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Cutting and Cultural Methods for Managing Northern Hardwoods in the Northeastern United States

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ABSTRACT

The steady increase in multiple use of northern hardwood forests in the Northeast makes it urgent for managers to keep selected stands highly productive. Maintaining a balanced structure by selection cutting is advisable for sugar maple and other shade-tolerant species. Stand harvesting in small blocks, strips, or patches works well for the highly valued yellow birch, paper birch, and white ash. Although the accepted cultural methods such as seedbed preparation, thinning, and improvement operations are helpful, new cultural methods must be developed to increase yields and shorten rotations.

NORTHERN HARDWOODS cover nearly 15 million acres (6.1 million hectares) or 35 percent of the commercial land area in the Northeastern United States — New Hampshire, Vermont, Maine, Massachusetts, and New York. These forests have always been important to many communities because they produce millions of cubic meters of timber each year, support a thriving summer and winter recreation trade, and provide a protective cover on the watersheds of public water supplies. The northern hardwood forest ecosystem also provides an excellent habitat for a variety of game animals and other wildlife.

Because many parts of the region in recent years have become readily accessible to people from large metropolitan areas by the expansion of highway and road systems, multiple use of northern hardwood forests is steadily increasing. Thus the productivity of northern hardwoods is of vital importance to the economy and welfare of the region. When stands are maintained in the most productive condition — stocked with desirable species, growing rapidly, and cut properly — most of the desired goods and services can be fully realized.

An important mission of our silvicultural research in the Northeast has been to develop alternative cutting and cultural methods for keeping northern hardwoods productive.

EXPERIMENTAL PROGRAM

Knowledge of managing northern hardwoods in the Northeast has been appreciably strengthened by basic and applied studies conducted by several federal, state, and university scientists. Many of the applied silvicultural studies have been conducted at the Bartlett Experimental Forest, located on the White Mountain National Forest in northern New Hampshire. The soils and vegetation on this 2,600-acre (1,052-hectare) forest ecosystem are fairly representative of many of the northern hardwood sites found not only in New Hampshire, but also in the other northeastern states.

The Experimental Forest is managed by the research project on silviculture and management of northern hardwoods, headquartered at the Northeastern Forest Experiment Station's laboratory in Durham, New Hampshire.

MANAGEMENT DECISIONS

Sugar maple (*Acer saccharum* Marsh.), yellow birch (*Betula alleghaniensis* Britton), and American beech (*Fagus grandifolia* Ehrh.) are the primary timber species in the northern hardwood forests. Associated species are numerous; the more important ones are paper birch (*Betula papyrifera* Marsh.), white ash (*Fraxinus americana* L.), red maple (*Acer rubrum* L.), eastern hemlock (*Tsuga canadensis* (L.) Carr.), and red spruce (*Picea rubens* Sarg.).

Although markets have been developed for practically all northern hardwood species, only sugar maple, yellow birch, paper birch, and white ash tend to command comparatively high stumpage and log prices. This has been the market situation for many years, and it probably will remain unchanged for many more years. Industry demands for top-grade logs of these four species often exceed the supply.

In developing a management program, a timberland owner must first decide whether he wants his growing stock to yield top-grade products such as veneer logs, sawlogs, and millwood or to yield mostly pulpwood and other bulk products. A second basic decision he must make is whether to manage for a high proportion of shade-tolerant species, intermediates, or intolerants. This would have a controlling influence over the silvicultural system he may use.

CUTTING AND CULTURAL METHODS

For Shade-Tolerant Species

Uneven-aged management implemented through selection cutting of individual trees or the harvesting of trees in groups of two or three is recommended for growing a high proportion of shade-tolerant species — sugar maple, beech, hemlock, and spruce (*Leak et al. 1969, Tubbs 1968*). Selection cutting will produce veneer logs, sawlogs, and millwood, with pulpwood as a byproduct.

To achieve maximum yields, the cuttings are repeated at 10- to 20-year intervals. Likewise, a deliberate attempt is made to mark trees for cutting in all diameter classes to develop and maintain a balanced stand structure. Residual basal area after cutting is usually 70 to 80 square feet per acre (16.1 to 18.4 square meters per hectare) in trees over 6 inches (15 centimeters) in diameter breast high (1.4 meters.) However, no cutting should remove more than about 40 square feet per acre (9.2 square meters per hectare).

