

MANAGEMENT FOR TIMBER PRODUCTIVITY: CURRENT STATUS AND TRENDS IN MINNESOTA

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ABSTRACT.—Based on surveys of management practices on about 50% of the timberland in Minnesota, we describe the current silvicultural trends in the 1990's. Between 1991 and 1996, statewide harvest increased slightly (8% by volume, 11% by acres). A greater emphasis on thinning was a significant factor in the rise in total acreage harvested. During the same time, the proportion of acres clearcut decreased from 89 to 86%. Residuals were left on 77% of the acreage harvested, double the proportion in 1991. The amount of natural regeneration increased by 7% while artificial regeneration decreased by 19% between surveys. Artificial regeneration efforts showed greater emphasis on site preparation, especially chemical site preparation, rather than later release. Overall, forest management trends in Minnesota seem to be moving toward a more intensively managed, but also more diverse forest.

In 1990, Minnesota initiated a Generic Environmental Impact Statement (GEIS) on timber harvesting and forest management (Jaakko Pöyry 1994). Part of that study collected and summarized basic information about silvicultural practices in Minnesota (Jaakko Pöyry 1992). To remain useful, this information needs to be updated periodically. A broad assessment of silvicultural practices and trends will help policymakers, industry groups, and others concerned about forest ecosystems. This study provides an update of current silvicultural practices developed at the request of the Minnesota Forest Resources Council (Puettmann *et al.* 1998). A comparison of the 1996 information with silvicultural practices applied in 1991 is a basis for investigation of current trends in forest management.

SURVEY OF PRACTICES

The survey of forest land managers in Minnesota was developed and administered during the spring of 1997, asking questions about practices employed during 1996. Survey questions were similar to those used in the 1991 survey. Each survey contained sections for background information, harvesting or silvicultural practice, and open-ended questions. The questionnaires were distributed to all major timberland owners (2 state agencies, 13 counties, 2 national forests, 6 forest industry firms, and 7 Native American bands). Nonindustrial private forest (NIPF) landowners, who own almost half the timberland in Minnesota, were excluded because a comprehensive address list was not available.

ANALYSIS

The survey data were summarized to compare 1996 and 1991 survey results, primarily in terms of percent. Estimates were also developed for the total area with harvesting and silvicultural activity statewide. This step assumed that (1) the relative proportions of harvesting and silvicultural systems used on nonsurveyed land was the same as on land covered by the surveys and (2) the average volume per acre harvested or treated under each harvesting or silvicultural system did not differ with ownership.

RESULTS

Twenty-five respondents completed the silviculture survey questionnaire. These respondents represented 100% of state, county, and federal land; 50% of industrial; and 86% of Native American ownerships. Because the respondent pool and the acreage covered by the silviculture survey were similar (1% smaller) to those in the 1991 survey (Jaakko Pöyry Consulting, Inc. 1992), the data obtained for 1996 are comparable to 1991 survey responses. The following discussion focuses on this comparison, but is limited to land holdings that responded to both surveys. However, any interpretation should consider the special circumstances that influenced forest management during 1991 or 1996. The major factor listed by the respondents was the July 1995 windstorms, which resulted in considerable salvage harvesting during 1996. Also, because many estimates presented are based on tabulating responses that were themselves estimates, small changes need to be interpreted with caution.

The respondents' ownerships cover a total of 7,720,204 acres, approximately 52% of the 14,723,200 acres of timberland in the state. A total of 1.97 million cords was harvested from timberland managed by the survey

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respondents. This figure was 51% of the 1996 statewide harvest of 3.81 million cords. Based on the 1996 survey, the estimated area with harvesting activity (192,514 acres) in 1996 was 11% greater than in 1991. The increased harvest area is partially due to thinning activity on federal and state ownerships; final harvest activity declined on many (especially public) ownerships.

Silvicultural Systems

Overall, the relative proportions of the various silvicultural systems and thinning activities changed little between 1991 and 1996. Clearcutting was still the dominant silvicultural system in 1996, but the proportion of clearcut land had declined from 89% in 1991 to 86%. The amount of acres harvested by patch, strip, seed tree and shelterwood, group selection, and single tree selection accounted for only a small proportion of the area logged in 1996.

Compared to the 1991 survey, the 1996 survey asked more detailed information about the condition of clearcuts after harvesting. Residuals (trees left in a clearcut for reasons other than regeneration) were left on 77% of the acres clearcut. This proportion was almost twice as high as in 1991. This shift can be attributed largely to changes in the management of public, especially federal, land. However, because of the various standards and the diversity of forest conditions in Minnesota, sites labeled clearcuts with residuals might be hard to distinguish from partial cut sites. The residuals were generally scattered throughout the site (67% of the acres with residuals) rather than being associated in clumps (33%). Typically, residual trees were left for wildlife habitat and as a riparian buffer. Other reasons included visual quality, seed production, nonmerchantability or immature trees, poor markets, public relations, Best Management Practices (BMP's), and species diversity. Most respondents indicated that all these concerns were considered within their organization, but priorities differed by site.

