WISCONSIN FOREST MANAGEMENT GUIDELINES

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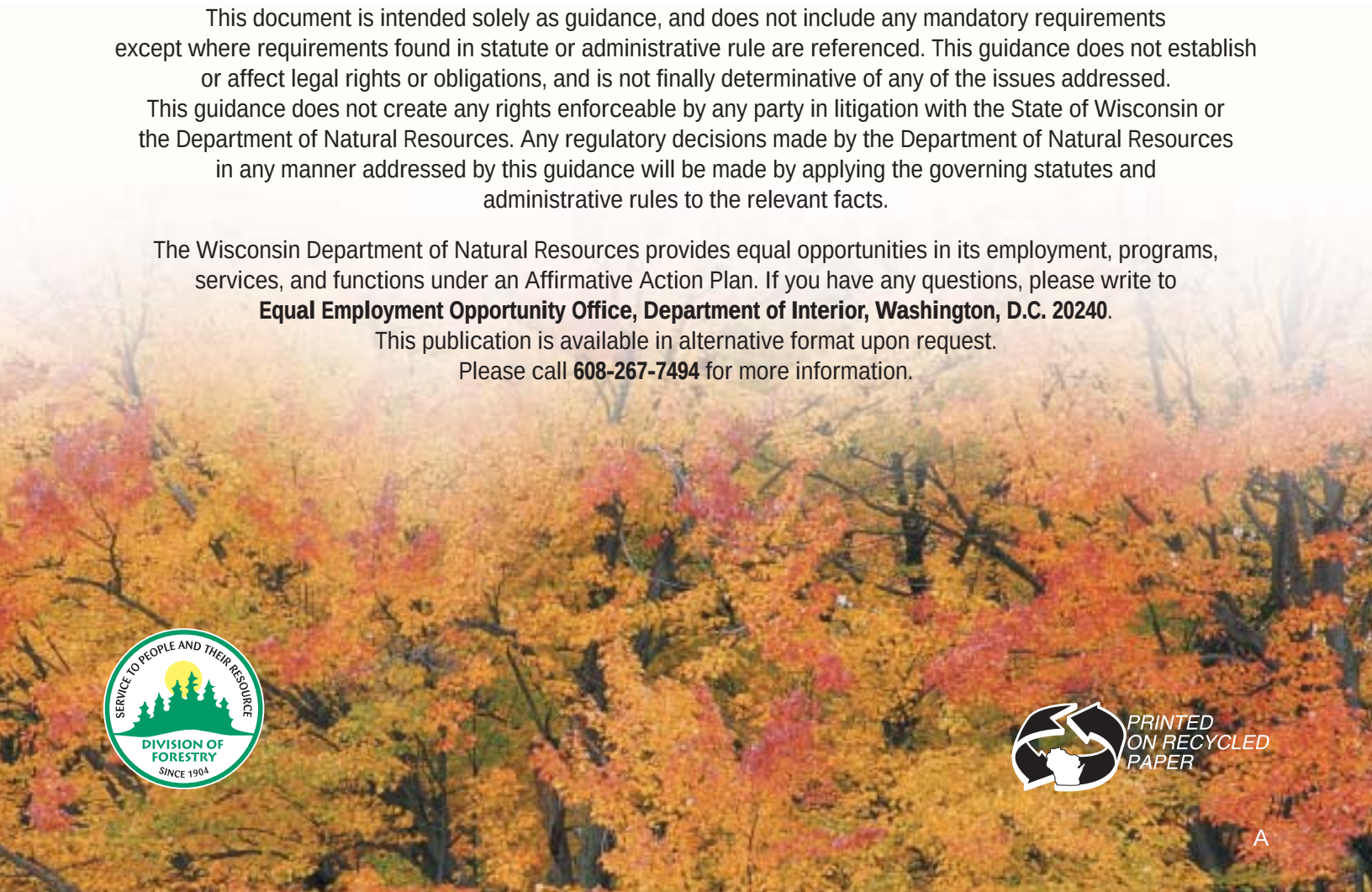

