 90% of the drinking water supply to New York City, spans 1,625 square miles and includes six reservoir basins and two major watersheds, the Catskill to the east and the Delaware to the west (Figure 1). The Watershed is approximately 78% forested (Hall et al. 2008).

Previous studies have indicated that parcelization of private forestland is occurring in both the Catskill and Delaware watersheds (LaPierre and Germain 2005, Hall et al. 2008). Between 1984 and 2000, the average parcel size dropped from 18 ac to 14 ac within the Catskill watershed counties and from 27 ac to 23 ac within Delaware County. For the Watershed as a whole, the influx of new parcels resulted in a decline of average parcel size from 19 to 16 ac over that period. Most notable is the increase in the total number and aggregate area of parcels in the 5- to 10-ac class—a lot size that is especially appealing to homeowners interested in the aesthetic values and privacy provided by a residence on a forested parcel (LaPierre and Germain 2005, Hall et al. 2008).

In this article, we seek to understand how parcel size and the history of subdivision influence the types and intensity of land use and forest management that owners engage in on their forested properties. To meet these objectives, we surveyed family forest owners throughout the Catskill and Delaware watersheds to gauge their awareness of forest management practices, their awareness of activities and factors affecting water quality in a forested watershed, and to identify the potential property-level impacts of their activities on water quality. To supplement the landowner survey, we used field data on forest stocking and quality collected at each property (Germain et al. 2007).

Methods

This case study of family forest owners was part of a larger study that required rigorous on-site data collection on forested properties in the Watershed. A sample of parcelized and intact properties was

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Jennifer A. Caron (jennifercaron8@gmail.com), California Public Utilities Commission, San Francisco, CA 94102. Rene H. Germain (rhgermai@esf.edu), SUNY-ESF FNRM, 316 Bray Hall, 1 Forestry Drive, Syracuse, NY 13210. Nathaniel M. Anderson (nathanielanderson@fs.fed.us), USDA Forest Service, Missoula, MT 59807. University of Montana. *This study was partially funded by the McIntire-Stennis program.*

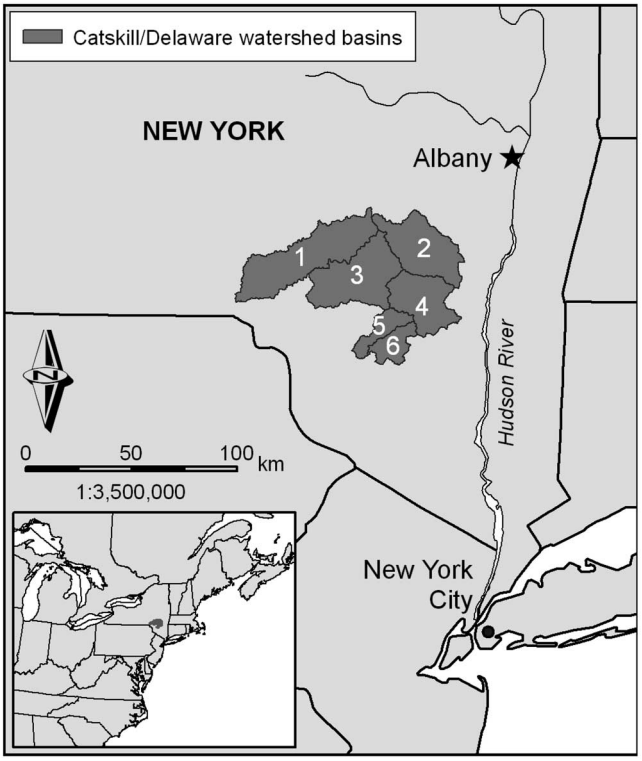

Figure 1. Location map of the Catskill/Delaware Watershed and reservoir basins: (1) Cannonsville, (2) Schoharie, (3) Pepacton, (4) Ashokan, (5) Neversink, and (6) Roundout. The Delaware Watershed includes the Cannonsville and Pepacton basins.