Distribution of numbers of trees and basal area for a typical stand at 80 square feet per acre (18.4 square meters per hectare) is:

		Trees		*Basal area*	
D.b.h. class		*Per acre*	*Per hectare*	*Per acre*	*Per hectare*
(in)	(cm)			(ft²)	(m²)
6-10	15-25	60	148	20	4.6
12-16	30-41	30	74	28	6.4
18+	46+	15	37	32	7.4
	Total	105	259	80	18.4

In many of today's uneven-aged stands, preferences for particular species in past cutting operations and heavy mortality or deterioration from disease attacks in some species (such as beech) have caused considerable variation in structure, stocking, composition, and grade. It may take three or more cycle cuts to improve the productivity of such stands. Yields from improvement cuttings may run 35 percent or higher in low-value products (*Filip 1967*). In subsequent cuttings, the yield should be mostly top-grade products.

To accomplish some of the needed cultural work, cull trees can be marked for optional removal by the logging operator. However, the trend is to have the sale contract require that the operator cut such trees, with an allowance on the stumpage for this work.

Often additional cultural work is needed in unmerchantable size classes to improve species composition—especially to reduce the overabundance of beech in favor of the higher-value sugar maple. Removing trees down to 2 inches (5 centimeters) in diameter breast high (d.b.h.) may be necessary.

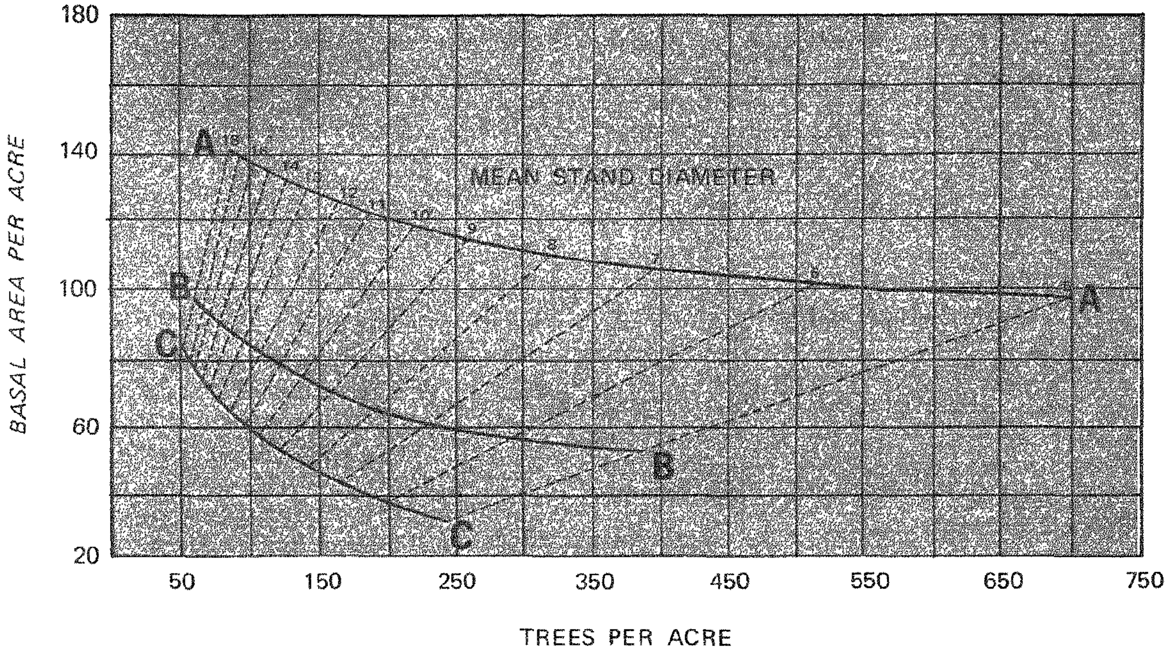
Aesthetically, the public generally accepts selection cutting because a residual stand always covers the site and disturbance from logging is not so apparent. Selection cutting now appears to be an important silvicultural option where multiple objectives must be considered, as on publicly owned timberlands.

For Species Intermediate or Intolerant of Shade

Even-aged management is recommended for growing a high proportion of intermediate and intolerant northern hardwoods. The commercially important species included here are yellow birch (intermediate), white ash (intermediate), and paper birch (intolerant). When used appropriately, even-aged management will produce top-grade products. The system is also well suited for pulpwood production, particularly in view of the trend toward greater mechanization in the woods.

Recently, we developed a stocking chart to help a manager determine when thinnings and harvest cuttings should be made in even-aged stands (fig. 1). The chart is based on number of trees per acre in the main canopy, average d.b.h. in inches, and basal area in square feet per acre. Three levels of stocking are defined: A, B, and C. Stands above the A-level are overstocked. Stands between A- and B-level are adequately stocked. Stands between B- and C-level should be adequately stocked in 10 years. Stands below the C-level

Figure 1.—Stocking chart for even-aged northern hardwoods.



are understocked. Thinning may be considered when stocking is at least midway between the B- and A-levels.

