NATURAL REGENERATION OF BIRCH IN NEW ENGLAND

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ALMOST ANY method of cutting will provide some natural regeneration of birch in the northern hardwood forests of New England. However, where high proportions of yellow and paper birch are to be naturally regenerated, cutting and cultural measures must be given special consideration. Generally some form of clearcutting—patches, strips, or blocks—and seedbed preparation are the prime requisites for successful stand establishment. These appear to be simple prescriptions to follow; but in many timber-management programs the clearcutting is not complete enough, and seedbed preparation is often overlooked.

Why clearcutting? Why seedbed preparation? Silvicultural studies on our Bartlett Experimental Forest at Bartlett, New Hampshire, and elsewhere in the region, demonstrate that cutting method and seedbed condition greatly influence the establishment and development of birch regeneration. These influences must be taken into account to achieve good natural regeneration of birch in New England.

EFFECT OF CUTTING METHOD

Regeneration that follows any cutting method comes from one or both of two sources: (1) advance reproduction that was already on the ground at time of cutting, and (2) seedlings and sprouts that originate after the cutting *(Leak and Wilson 1958)*.

Often in New England stands, the advance reproduction at time of cutting is mostly beech and sugar maple. Very little advance reproduction of yellow birch is present (about 2 percent), and practically no paper birch *(Jensen 1943)*. Therefore, for all practical purposes, to regenerate birch we must depend on seedlings that originate after cutting. If so, what cutting methods provide conditions that are favorable for birch seedling establishment—and later development?

Results of a comprehensive study of three cutting methods *(Leak and Wilson 1958)* — moderate selection, clearcut patches of 0.1 to 0.6 acre, and a clearcut block of 22 acres—show how cutting alone can affect species composition of regeneration (table 1).

Although the selection cutting was especially favorable for regenerating beech and sugar maple, a small proportion of yellow birch became established. However, the proportion of paper birch regeneration was negligible.

Patch cutting resulted in fairly good yellow birch regeneration. The larger clearcutting was highly favorable for paper birch. Of course, in both of these cuttings, as in selection cutting, the proportion of beech and sugar maple was very high, often exceeding that of birch.

In the clearcuttings, all trees over 2 inches d.b.h. that were left after logging were felled or girdled.

Other studies have also shown the favorable effects of patches, strips, and other stand openings on birch regeneration *(Barrett et al. 1962, Blum and Filip 1962, Marquis 1966)*. Often both yellow and paper birch establish

Table 1.—*Species composition of regeneration in stocked milacres*[1]

Tolerance group[2]	Selection cutting	Patch cutting	Clear-cutting
	Percent	*Percent*	*Percent*
Tolerant	92	62	43
Intermediate	7	34	19
Intolerant	1	4	38

[1] 10 to 15 years after logging.
[2] Commercial species included in each tolerance group: Tolerant: mostly beech and sugar maple; some hemlock and spruce. Intermediate: mostly yellow birch; some white ash and red maple. Intolerant: mostly paper birch; some aspen.

and develop in nearly equal proportions *(Blum 1966)*.

EFFECT OF SEEDBED CONDITION

Seedbed condition is probably one of the most important factors affecting birch establishment *(Marquis 1965a)*. Birch regenerates best on disturbed seedbeds where mineral soil is exposed or mixed with humus. In patch cuttings at Bartlett, seedlings were more numerous where mineral soil had been exposed in skidroads and other disturbed areas than in areas not disturbed by logging (table 2). In the Adirondack Mountains of New York, the number of yellow birch seedlings was five times greater on areas scarified to mineral soil as compared with areas not scarified *(Barrett et al. 1962)*. In the Berkshire Mountains of Massachusetts, there were twice as many paper birch seedlings on scarified seedbeds as there were on unscarified ones: 8,000 versus 4,000 seedlings per acre *(Cunningham, F. C., unpublished data. U.S. Forest Service, Durham, N.H.)*.

APPLYING WHAT WE KNOW

Cutting

Under favorable environmental conditions, and with good luck, heavy cutting of a mature stand may be all that is necessary to obtain satisfactory birch regeneration. Unfortunately this approach fails as often as it succeeds. It is better to rely on appropriate cutting methods and follow-up cultural measures to insure the desired results.