derived from previous studies by LaPierre and Germain (2005) and Hall et al. (2008). Parcelized and intact properties in the Watershed were identified from tax maps of the portions of the five counties (Delaware, Greene, Schoharie, Sullivan, and Ulster) that fell within the Watershed. This was done by comparing boundaries on year 2000 digital tax maps with paper tax maps from 1984 and using Arcview GIS to create new shapefiles that contained the properties that had been parcelized between these years and the properties that remained intact. A random subsample was created from the identified parcels, which was stratified by region of Watershed (Catskill or Delaware), parcel type (parcelized or intact), and acreage class. Counties in the subsample were divided as they were for the creation of the sample: The four Catskill counties were grouped together and Delaware County was separate. If a landowner owned more than one parcel in the subsample, the first parcel was kept in the subsample and the others were removed.

The goal of the fieldwork was to perform assessments on 30 parcels in each of the following groups: Catskill parcelized; Catskill intact; Delaware parcelized; and Delaware intact.

Based on the hypothesis that forest management, land use, and landowner perspectives vary with parcel size, the subsample was also stratified by acreage class. This study used the acreage classes described in LaPierre and Germain (2005): 5.0–9.9 ac, 10–49.9 ac, 50–99.9 ac, and greater than 100 ac of land. Because there are more parcels in the lower acreage categories, 25% of the parcels in the 5–9.99 and 10–49.99-ac classes were randomly selected to be included in the subsample. For both the 50–99.99 and >100 acreage classes, the sample was halved (Tables 1 and 2). The representation of the four acreage classes in each group was based on the total number of parcels in the subsample (Table 1).

Using parcel attribute data, we contacted 1,267 family forest owners (sum of column "parcels in subsample" in Tables 1 and 2) by mail to request permission to complete an on-site field survey and the landowner survey. Tax maps were examined again after the field season to ensure that none of the sampled properties in either parcelization group were further parcelized between 2000 and 2005, the year of the field survey. One hundred eighty-seven landowners were willing to allow a field assessment. During the summer of 2005, we conducted field assessments on 138 parcels, including 64 subdivided properties and 74 intact properties (Table 3). In the field, we systematically sampled each parcel using variable radius point samples on a rectangular sampling grid. 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 ft^2) across the sample with other regional assessments by Miles (2007) (92 ft^2) and Munsell and Germain (2007) (115 ft^2) to confirm that our sample was representative. A comprehensive description of the forestry field methods is included in Germain et al. (2007).

Data quantifying the duration of ownership tenure were collected in county offices by linking forest property tax map numbers with deed book and page references, allowing us to determine average ownership tenure. Tenure was also confirmed through the landowner survey. Parcels were grouped into three tenure levels: less than 10 years, 10 to 20 years, and more than 20 years.

Landowner Survey

A landowner survey was developed to complement and enrich the field data. The purpose of the landowner survey was to gather data from the property owners whose parcels had been visited. There were four objectives for the survey: (1) to determine whether owners were managing their forests, (2) to understand how owners used their land, particularly what improvements they made to their property during the parcelization study period, between 1984 and 2000, (3) to measure landowners' understanding of forest management, as well as their awareness of activities and factors affecting water quality in a forested watershed, and (4) to collect demographic information.

Demographic and forest management questions were drafted in part by using the *Private Forest Landowner's Survey of the United States* and the *National Woodland Owners Survey of America's Family Forest Owners* as guides (Birch 1996, Butler and Leatherberry 2004). Survey questions were also formulated with input from a stakeholder meeting held in the Watershed in November 2004. Demographic questions included type of resident (nonresident, full-time, or seasonal), length of ownership tenure, age, education and income. Two multi-item summated rating scales were created to measure landowner awareness of water quality and forest management (Specter 1992). Both scales used ten statements to interpret landowners' awareness of property-level impacts on water quality and forest management. The forest management scale included items on sustained yield management, forest aesthetics, and wildlife habitat. The water quality scale included items related to the impact of harvesting and homeowner activities on water quality. Cronbach's alpha was used to test if the questions for each of the scales were measuring a single construct. A pilot survey administered to 25 respondents resulted in favorable Cronbach's alpha scores of 0.85 and 0.80 for the forest management and water quality assessment scales.