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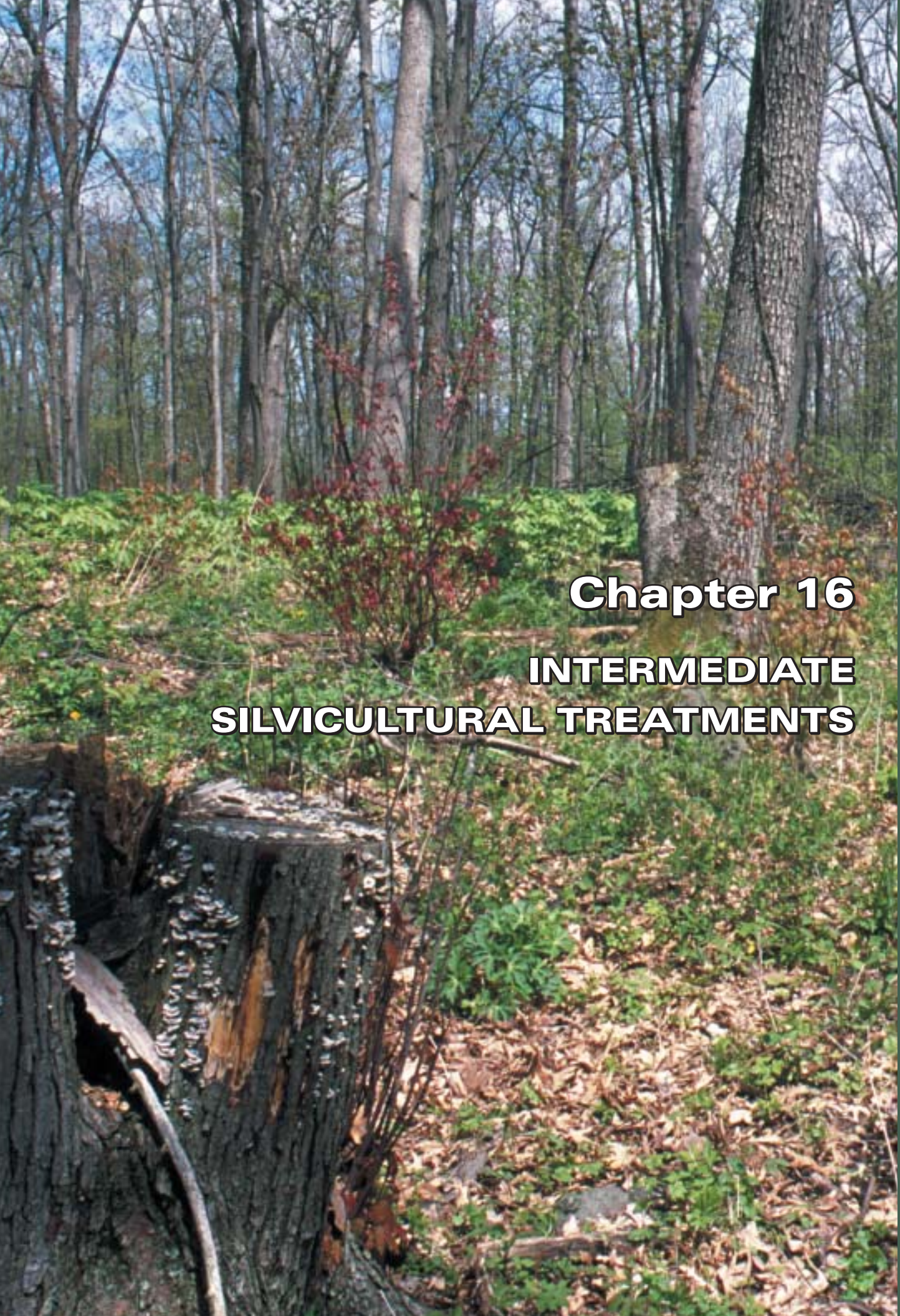