Although patch cuttings have been successful in regenerating a fairly high proportion of both birches, they are impractical to handle when the entire area of a stand is to be systematically covered over a period of years in an even-aged program of management. 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 *(Marquis 1965b)*. Patches should be no larger than about ⅔ acre *(Gilbert and Jensen 1958)*.

Clearcuttings up to 100 acres can be used to regenerate paper birch *(Marquis et al. 1969)*. However, in cuttings larger than about 5 acres, four to five well-distributed seed trees should be retained on each acre to insure an adequate seed supply. If cutting is done between late fall and early spring to take advantage of the current seed crop, seed trees may not be needed.

Strips are just as good as patches for regenerating birch *(Marquis 1966)*. When strips are cut in progressive order, they are readily adaptable for use in even-aged management.

In strip cutting, the heavy shade from border trees is required for only a few years to help the new seedlings become established. After that, a new strip is cut next to the original strip. For best birch regeneration, we recommend strips about 50 feet wide, oriented in an east-west direction.

With east-west strips, the new cuttings are made on the south edge of the previous strip. This provides sunlight for the established seedlings while at the same time it creates a new strip that is heavily shaded where new seedlings can become established. Thus succes-

Table 2.—*Stocking of birch and other species in patch cuttings by seedbed condition*[1]

Species	Skidroad		Disturbed		Undisturbed		Slashpile	
	M stems per acre	*%*	*M stems per acre*	*%*	*M stems per acre*	*%*	*M stems per acre*	*%*
Paper birch	57	(20)	25	(14)	6	(6)	1	(4)
Yellow birch	88	(32)	24	(13)	4	(4)	—	—
Sugar maple	28	(10)	23	(13)	36	(37)	7	(28)
Beech	11	(4)	9	(5)	13	(13)	6	(24)
Others	95	(34)	97	(55)	39	(40)	11	(44)
Total	279	(100)	178	(100)	98	(100)	25	(100)

[1] 3 years after logging.

sive clearcuttings, each on the south of the previous opening, create an environment that is successively favorable for best establishment and then for rapid growth.

In practice, the strips are cut in groups, in progressive order, so that every third or fourth strip is cut simultaneously (fig. 1). This allows the entire area to be cut over in three or four cycles of cutting, spanning 4 or 6 years if 2 years are allowed for establishment between cuts *(Marquis 1965b)*.

Seedbed Preparation

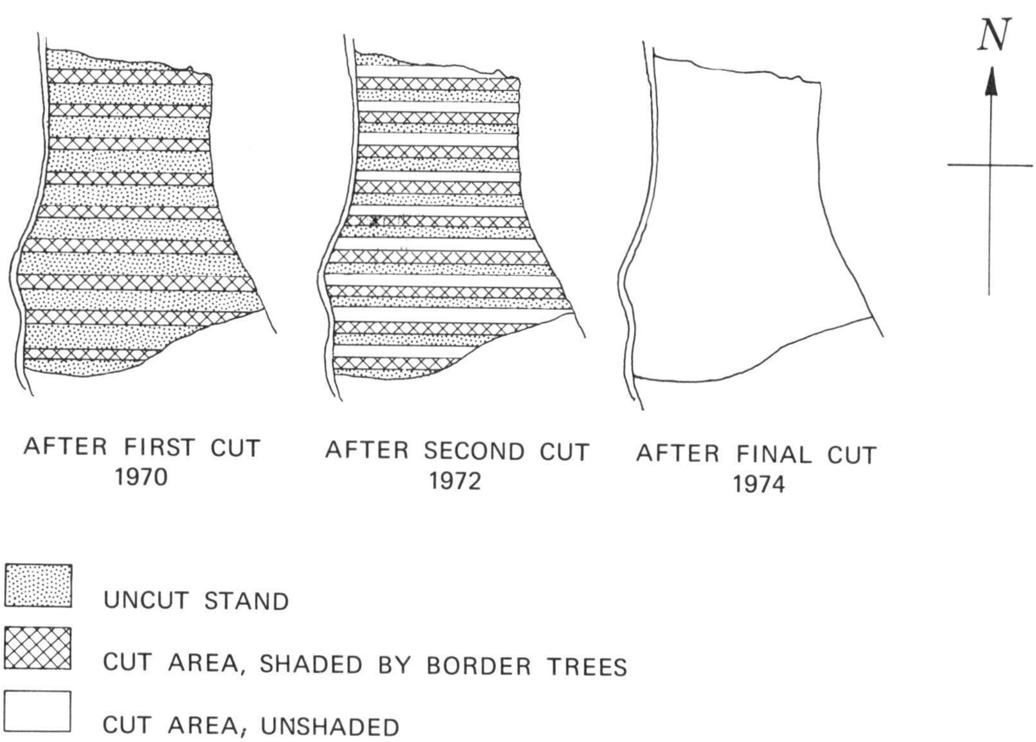
Seedbed preparation not only provides the desired mineral soil-humus mixture, but also removes much unwanted advance reproduction that often suppresses newly established birch seedlings.