The survey was mailed to the 138 landowners from the subsample whose properties received a field assessment in the summer

Table 1. Catskill counties: Sample and development of the subsample.

Acreage class	Number of parcels in the sample	Percent needed from sample	Number of parcels in the subsample	Percent of total subsample parcels	Minimum number of field visits
Parcelized					
5–9.99	316	25	79 (= 316 × 0.25)	45 (= 79 × 100/175)	14 (= 30 × 0.45)
10–49.99	190	25	48	27	8
50–99.99	53	50	27	15	5
>100	41	50	21	12	4
Total	600		175	100	30
Intact					
5–9.99	557	25	140	35	10
10–49.99	528	25	132	33	10
50–99.99	146	50	73	18	6
>100	109	50	55	14	4
Total	1340		400	100	30

Table 2. Delaware county: Sample and development of the subsample.

Acreage class	Number of parcels in the sample	Percent needed from sample	Number of parcels in the subsample	Percent of total subsample parcels	Minimum number of field visits
Parcelized					
5–9.99	332	25	83	55	16
10–49.99	185	25	47	31	9
50–99.99	25	50	13	8	3
>100	18	50	9	6	2
Total	560		152	100	30
Intact					
5–9.99	532	25	133	25	7
10–49.99	743	25	186	34	10
50–99.99	198	50	99	18	6
>100	243	50	122	22	7
Total	1716		540	100	30

Table 3. Number of survey respondents by stratum.

Property type	No. of properties visited	No. of survey respondents	Percent responded to survey
Parcelized	64	52	81.3
Catskill	36	31	86.1
<50 ac	28	25	89.3
>50 ac	8	6	75.0
Delaware	28	21	75.0
<50 ac	23	17	73.9
>50 ac	5	4	80.0
Intact	74	64	86.4
Catskill	40	34	85.0
<50 ac	24	21	87.5
>50 ac	16	13	81.3
Delaware	33	29	87.8
<50 ac	17	14	82.3
>50 ac	16	15	93.7

of 2005. One hundred four questionnaires were returned, of which 18 were late responders. Additionally, twelve landowners participated in the survey by phone. In total, the response rate was 84 percent (Table 1). To gauge nonresponse bias within the case study sample, survey responses of late respondents were compared to those of early respondents. There was no significant difference between early and late responders. Because of the self-selected nature of the sample, we had no means to compare the surveyed landowners with nonrespondents from the original sample frame of 1,267 landowners. Consequently, results should be viewed accordingly. The final Cronbach alpha scores were 0.87 and 0.68 for the forest management and water quality assessment scales.

SPSS Versions 12 and 16 were used to analyze the data. The scores for both scales were reversed and log transformed to normalize the data to meet the assumptions of analysis of variance (ANOVA). The log-transformed scales are considered to be continuous variables. Factorial 2×2×2 ANOVAs were conducted with two levels of each of three categorical variables: watershed (Catskill/Delaware), acreage class, and parcel type (parcelized/intact). The scales were not designed to be analyzed using ordinary least squares or a logistic regression. Pearson's chi-square test was used to identify statistically significant associations between all of the categorical variables, including groupings based on survey responses, with the effect size used to inform interpretations of significant test results. For example, we tested for independence between each survey question and parcel size class, and independence between each question and parcel type. Even though the subsample was specifically designed to test against these two variables, size class and parcel type, we also tested awareness and management questions for independence from the demographic responses. Because of the small sample size, the large number of strata, and the small number of responses to some questions, the sample sizes for responses based on owner classes in different strata were very small. To prevent the violation of assumptions in the chi-square tests, the responses to several questions in the survey were aggregated and the acreage class variable was reorganized from four classes to two classes: less than 50 ac (small) and greater than 50 ac (large). ANOVA was also used to compare the mean scores of the forest management awareness scale with groupings based on forest stocking measures, including percentage basal area, acceptable growing stock, and total volume. The Games Howell post hoc test was used to compare pairs from the ANOVAs. All of the statistically significant results are reported. Tables include the results of all of the chi-square tests.