Thinning

Sixteen percent of the area with harvesting operations on state land were thinned, followed by 15% on national forests, 5% on county, 5% on Native American, and 2% on forest industry land. The increased emphasis on commercial thinning in 1996 compared to the 1991 survey was paralleled by a doubling of noncommercial thinning activities to 3,055 acres. While commercial thinning increased on public land, the main increase in noncommercial thinning was reported by forest industry respondents (2,751 acres, compared to 203 acres in 1991).

Regeneration

A total of 86,143 acres were regenerated during 1996. A trend to rely more on natural regeneration (69,220 acres

of natural seeding and sprouting, a 7% increase over 1991) rather than artificial regeneration (16,566 acres for planting and seeding, a 19% decrease) was evident on all but federal lands. Managers relied on natural regeneration through sprouting or suckering on 62,374 acres (90% of the area with natural regeneration). Regeneration by natural seeding was limited to 6,846 acres or 10% of the natural regeneration acreage.

The amount of artificial regeneration declined from 1991 to 1996, with 21 and 16% fewer acres planted and seeded, respectively. A new trend was the planting of hybrid poplar cuttings on 357 acres in 1996.

Site Preparation

While the overall area with site preparation activities (13,950 acres) was similar to the acreage in 1991, the proportion of the area treated chemically increased to 38%. On land with chemical site preparation, 42% of the acreage received an aerial application of herbicides. Aerial application is most common on land owned by forest industry (1,260 acres). Aerial application is cheaper than ground application, but residual overstory trees hinder or eliminate low altitude overflights. On the other hand, the acreage with mechanical site preparation declined by 15%.

Release

The compilation of timber stand improvement efforts shows that the amount of regeneration release (11,217 acres) declined by 24% between 1991 and 1996. This decline was evident in all release methods. Reducing release efforts, a trend that is most apparent on county-owned land and, to some extent, on federal land, might suggest more efficient site preparation (with increased use of chemicals) and/or a trend toward acceptance of mixed species stands.

SUMMARY AND IMPLICATIONS

During the last decade, prices for forest products, especially pulpwood, increased. At the same time, our understanding of forest ecosystem increased and public concerns about the ecological consequences of harvesting deepened. Forest management practices in Minnesota have changed as a result of these trends.

The increased attention to wildlife habitat quality, riparian protection, aesthetics, and nutrient retention is reflected in the change of silvicultural systems used in Minnesota. While clearcutting was still listed as the dominant silvicultural system used in 1996, a higher proportion of clearcuts had residual trees, snags, and/or logs left after harvest. The areas clearcut with residuals can take on a variety of forms and are sometimes hard to distinguish from partial cuts. The continuation of this practice will

depend not only on the perceived benefits, but also on the cost of leaving residuals on harvested sites. For example, changes in demands or market value of certain species and size classes might influence the future of these practices.

While the benefit of a "legacy" in the form of residual trees is well recognized (Franklin *et al.* 1997), it is important to point out that residual trees may have a variety of negative impacts. Direct impacts include shading and competition for water and nutrients resulting in slower growth of the regeneration (Smidt and Puettmann 1997). Leaving a residual overstory favors shade tolerant species, like sugar maple or balsam fir. Light-demanding species, like quaking aspen, paper and yellow birch, and jack and red pine, might germinate or sprout. However, their growth, quality, vigor, and survival will be lower under residuals than in more open conditions (Arikian *et al.* 1998). Another concern is that leaving certain species as live residuals (e.g., red maple after quaking aspen harvest) may discriminate against regeneration of that species. These residuals will not sprout and may not be vigorous enough to produce seeds. In addition, regeneration costs may increase as mechanized operations, from skidding to herbicide applications, have to be modified to accommodate the residuals.

All organizations recognized the importance of thinning to ensure a healthy, vigorous forest, and the increases in stumpage values have made thinning more feasible. Overall thinning activities have increased. Commercial thinning activities became more common on public land, while precommercial activities increased on industrial ownerships. This difference might be due to the stand age class distribution on the different ownerships.

The trend to rely more on natural regeneration continues to be evident in Minnesota. The range of acceptable species and species mixtures has expanded, thus providing more opportunity for natural regeneration. Declining budgets may also be responsible for this trend, because natural regeneration is generally cheaper. On the other hand, natural regeneration from seed requires that harvesting operations are timed to coincide with good seed years. Delays in regeneration can effectively lengthen the period needed to achieve full stand establishment. Also, natural regeneration will likely require thinning or interplanting to achieve the desired stocking or spacing levels that match the productivity obtained by planting.

Site preparation and release operations go hand-in-hand to provide good growing conditions for tree regeneration. In the last few years, the emphasis has shifted to more intensive site preparation and less reliance on release treatments. Since crop trees are not yet present, site preparation allows for more efficient use of machinery.

Also, the choice of herbicide and timing of application does not have to be compromised to avoid injury to seedlings. Chemical site preparation was used more frequently, except on federal and Native American ownerships. For many sites, chemical site preparation is cheaper than most alternatives. It also may be more effective and longer lasting because of the ability of herbicides to prevent perennials from sprouting. Another explanation for the reduction of release operations is that many organizations accept mixed species stands, and species once considered weeds and treated are now left to grow.

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