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Managing Eastern Hemlock
A Preliminary Guide

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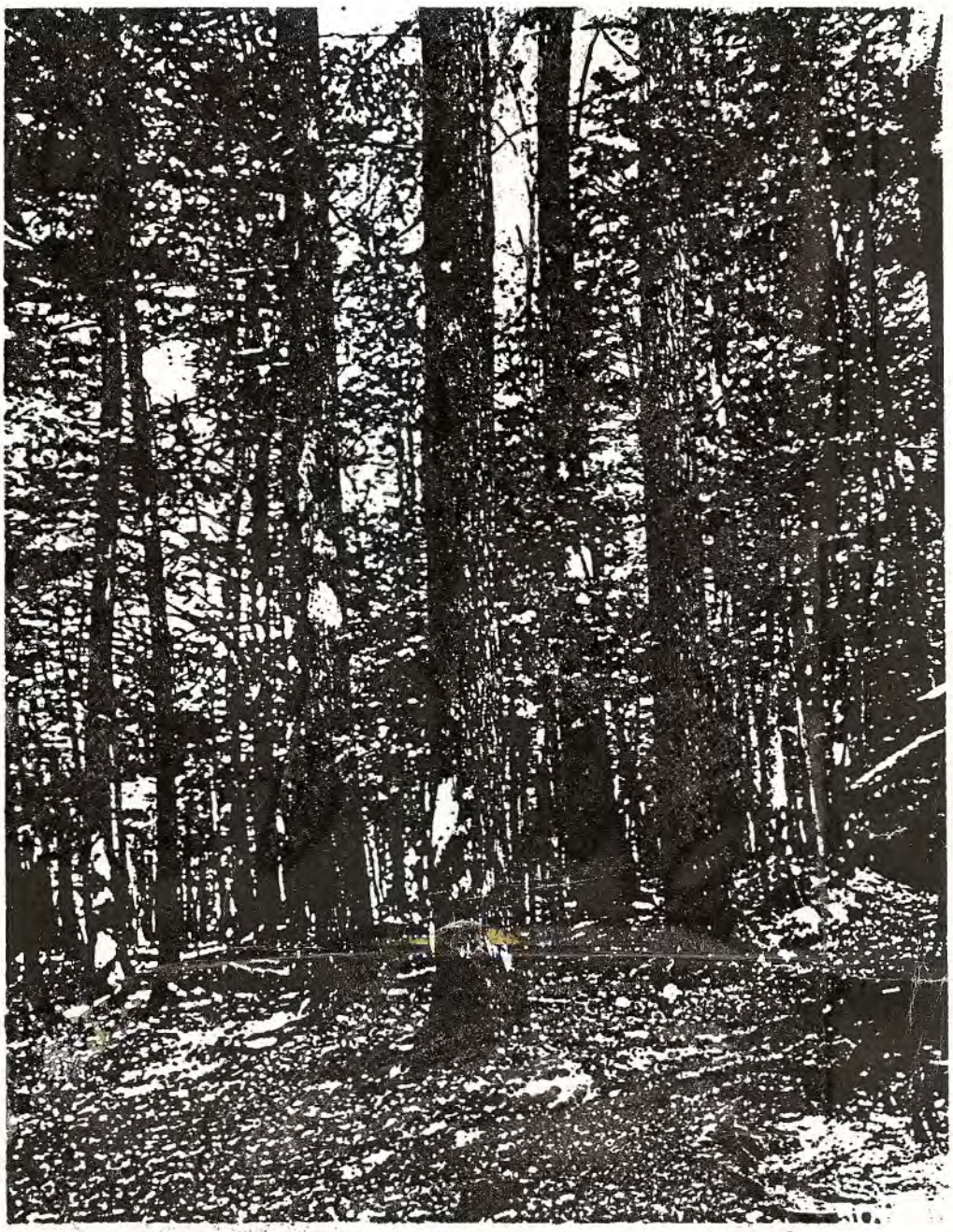

Managing Eastern Hemlock—A Preliminary Guide

A recent upswing in the demand for eastern hemlock has created the opportunity to manage this resource to a greater extent. The greatest market improvement has been for pulpwood, but the lumber industry and the private landowner also are expressing greater interest in the species.