Table 4. Demographic information by percent for size class.

Question	Answer	Total responses	5–49.99 Ac	>50 Ac
Age (yr)		$n = 116$	$n = 77$	$n = 39$
	≤44	5	7	3
	45–54	28	27	28
	55–64	32	34	28
	≥65	35	32	41
Education		$n = 115$	$n = 76$	$n = 39$
	High school or less	15	14	18
	Tech/some college	28	29	26
	Undergraduate degree	16	13	23
	Graduate/professional degree	41	44	33

Results

Demographics

Sixty-seven percent of the surveyed landowners were over age 55, and 35 percent of the landowners were over 65 years old. Fifty-seven percent had completed a bachelor's degree or higher. Forty percent of participants had a master's or professional degree (Table 4).

Owners were asked about type of residency and intentions to subdivide or sell their land in the future. Fifty percent of respondents live in a different county than their forested property. Forty-one percent of respondents are full-time residents (resident owners), 35 percent are nonresidents, and the remaining 24 percent are seasonal residents. Of those resident owners who have moved to their forested property in the last 20 years, over 50 percent describe the area that they moved from as suburban. Over 30 percent of the seasonal and nonresidents describe the area they live in as urban, and half live in a suburban area (Table 5). 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 was 17 years.

Forestland Use and Values

Landowners were asked to choose up to three reasons, from a list of nine, that best describe why they own their forestland, with space provided for a write-in description. Enjoyment was the most common response. Recreation, wildlife viewing, and "because the forest is part of the residence" were the next most common responses. Only six landowners chose timber management as one of their reasons for forest ownership. Similarly, five landowners chose investment to describe a reason for ownership. Write-in answers can be grouped in four categories: location of future home, hunting, preservation of forestland, and maple syrup production (Table 6).

Landowners were also asked to choose three items that best described the benefits they expected to derive from their property in the next ten years. The most common responses were enjoyment of the woods, wildlife, and green space. The second most common response was recreation. Timber production was selected least frequently to describe future benefits for the property owner. Additional benefits written in by landowners included preservation of forestland, future home location, privacy, and for their grandchildren to enjoy (Table 6).

Forest Management and Awareness Scores

Landowners were asked several questions about their forest management practices. In total, 28 owners (24%) sought advice from a forester. Twenty-four landowners (21%) had written management plans, with 20 plans (83%) written by a forester. Landowners with larger parcels (>50 ac) were four times more likely to have a written management plan ($\chi^2 = 9.831$, $P = 0.002$). Thirty-eight landowners (34%) had a commercial harvest on their properties during their ownership tenure. Of these, seventeen landowners (45%) had their harvests managed by a forester. More than half (58%) of the participants do not intend to harvest.

Landowners who used a forester to develop a written management plan had a higher mean score on the forest management assessment, indicating deeper knowledge of forest management practices than landowners without a management plan ($F = 7.923$, $P = 0.006$). Based on the results of the field assessments, landowners with better-stocked forests, as quantified by a higher percentage basal area in acceptable growing stock combined with higher total volume (bdft) did not have significantly different mean forest management assessment scores than did landowners with more poorly stocked forests. The portion of landowners who have a written management plan is three times greater for owners living in the same county as their property than for owners living in a different county ($\chi^2 = 5.48$, $P = 0.05$). There was no statistically significant difference in the forest stocking between owners who had a written management plan and those who did not. Additional grouping variables from the survey that were tested but had no statistically significant effect on forest stocking measures include length of ownership, type of resident, county of residence, reasons for owning property, expected benefits from ownership, frequency of use, age, and education level.