Chapter 16

INTERMEDIATE SILVICULTURAL TREATMENTS

CHAPTER 16 — INTERMEDIATE SILVICULTURAL TREATMENTS

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Figure 16-1 and 16-2: The importance of tending an even-aged stand is illustrated by comparing these two plots in the famous Star Lake thinning experiment started by Fred Wilson with red pine planted in 1913. Figure 16-1 (left) shows the poor growth and mortality in the plot that was never thinned. The adjoining plot, Figure 16-2 (right), shows the impact that periodic thinnings (every five to 10 years starting in 1943) can have on red pine growth and quality.

Intermediate treatments begin after regeneration is established and are carried out as needed throughout the life of a forest stand. These treatments make up the "tending" portion of an overall silvicultural system. **Primary goals include improvement of stand composition, structure, growth, quality, health, and the production of specific benefits desired by the landowner.** Some intermediate treatments, often called **timber stand improvement (TSI)**, are non-commercial, requiring outright investment by the landowner. Other intermediate treatments can generate enough revenue to offset the cost of their implementation.

Integrated Resource Management Considerations

- Intermediate treatments can affect timber productivity, stand structure, wildlife habitat, species and habitat diversity, aesthetics, water quality, and soil condition. Careful consideration must be given to all the ramifications of a planned treatment.
- Intermediate treatments generally improve tree vigor and health, but high intensity treatments in stands lacking vigor and strength can cause stress and short-term predisposition to health problems. Logging damage can cause wounds that predispose trees to future health problems.
- Non-native invasive species can be encouraged or discouraged by intermediate treatments and operations. They can preclude the success of treatments. Exotics should be controlled and/or eliminated during intermediate treatments to the greatest extent possible.
- Intermediate treatments can increase visual penetration and access. Season or hours of operations may need to be restricted to mitigate visual impacts.
- Heavy equipment can damage cultural resources.

PLANNING

- Conduct on-site meetings with the landowner, forest resource manager, and logger prior to implementing operations. Clarify objectives, specifications, regulations, and site limitations.
- Identify crop tree management objectives, characteristics, number per acre and spacing.
- Consider the retention of reserve (leave) trees, snags, and coarse woody debris.
- In some cases, logging residues (slash) and stumps can facilitate infestations, and may require treatment. Timing of cutting (and other operations) should consider disease and insect cycles.
- Evaluate soil conditions and control heavy equipment operations to limit compaction, rutting, and erosion.
- If necessary, evaluate the need for additional slash control measures, or seasonal operating restrictions to mitigate visual impacts.
- Identify any cultural resources that may occupy the site and develop measures to protect them.
- Identify occurrences of non-native invasive species, and, if necessary, treat infestations prior to conducting stand improvement activities to help prevent spread.

Figure 16-3: Having a trained forester collect inventory data for each stand on the property is necessary before prescriptions can be developed to achieve the management objectives.

Figure 16-4: Frequent communication between the forester, landowner and other resource professionals helps insure that management objectives are fully achieved.

OPERATIONAL CONSIDERATIONS

Intermediate treatments can be grouped into release, thinning/improvement, salvage/sanitation, and pruning operations.

Release

Release is a treatment designed to free young trees (saplings and seedlings) from undesirable, usually overtopping, competing vegetation. **The purpose is to regulate species composition and to improve growth and quality.** Release treatments are designed to provide potential crop trees with sufficient light and growing space, by freeing their crowns and controlling competition.

The need for release treatments are based on a number of considerations.

- An assessment of the relative growth rates (height growth in particular) of the competing and desired species.
- The degree of impact the competing species has on the health and vigor of the desired species.
- The relative cost/effectiveness of a partial versus complete release versus no action.