Hemlock was highly prized and heavily used by the early homebuilders. It was not until the turn of the century and the depletion of old growth that the use of hemlock declined, reaching its lowest level in history during the depression years. Western products have, for the most part, replaced hemlock in the housing industry but it still is being used locally, albeit on a limited scale, for framing, sheathing, roofing, and subflooring. With the approaching maturity of many second growth stands, and an abundant hemlock resource close to ready markets, it is reasonable to expect that hemlock can come into its own again.

The primary intent of this discussion is to provide field foresters with the best technical information available for effective management of hemlock stands. A secondary objective is to encourage foresters to promote hemlock as a local source of raw material for the housing industry.

The recommended guidelines can be considered acceptable at best. As new research information becomes available, the guidelines will be improved.

Background

Hemlock is the most tolerant of eastern conifers. It can regenerate under heavy shade, never stagnates, and will respond to release after an indefinite period of suppression. Hemlock yields a higher volume per acre than any other conifer species, except red and white pine.

Hemlock is a shallow rooted tree species that is highly vulnerable to root damage and tree mortality when suddenly exposed to full sunlight and high evaporation of soil moisture. Any amount of commercial thinning of pole and sawtimber stands will result in root damage and ultimately tree mortality of varying degrees, but maintaining a high residual stocking can minimize these losses.

Hemlock rarely germinates and becomes established in open areas. Only a few seeds will germinate and survive under a very light overstory, because of moisture stress created under these conditions. Seedling development depends upon the continuous availability of moisture in the upper soil horizons throughout the growing season. Consequently, a high density overstory—70-80% crown cover—to provide shade on a prepared site is necessary to establish new stands. The most favored conditions for successful establishment of hemlock are shaded seedbeds made up of a mixture of the organic layer and mineral soil, free of understory vegetation competing for soil moisture.

Seedlings of hemlock develop slowly for the first 2 years. First-year seedlings may grow 1 to 1½ inches in height with the roots extending less than ½ inch into the soil. Because of their stable moisture requirements, seedlings are very sensitive to high temperatures and drying of the surface soil during this establishment period. Once the root system has reached a soil depth not radically affected by surface drying, usually after the second year, the seedlings grow more rapidly without interference of overhead shade. Seedlings are fully established when they are 3 to 5 feet tall and, at that time, can be released completely from overhead competition without fear of mortality.

Hemlock can sustain suppression for an extended period of time—up to a rotation length or more—and still retain their youthful vigor. This enables them to respond readily to release, and also to develop and maintain a higher average growth rate than open-grown stands. Suppressed, understory, hemlock trees represent a reliable source of crop trees that can be nurtured to sawtimber size because the length of the suppression period influences the rate of growth after release. The older the tree is when released, the greater it seems to respond to freedom. Additionally, hemlocks that have grown to an appreciable size under suppression generally overtake their open grown associates after being released, and the trees are of higher quality as well. Suppressed trees have smaller limbs that prune early and possess fewer problems with butt rot and shake.

Site index curves are not available for hemlock because of the difficulties in finding dominant trees that have not been suppressed or have been free to grow during their life span. This is associated with the rigid overstory and seedbed requirements for successful natural regeneration of the species. They need shade to germinate, but few are released naturally during their younger years. The average height of hemlock at age 50 in New York is about 16-17 feet. In Michigan, it is close to 20 feet.

The even-aged or uneven-aged (selection) management systems can be successfully employed in managing hemlock, but with certain limitations on the selection system. In the Lake States, the selection system has not been successful in all cases because of the problem associated with regeneration. In the east, the selection system has been successfully used on a limited basis but the even-aged system is the one most frequently employed by field foresters.