Land Use and Property Improvements

The sample design did not allow for comparisons between landowners who differ in their residency status. However, there are several notable differences among residency groups, particularly regarding land use on the nonforested portions of their property. Nearly half of the respondents have built some type of structure on their property during their ownership tenure, but less than one-third added a new driveway (otherwise a primitive grass and dirt driveway). Forty-seven percent of landowners stated that they added a garden or expanded or added a lawn. Additionally, 36% of landowners used fertilizers, pesticides, or other additives for lawn or garden maintenance (Table 7). The proportion of resident landowners who have added a structure or driveway is 2.2 times greater than that of seasonal or nonresidents ($\chi^2 = 6.896$, $P < 0.05$). Additionally, the proportion of owners living in the same county as their property who added a driveway or structure is 2.4 times more than owners living in a different county ($\chi^2 = 5.053$, $P < 0.05$). The proportion of resident landowners that used additives, such as fertilizers and pesticides, on their lawns and gardens is 3.9-times greater than seasonal and nonresident owners ($\chi^2 = 38.568$, $P < 0.0001$). Similarly, the proportion of landowners who use additives on their lawns or gardens is 7.9 times greater for owners living in the same county as their property than for owners living in another county ($\chi^2 = 26.183$, $P < 0.0001$).

Water Quality Awareness

Owners' awareness of activities that can have an impact on water quality was assessed through a summated scale. When comparing mean water quality assessment scores, acreage class was the only stratum for which the means were significantly different. Owners with large properties scored significantly higher than owners with parcels less than 50 ac. The mean score of owners with larger parcels

Table 5. Ownership trends by percent for size class.

Question	Answer	Total responses	5–49.99 Ac	>50 Ac
Plans to sell in		$n = 112$	$n = 74$	$n = 38$
$\chi^2 = 3.091$, $P = 0.213$	≤10 yr	19	20	14
	11–20 yr	3	6	0.0
	≥21 yr/won't sell	78	74	86
Plans to subdivide		$n = 113$	$n = 75$	$n = 38$
$\chi^2 = 0.241$, $P = 0.624$	Yes	9	8	11
	No	91	92	89
Live in same county		*n = 116*	$n = 77$	$n = 39$
	Yes	50	53	44
	No	50	47	56
Type of occupant		$n = 116$	$n = 77$	$n = 39$
	Full-time; >8 mo	41	39	46
	Seasonal; <8 mo	24	26	21
	Nonresident visit	35	35	33
Full-time owners moved from		$n = 38$	$n = 27$	$n = 11$
	Urban	29	30	27
	Suburban	55	59	46
	Rural	16	11	27
Seasonal and resident owners 1st home in		$n = 66$	$n = 46$	$n = 20$
	Urban	32	33	30
	Suburban	51	54	45
	Rural	17	13	25

Table 6. Forestland values and use by percent for size class.

Question	Answer	Total responses	5–49.99 Ac	>50 Ac	χ^2	*P* value
Reason for owning forest[a]		$n = 116$	$n = 77$	$n = 39$		
	Investment	5	5	5	$\chi^2 = 0.003$	$P = 0.959$
	Recreation	15	15	17	$\chi^2 = 1.774$	$P = 0.183$
	Timber production	5	3	8	$\chi^2 = 5.23$	$P = 0.022$
	Domestic use	6	6	5	$\chi^2 = 0.003$	$P = 0.955$
	Enjoyment	22	24	18	$\chi^2 = 1.621$	$P = 0.203$
	Part of farm	3	1	6	$\chi^2 = 8.383$	$P = 0.004$
	Part of residence	14	14	13	$\chi^2 = 0.140$	$P = 0.709$
	Estate to pass on	10	10	10	$\chi^2 = 0.041$	$P = 0.839$
	Wildlife viewing	14	16	11	$\chi^2 = 1.715$	$P = 0.190$
	Other (write in comment)	6	6	7	—	
Future benefits of owning forest[a]		$n = 116$	$n = 77$	$n = 39$		
	Investment	12	15	11	$\chi^2 = 1.427$	$P = 0.232$
	Recreation	22	21	21	$\chi^2 = 0.012$	$P = 0.811$
	Timber production	7	2	15	$\chi^2 = 18.604$	$P = 0.0001$
	Domestic use	11	12	8	$\chi^2 = 0.911$	$P = 0.340$
	Enjoyment	32	34	29	$\chi^2 = 4.991$	$P = 0.025$
	Firewood	10	10	10	$\chi^2 = 0.047$	$P = 0.829$
	Other (write in comment)	6	6	6	—	
Recreational activities[b]		$n = 116$	$n = 77$	$n = 39$		
	Mountain biking	3	3	2	$\chi^2 = 0.049$	$P = 0.824$
	Dirt biking	3	1	5	$\chi^2 = 6.476$	$P = 0.011$
	Cross-country ski	8	7	8	$\chi^2 = 1.923$	$P = 0.166$
	Snowmobiling	5	4	8	$\chi^2 = 6.777$	$P = 0.009$
	4-wheeling	9	6	12	$\chi^2 = 8.476$	$P = 0.004$
	Hunting	16	14	18	$\chi^2 = 8.004$	$P = 0.005$
	Hiking	26	30	23	$\chi^2 = 0.911$	$P = 0.340$
	Wildlife viewing	30	35	24	$\chi^2 = 0.005$	$P = 0.946$

