NATURAL REGENERATION OF YELLOW BIRCH IN THE LAKE STATES

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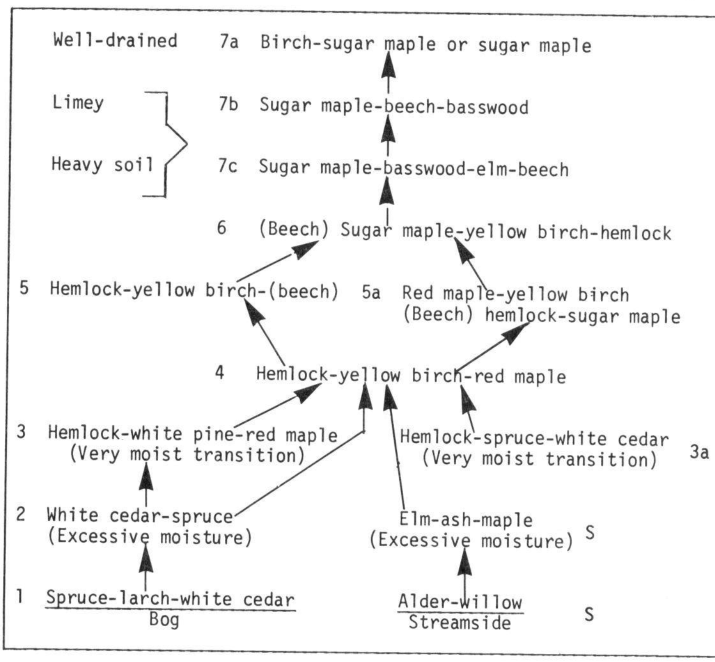
YELLOW BIRCH has been a difficult species to regenerate in the Lake States. This is partly because, although yellow birch is a member of the climax, it displays few of the attributes of a climax species (such as ability to grow in shade, and ability to seed on undisturbed forest floor). Though yellow birch functions as a pioneer species after stand disturbance, techniques ordinarily used to regenerate pioneer species are not usually successful. Results with group selection have been the most consistent, but this system is difficult to apply.

An understanding of basic ecological trends is helpful in evaluating the results of the many silvicultural trials and in identifying the sites where yellow birch regeneration should be most successful. Undisturbed stands in the most important types are temporary (fig. 1) but long-lived, and over long time periods tend toward the sugar maple or sugar maple-beech type in which yellow birch occurs consistently but in low numbers.

The most important place of yellow birch in old-growth stands is on moist sites. Yellow birch is prominent in moist-site associations

Figure 1.—Illustration of northern hardwoods successional series. (From L. Braun, Deciduous Forests of Eastern North America.)



but declines and nearly disappears in the more mesic types.

It should be pointed out that other developmental series exist, depending on climate, soil, and topography *(Whitford 1901)*. However, most soils have a generally similar pattern of succession: white birch, the poplars, and various conifers preceding the more mesic hardwoods. This process has been noted on such soils as sands, clays, and loams and on shallow to bedrock sites.

The principal difference is in the rate of succession, and this seems true of secondary successions, too. For example, on sand soils, the various pines continue for long periods of time before giving way to more mesic trees such as hemlock, yellow birch, and the maples. Once these latter species are established, extreme disturbance can start succession anew with grass and shrubs; and long periods are required to restore mesic vegetation, which includes yellow birch. Moderate disturbance (such as selection cutting) may speed the process toward mesic communities. The same is true of wetter sites and shallow sites, where the grass-brush stage is prolonged for many years after extreme disturbance (such as clearcutting). On the other hand, moderately moist sites appear to rebound more rapidly to the mesic or climax vegetation even after rather severe disturbance.

Yellow birch invades a wide range of soils and topography after heavy cutting and fires. Although the occurrence of yellow birch is directly related to seedbed and overstory disturbance, all disturbances will not result in stands of yellow birch. Controlled-environment studies in the Lake States have helped, along with the ecological relations discussed, to show how yellow birch becomes established on such a wide variety of sites, and to indicate what environments should prove to be the most successful for regeneration.

In general, any combination of factors that provides a relatively cool, moist environment will result in successful initial establishment and growth.

On well-drained sites, shade favors germination by keeping surfaces cool and moist. Survival and growth are relatively good in either light shade or full sunlight on such sites, if the sites are scarified *(Tubbs 1969)*. Undisturbed litter, because of high temperature, low moisture, and physical impediments, prevents appreciable germination except under relatively dense shade where growth and survival are poor.