It is believed that the thinning of hemlock stands in the Lake States should be of lower intensity (higher residual stocking) than should be applied in New England. New England tends to be cooler, more humid, and has a higher annual rainfall than the Lake States, enabling hemlock stands in the east to withstand heavier thinning intensities.

Forestry Practices

Even-aged management is the preferred system for small groups or scattered patches frequently encountered, as well as for larger acreages occupied by the species. The stocking chart provides thinning intensities for the various stages of stand development and varies with the proportion of hemlock and hardwoods making up the stand.

In mixed stands of hardwoods and hemlock where the proportion of hemlock is 15% or more, it is feasible to manage for or to feature hemlock, but at varying residual stocking levels. Marking intensity, therefore, is in proportion to the amount of hemlock present in the stand initially. Growing space requirements of hemlock are not as great as those of the hardwoods so residual stocking is at a higher level in stands where hemlock predominates.

The stocking chart (Fig. 1) for hemlock identifies two levels of management relating to the proportion of the hemlock component. As an example, a stand averaging 10 inches in diameter that contains 15 to 29% hemlock would be marked to favor hemlock to a residual stocking of about 95 ft.^{2} of basal area of both hemlock and hardwoods—B′ level. This same stand, with 30% hemlock or more, would be managed to 125 ft.^{2} of basal area—B level. If less than 15% hemlock, the stand should be managed for the hardwood type represented, using the appropriate stocking chart.

Thinning Stands

The thinning operation should result in the removal of at least 25 to 30 square feet of basal area. But in heavily stocked stands—200 square feet or more—not more than ⅓ of the total basal area should be removed at one time. Stands with stocking below 200 square feet of basal area can be thinned to the B or B′ level in one operation, without serious side effects.[1] Excessive cutting to residual stocking below the B level results in reduced growth and increased mortality, and contributes to windthrow problems. In addition, hardwood encroachment approaches a serious problem where stocking is reduced below the recommended minimum residual level.

In marking young stands of hemlock, those selected first for removal should be low vigor trees or those exhibiting seams, rot, or injury in the butt section and possess many large, broken or dead limbs. These defects indicate interior rot, decay, and shake most common with the species.

Regeneration

The timing of regeneration is set when the stand is considered mature by the practicing forester, which is usually when the trees average 16 to 18 inches DBH. These are the size classes that provide the best log quality with few defects and are readily accepted by the sawlog market.

[1] In the Lake States, reducing stocking to B level in one operation might apply to stands stocked at 180 sq. ft. or less on some sites.