[a] Owners were asked to check as many as three answers that best described their reasons for owning property.
[b] Owners were asked to select as many recreational uses as applied.

was 5.23 (SE = 0.087) out of 6 compared to 4.91 (SE = 0.092) out of 6 for owners of smaller parcels (F = 6.234, $P = 0.014$).

Discussion

A few trends were detectable from this group of 138 landowners, based on whether a property had been parcelized or remained intact between 1984 and 2000. When examining the impact of parcelization, it is important to consider the trend toward smaller parcels because the size of forest holdings influences management objectives and options (Butler 2008). The number of small parcels is increasing at a high rate across the study region. For example, in the NYC watershed between 1984 and 2000 parcelization resulted in a 29 percent increase in parcels in the 5 to 49.9-ac size class (LaPierre and Germain 2005). Furthermore, the same study reported a 43 percent increase in parcels between 5 and 9.9 ac. Eventually, most of these newly parcelized properties are developed with structures and driveways, further increasing impervious surface area coverage throughout the Watershed (Hall et al. 2008).

This study clearly documents that owners of large parcels (>50 ac) had significantly higher water quality awareness scores than did

Table 7. Land use by percent for parcel type and size class.

Question	Total responses	Parcel type		Size class	
		Intact	Parcelized	5–49.99 Ac	>50 Ac
Graze livestock	$n = 111$	$n = 61$	$n = 50$	$n = 73$	$n = 38$
% yes	6	10	2	0	18
Mow fields	$n = 111$	$n = 60$	$n = 51$	$n = 74$	$n = 37$
% yes	60	67	51	53	73
Return field to forest	$n = 82$	$n = 46$	$n = 36$	$n = 52$	$n = 30$
% yes	13	11	17	17	7
Built a structure	$n = 110$	$n = 60$	$n = 50$	$n = 73$	$n = 37$
% yes	48	55	40	44	57
Added a driveway	$n = 110$	$n = 60$	$n = 50$	$n = 74$	$n = 36$
% yes	29	27	32	31	25
Planted a garden	$n = 110$	$n = 59$	$n = 51$	$n = 73$	$n = 37$
% yes	47	47	47	49	43
Established a lawn	$n = 109$	$n = 59$	$n = 50$	$n = 74$	$n = 35$
% yes	33	31	36	38	23
Expanded lawn	$n = 110$	$n = 60$	$n = 50$	$n = 73$	$n = 37$
% yes	30	27	34	29	32
Established forest road	$n = 110$	$n = 60$	$n = 50$	$n = 74$	$n = 36$
% yes	35	38	30	27	50

owners with small parcels. In addition, this cohort of landowners is more likely to have a written management plan. Given their important role of maintaining water quality, it is encouraging that larger landowners, who in aggregate control more area in the watershed, are engaged in the management of their property through management plans. This level of engagement is perhaps translating into higher water quality awareness. We qualify this relationship because we found no relation between the presence of a management plan and forest stocking. None of the many variables examined had an influence on forest stocking, which was reported on average as mediocre across the board (Germain et al. 2007). We did, however, find a significant relationship between the presence of a management plan written by a forester and forest management awareness, suggesting some level of engagement, but not necessarily translating into on-the-ground results.