Complete release involves the release of an entire layer of vegetation. Examples would be the control of aspen suckers and brush in a new pine plantation, or the control of competing red maple stump sprouts after the establishment of red oak seedlings following a shelterwood harvest. In these situations, essentially all of a particular species in the stand are considered crop trees. The objective is not necessarily to kill the competing species, but to set back and/or retard their growth so as to allow the desired species to gain dominance. A complete release normally occurs soon after a new stand is established, when competing vegetation begins to interfere with the free growth of the desired species and/or individuals.

Partial release involves the release of only selected crop trees. A partial release is usually done before the main stand is 15 years of age, and involves the following criteria:

- Crop trees are selected based on landowner objectives, species, tree vigor, and tree quality.

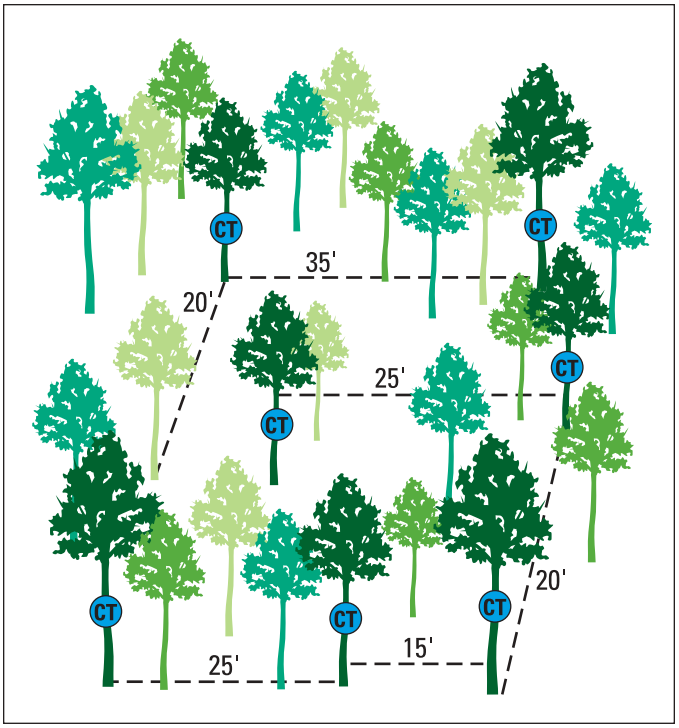


Figure 16-5: Spacing is an important consideration when selecting crop trees (CT). If you space crop trees 25' apart, you will end up with about 70 crop trees per acre. Some crop trees can be spaced 15' apart, while others can be spaced 35' apart.

The maximum number of well-spaced crop trees per acre generally ranges from 50 to 200, depending on landowner objectives and stand condition (see the crop tree selection guidelines in Appendix A).

- Only the direct competitors are cut. Any plant that is not going to suppress, endanger, or hamper the growth of desired individuals is left to grow. All trees with crowns that touch or interfere with each crop tree are removed.
- When sprout clumps are involved, all but the best one or two stems are cut. Healthy, low sprouts originating less than six inches above the ground with a u-shaped stem attachment, of a relatively large size, well-shaped and with a well-developed crown, are selected for retention.

There are three types of release treatments: weeding, cleaning, and liberation. They are differentiated based on the type, age, and size of vegetation eliminated. Within a stand, they can be applied individually or in concert, once or multiple times.

WAYS TO CONTROL COMPETING SPECIES	
Physically Tear the Plant Out of the Soil	• A very effective but expensive method.
Cutting	• Effective against species that do not sprout, e.g., most conifers. • Species that sprout may require repeated treatments to effectively control. Cutting in late spring and summer is most effective. • Relatively expensive, unless a product can be harvested.
Girdling (see Figure 16-6)	• Effective against species that do not sprout. • Most effective when done in late-spring and summer. • Generally applied only to trees greater than 4" DBH.
Fire	• Usually kills trees by girdling. • Generally not used to release young trees.
Herbicides	• Very effective and often the most cost-effective. • Methods of application for release operations include: aerial spraying, ground-level foliar spraying, basal spraying, stump spraying, and bark incisions. • Herbicides are toxic chemicals, see Chapter 14: Pesticide Use.