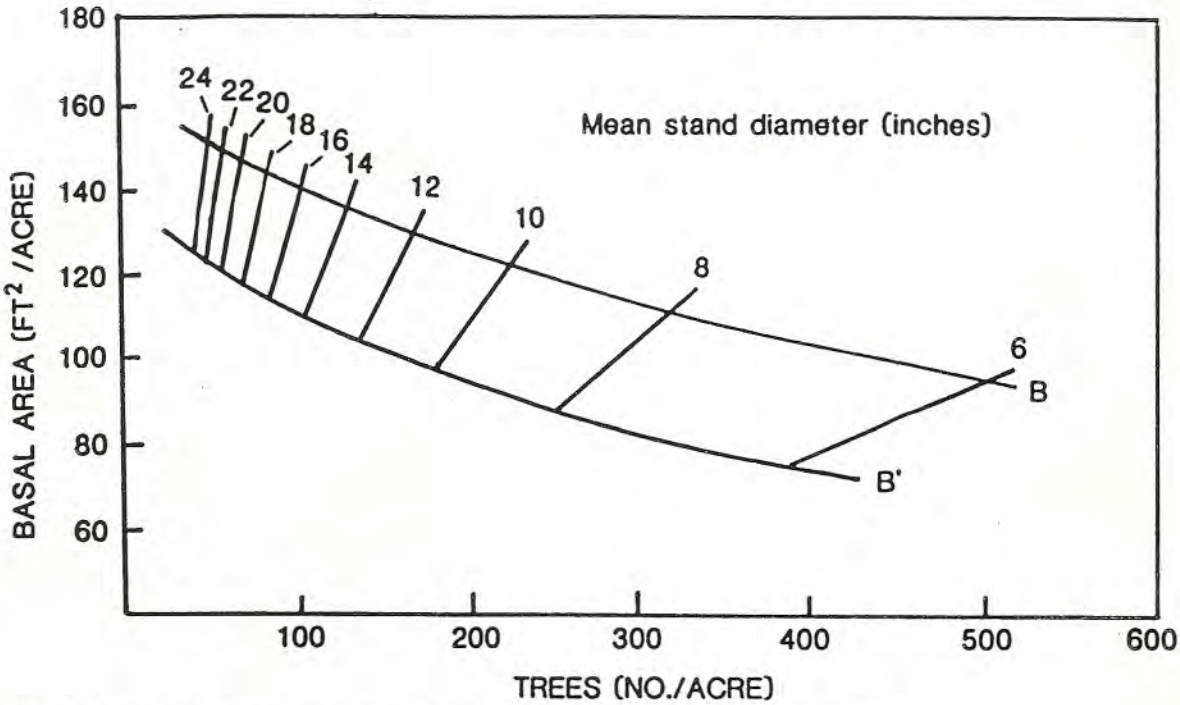

Figure 1. Residual stocking levels (B and B′ levels) for even-aged hemlock stands based on number of trees, mean stand diameter, and basal area per acre. B level represents minimum residual stocking of stands with 30% or more hemlock initially. B′ level applies to stands with 15 to 29% hemlock. (In mixed stands, the percentage of hemlock is based on a comparison of hardwood stems in the main crown canopy and *the hemlock 6 inches DBH and larger in the overstory and understory positions.)*

The shelterwood system is the best method of regenerating hemlock at rotation age, using two or three cuts to remove the overstory. It is effective because the system compensates for the slow seedling development for the first 2 years by reducing moisture stress and by preventing hardwood establishment. To capitalize on this most important advantage, it is essential to adhere to the following conditions in implementing the shelterwood cutting method.

(1) Remove trees mostly from the codominants and lower crown classes and leave the best dominant trees well distributed over the area.

(2) Avoid making large openings in the overstory. Openings in the crown should not be larger than one-half the height of main canopy trees.

(3) Adhere to residual stocking guidelines. For the *preparatory cut*, use the stocking chart's B level as the residual stocking. For the *seed cut*, leave 110 square feet of basal area.

(4) Some site disturbance is essential. Until the seedlings become rooted into the mineral soil, they are highly vulnerable to moisture stress. In the east, summer logging can accomplish much of the needed site scarification to improve seedbed condition. In the Lake States, additional scarification is necessary.

(5) Kill or remove advanced hardwood regeneration.

(6) When reproduction is well established—3 to 5 feet tall—remove the overstory trees. Winter logging is preferred to provide protection to the advanced growth of hemlock.

Strip cutting is an acceptable method of regenerating hemlock at rotation age. It is particularly applicable to dense, mature stands not previously managed because it provides easy access into the stand for logging equipment.

The strips should be narrow—no wider than one-half dominant tree height and protected from use during subsequent logging operations. As in the shelterwood system, the site must be properly scarified and all competing hardwood brush and tree species must be removed to develop the best seedbed conditions.

Strip cutting can serve to regulate a stand for sustained yield by developing a representation of each size class in the strip units. In other words, the goal should be to develop a strip unit of seedlings, one of saplings, another of poles, and finally a unit of sawtimber. This procedure is a long-range venture, but it is appealing to landowners interested in wildlife.