Type of residency appears to be an important factor to consider when studying the impacts of parcelization. Resident owners were more likely to add structures and a driveway. If properties are subdivided and the new owners live far away, they may not invest in adding structures to their properties. When an owner transitions from a part- to full-time residency on their property, they appear to be more willing to commit resources to making property improvements. The transition results in more impervious surface area on the landscape and potentially additional runoff. Resident owners were also more likely to engage in practices that may impact water quality more directly, such as using additives on their lawns. It is important to note that owners living within the same county as their property (perhaps resident) were more likely to have management plans. Whatever stewardship benefits a management plan may provide, may be countered by the increased impervious surface area generated by resident owners.

Beyond Parcelization

Although the sample size was relatively small, it is worth noting the ways in which this self-selected high-resolution case study group mirrors or differs from the National Woodland Owners Survey (Butler 2008). Such a comparison may help shed some light on regional differences among family forest owners, as well as facilitate interpretation of the results for resource managers. Among the key similarities between this group of NYC watershed landowners and their national counterparts are that they are older than the general population, share the same general reasons for owning forestland, and have harvested their properties at the same frequency. Their top reasons for owning forestland, as well as for projected future benefits, included enjoyment, recreation, wildlife viewing, maintaining green space, and part of residence.

Some notable differences include educational level, land tenure, use of management plans, and intentions to sell. These differences can either facilitate or pose challenges to forest management and water quality, depending on how they are manifested in landowner behavior.

Educational level is likely to be neutral in terms of its overall influence on forest management and water quality. The study respondents reported more formal education than their national counterparts, with 85% with some college versus 62% at the national level. Particularly noteworthy is that 41% of the study respondents completed graduate degrees, more than twice reported by national respondents. A majority of the case study respondents originate from suburban areas in and around the greater NYC region, where access to higher education is readily available and customary, especially for families in higher income brackets. The average land tenure for the case study was 17 versus 25 years at the national level. The shorter tenure implies that parcels are turning over at a faster rate, which can lead to more liquidation harvesting, selling and subdividing of parcels, and subsequent development—none of which contributes to forest management and maintaining water quality. On a similar note, 19% of the study respondents reported intentions to sell their forested parcel in the near future. This figure is quite high when compared to the 4% reported by national family

forest owners. Further, 9% of the study respondents expressed intent to subdivide their property, versus less than 1% at the national level.

On a more positive note, 21% of the study respondents have written management plans compared to the national average of 3%. Munsell and Germain (2004) reported a similar figure of 20% for the NYC watershed study, in which they found an association between participation in forestry extension activities and use of a management plan. The high percentage of management plans in the NYC watershed is strongly linked to the significant presence of the Watershed Agricultural Council (WAC) Forestry Program. WAC conducts forestry extension activities and subsidizes the completion of forest management plans for family forest owners who hold at least ten ac of forestland and who do not presently have a management plan. Beyond providing information about the timber resource, the plans contain water quality–specific provisions for managing riparian areas and implementing best management practices (WAC 2010). Landowners living within the same county as their forested property were more likely to have a management plan, suggesting that localized outreach is effective when the target audience is geographically available. Written forest management plans have long been viewed as a promising vehicle for building knowledge and stewardship among forest owners. Not only do plans foster sustainable forestry, but they also serve to educate and engage forest owners. When family forest owners better understand their forests and are active in management, they are more apt to become better stewards (Laford and Parker 1988, Best and Wayburn 2001). Unfortunately, as previously reported, our results are mixed on the relationship between forest stewardship and management plans.

Conclusions

As the dominant landowner group in the region, family forest owners hold the key to water quality. It is somewhat disconcerting that the respondents from this case study are more likely to sell and subdivide than their national counterparts. High property taxes in the region can exacerbate parcelization by making timber management unable to cover the costs of ownership, further inducing landowners to subdivide and sell (D'Amato et al. 2010). As new parcels become developed, water quality will suffer. Watershed resource managers may not be in a position to slow the rate of parcelization. This makes it all the more important to promote wise stewardship on these new, smaller parcels. Many of the landowners have suburban roots, which may contribute to a lack of awareness about forest stewardship and water quality — particularly with respect to owners of smaller parcels. Their lack of interest in forest management and associated timber harvesting is not a problem for water quality. In fact, undisturbed forest cover is good for water quality. The issue with smaller parcels is the potential for development, which brings a myriad of water quality externalities. As larger parcels are subdivided and subsequently developed, it is critical that resource managers work closely with owners on strategies to manage water pollutants and curtail surface flow from their respective properties.