Figure 16-6: Girdling can be an effective way to remove selected larger trees from a stand with minimal damage to surrounding reproduction.

Some general operational considerations relative to release treatments that remove large, overtopping trees are:

- Cutting may allow the realization of income, but protection of the young stand from felling and harvesting operations is critical.
- Care should be taken that following the elimination of high shade, intense crown competition from sprouts or the release of fast growing weed species does not develop.
- Reserve trees can provide benefits related to wildlife, aesthetics, water and soil quality, protection of special or sensitive sites, landmarks, and, in certain cases, timber production. Where objectives include the retention of reserve trees, residual crown closures of less than 20 percent generally will not significantly impair the development of the young stand.
- In most cases, nearly full sunlight is preferred to promote optimum growth of young, established stands.

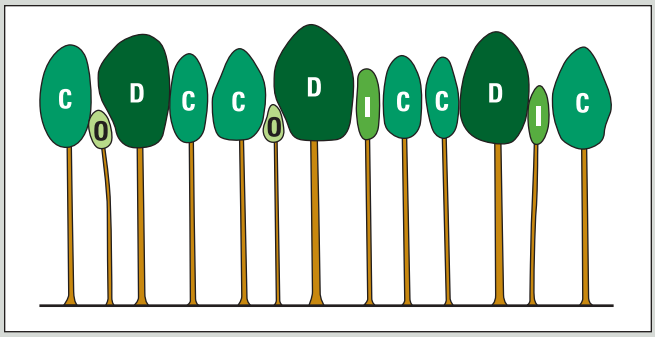


Figure 16-7: This illustration shows the relative positions of trees in the different crown classes in an even-aged stand that has not been thinned.

DOMINANT (D)

Dominant trees have crowns extending above the general level of the crown cover, and receive full light from above and partly from the side. Dominant trees are larger than the average trees in the stand, and have well-developed crowns that may be somewhat crowded from the sides.

CODOMINANT (C)

Codominant trees have crowns forming the general level of the crown cover, and receive full light from above but comparatively little from the sides. These trees usually have medium-sized crowns that are often crowded on the sides.

INTERMEDIATE (I)

Intermediate trees are shorter than dominant and codominant, but have crowns extending into the crown cover formed by codominant and dominant trees. Intermediate trees receive a little direct light from above, but none from the sides. They usually have small crowns that are considerably crowded on the sides.

OVERTOPPED (O)

Overtopped, also called suppressed, are trees with crowns entirely below the general level of the crown cover. Overtopped trees receive no direct light either from above or from the sides.

Thinning

Thinning is a cultural treatment, in stands past the sapling stage, made to reduce the stand density of trees primarily to improve growth, enhance forest health, or recover potential mortality. Typically, **it entails the removal of trees to temporarily reduce stocking to concentrate growth on the more desirable trees.** Normal thinning does not significantly alter the gross production of wood volume. Thinning impacts stand growth, structure and development, and increases economic yields. Individual thinnings can be commercial or non-commercial (TSI), depending on landowner objectives and local markets for materials cut in the thinning operation.

How and when thinnings are applied depends on landowner objectives and the desired benefits. A schedule of thinning for a stand should identify the thinning methods to be used, the intensity of application, and when thinnings will occur. Ideally, a thinning schedule should be systematic, flexible, and consistently followed throughout the rotation. In selecting trees for thinning, primary focus should be on the trees that will remain, as opposed to those to be cut.

There are five basic methods of thinning. Stand conditions and thinning needs vary over time, often resulting in the application of more than one method over a stand's rotation. The five methods of thinning are: low thinning, crown thinning, mechanical thinning, dominant thinning, and free thinning.

LOW THINNING

Low thinning, or thinning from below, (see Figure 16-8) involves removal of trees from the lower crown classes to favor those in the upper crown classes. This strategy of removing the smallest trees and retaining the largest trees accelerates and simulates somewhat the natural elimination of the lower crown classes through competition.