Uneven-aged Management

The literature suggests using the selection system in managing hemlock in the east but residual stocking and stand structure guidelines have not been published. Estimates based on field experience suggest that a residual stocking of 130 square feet of basal area of stands predominantly hemlock (50% or more), a stand structure (diameter distribution) of 35% poles, 5 to 10 inches DBH, and 65% sawtimber, 12 inches and over, are acceptable standards for the implementation of the uneven-aged system (Fig. 2). It is believed that these guidelines will ensure a balanced growth between poletimber and sawtimber size classes, will provide a continuous flow of ingrowth into the sawtimber class, and will accommodate regeneration needs if proper care is given to seedbed requirements.

Because of the experienced failures of the uneven-aged system on the upland sites in the Lake States, this system is not recommended on these areas until more research information becomes available. However, on lower moist sites where sugar maple and red maple regeneration is not established, the system can be successfully employed.

Figure 2. Residual stand structure for hemlock designed for 130 square feet of residual basal area, up through the 18-inch class.

DBH Class (Inches)	Trees Per Acre (Number)	Basal Area Per Acre Sq. Ft.	Percentage Distribution
6	58	11	
8	44	15	
10	34	19	
Sub-total:	136	45	35%
12	26	21	
14	20	21	
16	15	22	
18	12	21	
Sub-total:	73	85	65%
Total:	209	130	100%

Mixed Hemlock-White Pine Stands

Frequently encountered are even-aged stands of hemlock-white pine with a minor component of hardwoods. Usually the white pine is in the dominant position along with hemlock. In most cases, hemlock also occupies the lower crown positions of varying degrees, dependent on past cutting practices, but rarely is white pine found in these lower crown classes.

The preponderance of a species or timber type identifies the stocking chart to use in management. In dealing with mixed hemlock-white pine stands, either chart can be used because the recommended minimum residual stocking levels are essentially the same for the two species.

In managing mixed hemlock-white pine stands, the intent usually is to favor white pine because of its higher value. Although the tending recommendations of these stands are straightforward—remove competing hemlock around the pine—the practices employed in the regeneration process vary with the species desired in the new stand. If the choice is to increase the white pine component and there is an abundance of understory hemlock, a portion of the understory trees must be removed, along with the hardwoods, during the installation of the first cut of the shelterwood system. The amount of hemlock to remove will depend upon how extensive that species covers the area and the amount of white pine desired in the new stand. White pine and hemlock seedlings that become established in the openings created under sheltered trees compete with one another but the white pine will quickly outgrow the hemlock because of the slower height growth of hemlock.

Leaving understory hemlock trees while implementing the shelterwood system favors hemlock trees and enables them to respond to release and eventually to assume dominance. In the process, site conditions under their canopies are not favorable to white pine establishment. Regulating the density of understory hemlock trees in mixed hemlock-pine stands is a way to control the consistency of the new stand in some areas.

Conclusion

Eastern hemlock, remarkably tolerant, has the capacity for sustaining suppression for a rotation length or more and still retain its youthful vigor when released.

Hemlock is a shallow rooted tree species that is highly vulnerable to root damage and tree mortality. Maintaining a high residual stocking in the thinning operations can minimize these losses.

Hemlock seedling development depends upon the continuous availability of moisture during the required 2-year establishment period. Shaded seedbeds made up of a mixture of the organic layer and mineral soil, free of understory vegetation, are the most favored conditions for successful establishment of hemlock.

Both even-aged and uneven-aged management systems can be successfully employed in managing the species, but even-aged management is preferred and the one most frequently used by field foresters.

Under even-aged management, the stocking chart provides thinning intensities for the various stages of development and varies with the proportion of hemlock and hardwoods making up the stand. The shelterwood system is the best method of regenerating hemlock at rotation age—using two or three cuts to remove the overstory.

It is estimated that a residual stocking of 130 square feet of basal area of stands predominantly hemlock with a stand structure of 35% poles and 65% sawtimber are acceptable standards to implement the uneven-aged system.

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