On moist sites, full sunlight is detrimental to birch regeneration regardless of the seedbed prepared. Light shade is necessary for good germination, survival, and growth *(Godman and Krefting 1960, Tubbs 1969)*. Scarification ensures adequate germination; but germination may occur on undisturbed seedbeds, too, on these sites (*Tubbs 1969, Godman (1959)*. Scarification that mixes the mineral soil and humus is best because growth is usually poor on mineral soil. Root shoot ratios are better in mixtures than in humus alone (*Tubbs and Oberg 1966*). Mixing mineral soil and humus is particularly important on well podzolized soils whose A_2 and B horizons are relatviely infertile. Growth is better under partial shade on moist sites and in full sunlight on well-drained sites (*Tubbs 1969*)

Competition with other tree species influences the regeneration of yellow birch in the Lake States. Red maple is a shade-tolerant competitor in wet-mesic and dry-mesic situations, chiefly because it is a prolific sprouter. Sugar maple competes on all sites, but seems most important on mesic sites. It owes its success to several factors: good seed years are frequent (USDA Forest Service 1965); it has a low temperature requirement for germination, which allows it to germinate early while moisture supplies are adequate (*Tubbs 1965*); it persists under dense shade (*Ashby 1961, Logan 1965*); and it can respond to release at advanced ages (*Tubbs 1969*). In addition to this, we have demonstrated an antagonism between yellow birch and sugar maple, which appears not to be normal physical competition.[1]

Competition with grasses and shrubs may also hinder birch regeneration. It is uncertain, however, whether these groups of plants are directly responsible for failures of yellow birch regeneration or whether the environment that favors them is simply unfavorable to yellow birch.

Biotic influences may sometimes work against yellow birch. Plantation failures in the Lake States have been attributed to deer, hare,

[1] Unpublished data, North Central Forest Experiment Station, Marquette, Michigan.

and mouse damage, for example; and some authors have attributed forest regeneration failures to deer damage (*Stoeckeler and Limstrom 1950, Graham 1954*).

On the other hand, Winget et al. (*1965*) argued that competition and poor environment have more impact than animals. Jacobs' observations (*J. Forestry, in press*) support Winget's argument.

Influence of Cutting Methods on Regeneration

Silvicultural trial results are for the most part predictable on the basis of our ecological and silvical information. Although moist sites are generally best for yellow birch production, each site responds best to a specific method of regeneration.

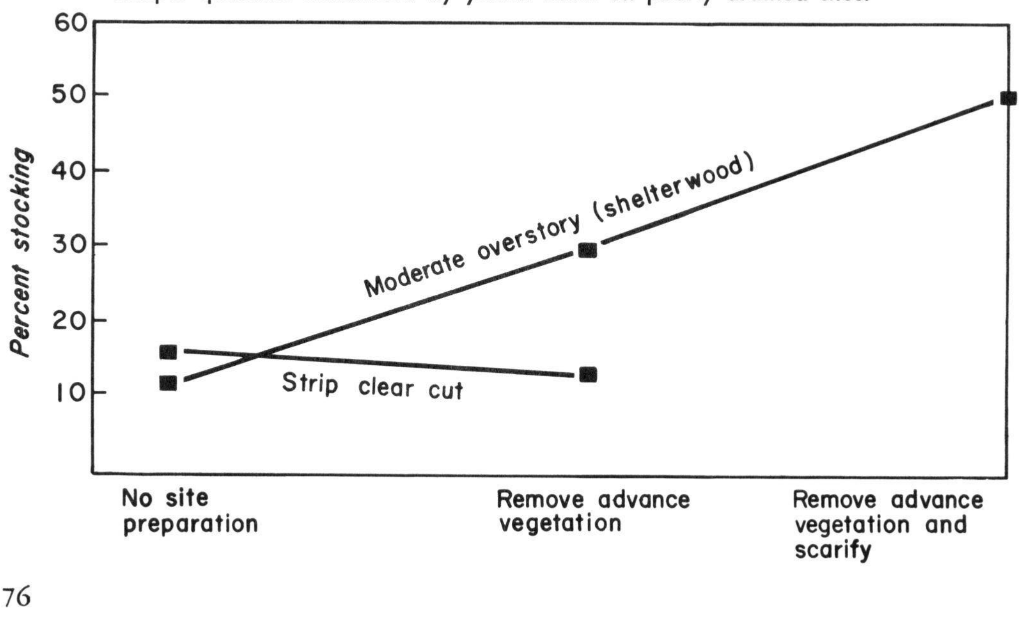
Regardless of the cutting method or silvicultural system used, little yellow birch regeneration follows unless advance regeneration is removed or the site is scarified (figs. 2 and 3). On well-drained sites, controlling advance regeneration results in a greater increase in birch stocking on clearcut areas than under a shelterwood stand, but the shelterwood cutting provides better stocking on poorly drained sites. Scarification is more effective and probably more necessary on the drier upland sites than on the cooler, more moist sites.

Results of clearcutting are usually inconsistent on moist sites or sandy sites even with site preparation. For example, removing advance regeneration on a poorly drained site after strip clearcutting produced few birch seedlings and resulted in brush and grass invasion (fig. 2). A scarification trial on a well-developed sandy soil did not increase birch regeneration, apparently because the resulting sandy seedbed was a poor substrate for seedling growth.