You might think that summer logging with tractors or skidders would prepare enough of the required seedbed. It doesn't. Less than 10 percent of a cutting area gets scarified in the usual logging operation *(Bjorkbom 1967, Marquis and Bjorkbom 1960)*. I consider this too low for successful birch establishment. I think the proportion should be at least 25 percent, and it should be well distributed. For maximum benefit, the goal should be about 50 percent *(Marquis et al. 1969)*.

In most cases, seedbed scarification should be done after logging. Nevertheless, in special situations it can be done before logging. An experienced operator can achieve a fairly good scarification job with a regular large-size bulldozer. But too often an operator finds blade control very difficult, and deep scalping results. A rock rake or root rake is better adapted for scarification than a solid blade. Rakes are readily available in New England, and are preferred for getting a better job done *(Filip and Shirley 1968)*.

Seedbed scarification costs will vary, depending on the obstacles encountered—slash, rockiness, steepness, etc.—and the additional area

Figure 1.—Stages in progressive strip cutting of east-west strips. The cut area shaded provides ideal conditions for seedling establishment. The cut area unshaded provides ideal conditions for seedling growth.



needed to supplement the soil disturbed by logging. Based on our experience, costs can be expected to range from about $9 per acre for 25-percent coverage to $34 per acre for nearly complete area scarification (table 3).

Controlling Residual Trees and Stump Sprouts

All stems larger than about 2 inches d.b.h. (or 10 to 15 feet tall) should be removed after any clearcutting if the production of quality material is the objective *(Leak et al. 1969, Marquis et al. 1969)*. This can be done economically by applying an herbicide. Several herbicides and methods of application can be used effectively. One of these is 2,4,5-T in basal incisions. A mixture of 2,4,5-T ester in fuel oil is applied with a tree injector in overlapping cuts made near the base of the tree. If a majority of the trees are less than 10 inches d.b.h., a 40-pound aehg (acid equivalent per hundred gallons) dilution can be used. Each injector cut should receive about 2 milliliters of solution. For larger trees, more herbicide, or a stronger solution, would be required.

The time required to inject trees larger than 2 inches d.b.h. after clearcutting and scarification operations will range from 1 to 5 man-hours per acre. The following equation gives a fairly accurate estimate of injector time:

$$Y = 0.88 + 0.0041X$$

Where Y = Man-hours per acre.
X = Average d.b.h. (in inches) of trees treated, multiplied by number of trees treated per acre.

After clearcutting northern hardwoods, stumps of most species commonly develop sprouts. Stumps smaller than about 12 to 14 inches in diameter generally produce more sprouts than larger stumps *(Solomon and Blum 1967)*. Red maple is the most prolific sprouter. The number of sprouts increases as the stump diameter approaches 9 inches, and decreases at greater diameters. Beech has a tendency to produce many root suckers. Where vigorous sprouts or root suckers compete with birch, control is often necessary. This can be done by basal-spraying the troublesome sprouts with a 2,4,5-T solution.

Table 3.—*Scarification costs with a rock rake*[1]

Area scarified (percent)	Time required	Cost [2]
	Hours/acre	*$ per acre*
80	2.00	34.00
50	1.30	22.10
25	.54	9.18

[1] Mounted on a D-7 crawler tractor.
[2] Includes equipment and operator but not supervision and transportation.

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