- This type of thinning generally removes smaller diameter trees, and marketability can sometimes be difficult.
- Light- to medium-intensity low thinnings (removing suppressed and intermediate trees) are not recommended except in specific cases. They facilitate utilization of trees that would otherwise die due to suppression (competition), but the release of the remaining trees from competition is minimal.
- Heavy low thinnings are generally recommended. They involve the removal of some codominants in order to create canopy openings and release the crowns of crop trees to stimulate their growth. Stocking guides are used to help determine residual density levels.

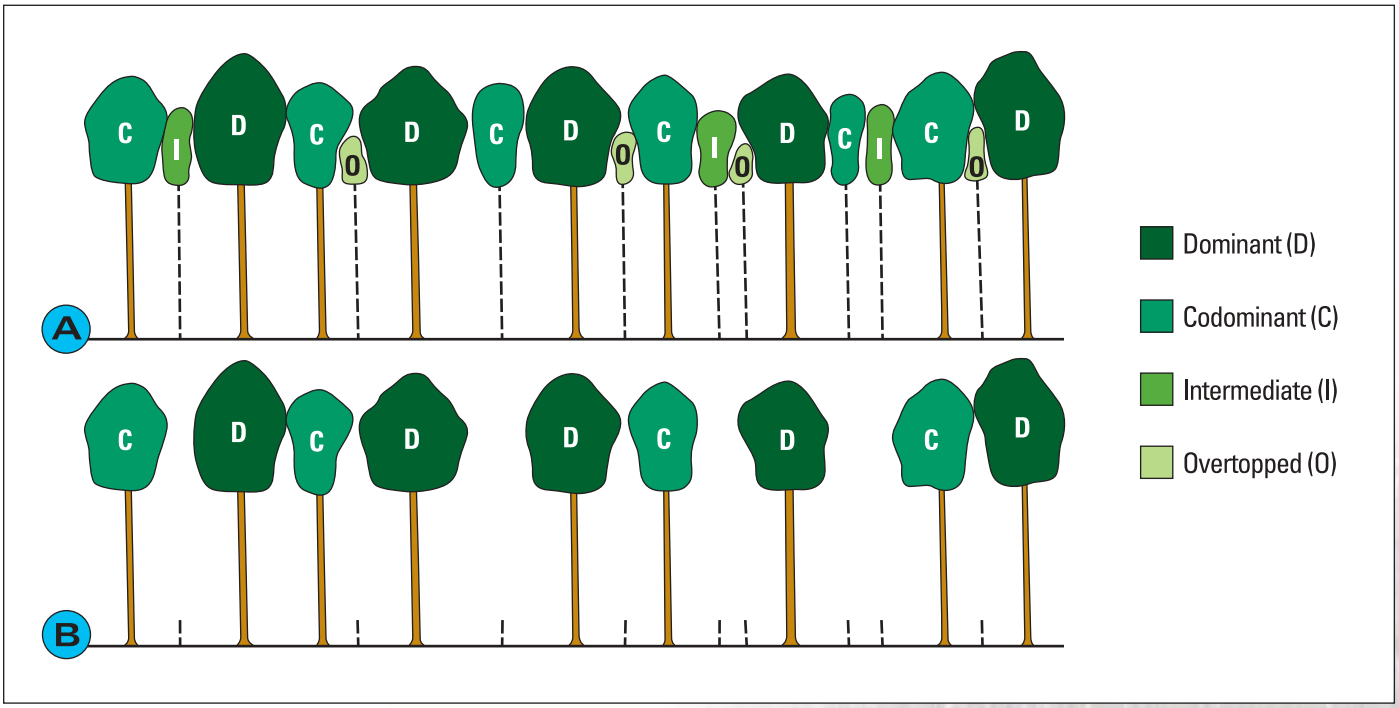


Figure 16-8: How a stand might look before (A), and after (B), a low thinning. The letters on the tree crowns denote crown classification.