Adequate birch regeneration may occur even without special site treatment, but it seldom persists. Ten years after a commercial clearcutting of old-growth hardwoods on a poorly drained site, half the sample plots contained yellow birch. Some of these trees reached sapling size in the next 16 years, but stocking dropped to 5 percent.

Group selection seemed to offer ideal conditions for yellow birch regeneration—particularly if coupled with scarification. Trials indicated that 1/10-acre groups resulted in the most birch regeneration (*Eyre and Zillgitt 1953*). Although group selection seems effective for regenerating yellow birch in mature stands, it is difficult to practice. Groups are hard to identify, and management is complex. For this reason group selection is recommended only when combined with individual tree selection (*Arbogast 1957*). Creating groups is left to the marker's judgment, and

Figure 2.—Influence of cutting method and site treatment on percent of sample quadrats dominated by yellow birch on poorly drained sites.



no specific attempt is made to return to the groups to apply timber-stand-improvement practices. Marking for release can be done during regular marking when practical. This system has proved reasonably successful in stimulating increases in the number of yellow birch.

There has been some question whether or not individual tree selection would eventually result in pure stands of maple, with yellow birch excluded entirely. After 40 years of periodic cutting, small amounts of yellow birch are still being produced from selection stands. Continual disturbance over moist seedbeds on swamp edges, drainageways, and rotten logs apparently results in suitable conditions for a few birch.

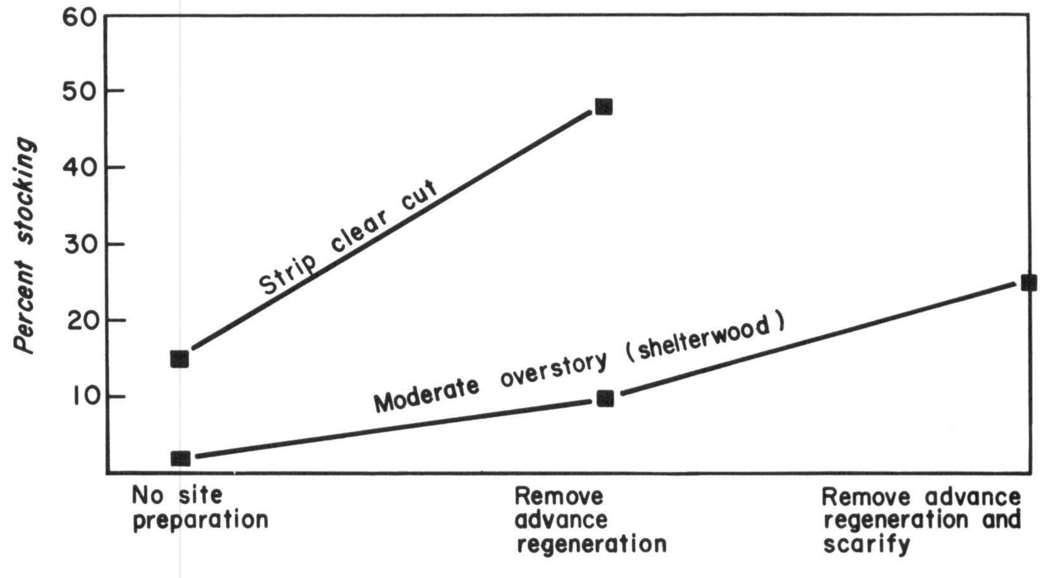
In the Lake States, methods of controlling competition and providing seedbeds have been studied less frequently than other factors. Summer logging has not proved advantageous *(Church 1961)*. Poisoning with shelterwood cutting *(Tubbs and Metzger, unpublished manuscript)*, disk scarification *(Godman and Krefting 1960)*, *mounding (Tubbs* 1963), and bulldozer-blade scarification (*Tubbs and Metzger*) have all been tried and have proved successful in increasing initial yellow birch establishment.

Since removing advance regeneration alone seemed a promising way to increase yellow birch on sites difficult to scarify, we made one trial of spring burning under shelterwood on a rocky, shallow-soil site. Numbers of yellow birch 2 years after burning varied from 111,000 per acre to nearly 3 million, depending on burn conditions, and sugar maple decreased drastically. Limited trials indicate that partial shade is necessary for establishing yellow birch after controlled burning in the Lake States climate (*Tubbs 1969*), regardless of the soil moisture.

I should point out that yellow birch is seldom found in association with aspen or white birch in the northern Lake States, so regeneration techniques used to produce yellow birch do not produce white birch as they might in other regions.

The evidence so far indicates that an overstory should be left, temporarily at least, on moist sites (those that exhibit impeded drainage) or on areas to be prepared by burning. Removal of advance regeneration is necessary to increase yellow birch numbers, and preparation of a mixed mineral soil-humus seedbed results in optimum conditions on any site tested thus far. Strip clearcutting has proved successful when coupled with site preparation only on well-drained medium-texture soils.

Figure 3.—Influence of cutting method and site treatment on percent of sample quadrats dominated by yellow birch on moderate to well-drained sites.



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