Where high proportions of the birches are to be naturally regenerated, special attention must be given to cutting and cultural methods. Generally some form of complete stand removal for the final or harvest cutting—and seedbed preparation—are needed for successful stand establishment. Optimum conditions for regenerating white ash have not been determined experimentally. However, the conditions that are favorable for yellow birch tend to be favorable for white ash.

Complete stand removal can be done in patches, strips, or blocks. In each case, the harvesting of merchantable trees is followed by mechanical or chemical removal of all unmerchantable trees down to 2 inches (5 centimeters) in d.b.h. Frequently, the harvesting and follow-up cultural treatment are done as two separate operations. However, in some stands it may be more efficient and less costly to contract with the logging operator to fell the unmerchantable trees during logging.

Patches range from 0.1 to 0.75 acre (0.04 to 0.3 hectare) in size. Although patch cuttings encourage the regeneration of both birches, they are difficult to lay out and impractical to handle when the entire area is to be systematically covered over a period of years. However, patches are appropriate when used in combination with selection cutting under uneven-aged management. Groups of mature, overmature, or defective trees are used as nuclei for the patches (*Gilbert and Jensen 1958*).

Strip cutting equals patch cutting silviculturally, but is more feasible to apply. Strips are particularly favorable for regenerating yellow birch (ratio as high as 10 yellow birch to 1 paper birch). Strips can be 50 to 100 feet (15 to 30 meters) wide; but for best yellow birch regeneration, they should be about 50 feet (15 meters) wide and oriented in an east-west direction. In practice, the strips are cut in groups in progressive order, so that every third or fourth strip is cut simultaneously on the south edge of the previous strip. The progressive cutting provides sunlight for the established seedlings while at the same time it creates a heavily shaded new strip where new seedlings can become established.

Block cutting is more favorable for regenerating paper birch than yellow birch. This cutting method will result in regeneration composed roughly of two-fifths intolerants, one-fifth intermediates, and two-fifths tolerants (*Leak and Wilson 1958*). To insure prompt and adequate natural birch regeneration, a seed source must be available. The adjacent stand can provide the seed source in block cuttings up to 10 acres (4 hectares). For larger blocks, the cutting should be done between September and April during a good seed year to take advantage of the seed from harvested trees. Otherwise, leaving seed trees would be necessary. According to our experience, birch seeds usually do not remain viable beyond the first growing season.

Birch regenerates best on disturbed seedbeds where mineral soil is partially exposed or mixed with humus (*Barrett et al. 1962, Marquis 1965, Filip 1969*). If about 50 percent of the soil surface is not disturbed during the logging operation, additional roughing-up or scarification should be considered. Scarification of 50 percent of the surface area with a large tractor and root rake (toothed blade) will require about 1.3 hours per acre (3.2 hours per hectare) (*Filip and Shirley 1968*). Seedbed preparation with power equipment not only provides the desired mineral soil-humus mixture, but also removes much unwanted vegetation that often suppresses newly-established birch seedlings.

The public tends to resent even-aged harvesting, especially when the openings are readily visible from main roads or roadside vistas. The unsightliness of logging slash and snags resulting from after-logging cultural work causes much of this resentment. The aesthetic problem can be minimized in several ways: utilizing all material possible from the harvesting operation, leaving an uncut strip adjacent to roads, felling all unmerchantable stems, restricting the size of cutting, making irregular cutting boundaries to blend with the landscape, removing some of the slash, cutting up slash so that it will lay close to the ground, and fertilizing the cut-over area to stimulate the height growth of regeneration.

RESEARCH NEEDED

In the Northeast, probably more than elsewhere in the United States, heavy recreational and aesthetic pressures are forcing the withdrawal of land from timber production or restricting such use. Coupled with these pressures is the ever-increasing cost of owning timberland. Foresters are faced with the inevitable problem of growing more and better timber on less land. It is imperative that new cultural methods for shortening rotations and increasing timberland productivity be developed. Of several alternatives, forest fertilization offers considerable promise.

Laboratory and greenhouse studies have shown that yellow birch seedlings, in particular, respond appreciably in height and weight growth from additions of nitrogen, phosphorus, and dolomitic limestone to northern hardwood subsoils (*Hoyle 1969*). In field tests, broadcast applications of limestone and fertilizer after complete stand removal and scarification increased average height growth of free-to-grow paper birch seedlings by 55 percent in two growing seasons. These results are encouraging. However, more research is needed to determine the full range of growth responses that are possible with fertilizers and to evaluate the cost-benefit ratios that may be expected under various circumstances.

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