Whereas helping small parcel owners become better stewards, it is also important to maintain a high percentage of forestland in large parcels (>50 ac). Sustainable forest management on large parcels is compatible with water quality. This two-pronged approach of improving stewardship on small parcels and maintaining large parcels could serve as a strategy for ensuring long-term water quality in this high-profile watershed.

Literature Cited

Best, C., and L.A. Wayburn. 2001. *America's private forests: Status and stewardship.* Island Press, Washington, DC. 268 p.

Birch, T.W. 1996. *Private forest-land owners of the United States, 1994.* USDA Forest Service Northeast Experiment Station Resource Bulletin NE-134. USDA Forest Service, Radnor, PA.

Butler, B.J. 2008. *Family forest owners of the United States, 2006*. Gen. Tech. Rep. NRS-27. U.S. Department of Agriculture, Forest Service, Northern Research Station, Newtown Square, PA. 72 p.

Butler, B.J., and E.C. Leatherberry. 2004. America's family forest owners. *J. For.* 102(7):4–9.

D'Amato, A., P. Catanzaro, D. Damery, D. Kittredge, and K. Ferrare. 2010. Are family forest owners facing a future in which forest management is not enough? *J. For.* 108(1):32–38.

Germain, R., K. Brazill, and S. Stehman. 2006. Forestland parcelization in Upstate New York despite economic stagnation and a declining population. *North. J. Appl. For.* 23(4):280–287.

Germain, R.H., N. Anderson, and E. Bevilacqua. 2007. The effects of forestland parcelization and ownership transfers on nonindustrial private forestland forest stocking in New York. *J. For.* 105(8):403–408.

Hall, M., R. Germain, M. Tyrrell, and N. Sampson. 2008. *Predicting water quality from land use change projections in the Catskill-Delaware watersheds.* Prepared for the New York State Department of Environmental Conservation, Albany, NY. 448 p.

Laford, R.J., and R.G. Parker. 1988. Forest management plans for private landowners: An evaluation of New Hampshire's experimental cost share program. *J. For.* 86(10):19–21.

LaPierre, S., and R.H. Germain. 2005. Parcelization of private lands in the New York City Watershed. *J. For.* 103(3):139–145.

Miles, P. 2007. *Forest inventory mapmaker web-applications version 2.1.* US For. Serv. North Central Research Station, St. Paul, MN. Available online at www.ncrs2.fs.fed.us/4801/fiadb/index.htm; last accessed Sept. 10, 2007.

Munsell, J.F., and R.H. Germain. 2004. Forestry extension participation and written forest management plan use in the New York City's water supply system. *J. Extension* 43(2):1–11.

Munsell, J.F., and R.H. Germain. 2007. Woody biomass energy: An opportunity for silviculture on nonindustrial private forestlands in New York. *J. For.* 105(8):398–402.

Spector, P.E. 1992. *Summated rating scale construction: An introduction*. Sage Publications, Newbury Park, CA.

Stein, S., and B. Butler. 2004. *On the frontline: Private forests and water resources*. US Department of Agriculture, Forest Service, Wildland Waters, FS 790. 24 p.

Vickery, B., R. Germain, and E. Bevilacqua. 2009. Urbanization's impact on sustained yield management as perceived by forestry professionals in central New York. *For. Policy Econ.* 11(1):42–49.

Watershed Agricultural Council. 2010. *Watershed farm and forest: 2009 annual report*. Watershed Agricultural Council, Walton, NY. Available at www.nycwatershed.org/pdfs/WFF%20AnnRept%202006%20Final%20.pdf; last accessed Dec. 10, 2010.