CROWN THINNING

Crown thinning, or thinning from above, (see Figures 16-9 and 16-10) involves removal of trees from the dominant and codominant crown classes in order to favor the best trees of those same crown classes. Large intermediates that interfere with crop trees also can be removed. The method stimulates the growth of selected, preferred trees (quality) without sacrificing the production of quantity.

- Crown thinnings are normally used to develop quality sawtimber. They are usually commercial operations and the trees removed are relatively large.
- Crop trees are selected based on landowner objectives, species, vigor, quality, strength, and health (see the crop tree selection guidelines in Appendix A).
- Crown thinnings are recommended as the primary method to develop and manage quality hardwood stands for the production of high value sawtimber and veneer logs.
- 20 to 150 well-spaced dominant and codominant crop trees per acre are released. In fast growing young stands with small crowned competitors, crop trees are released on four sides. In slower growing older stands with larger crowned competitors, crop trees are released on one to three sides.
- To optimize growth, the remaining stand should also be thinned. Release the best dominant and codominant trees by removing high risk, low vigor competitors. Stocking guides are used to determine residual stand density.
- To be most effective, crown thinning requires considerable skill in tree selection and density management. The timing and intensity of a particular thinning is important in managing stem form and natural pruning.

Figure 16-9: This crop tree, released on two to three sides by cutting competing trees, is now free to grow.

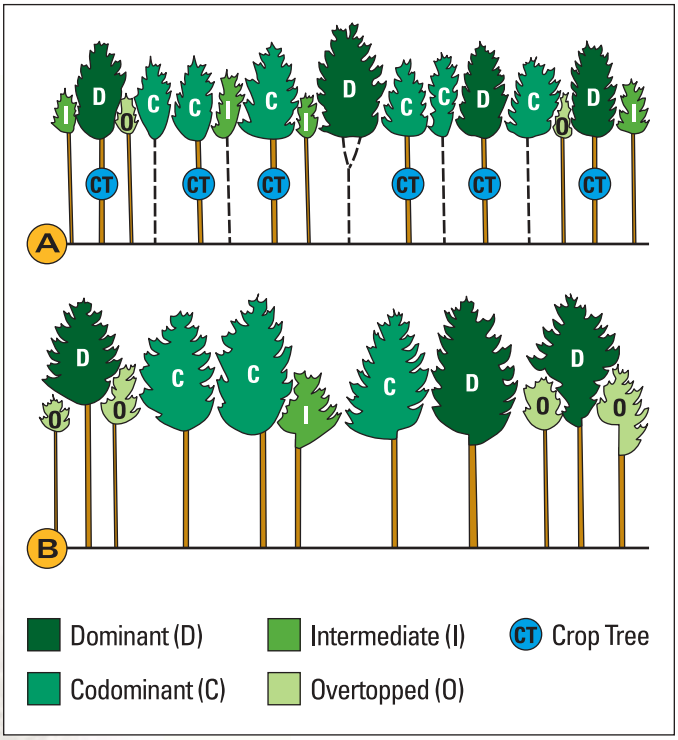


Figure 16-10: The upper sketch (A) shows a coniferous stand immediately before a crown thinning. The crop trees are indicated by the blue circles marked "CT." The lower sketch (B) shows the same stand about 20 years after the crown thinning, which has reclosed to the point where a low thinning would be desirable.

MECHANICAL THINNING

Mechanical thinning is the removal of trees in rows, strips, or by using fixed spacing intervals.

- Frequently, these are the first thinnings in young stands that are densely crowded and/or relatively uniform with little differentiation into crown classes. This method becomes less suitable as variation in the size and quality of the trees increases.
- **Row thinnings** (see Figure 16-11) cut all trees in rows or strips at fixed intervals throughout the stand. They are often utilized for the first thinning(s) in plantations where the rows are readily apparent. The removal of every third row is the most common practice. They are also used to provide access for harvesting equipment in dense, unthinned stands.
- **Spacing thinnings** involve selection of trees at fixed intervals for retention and cutting the rest. This strategy is most applicable as the first thinning in very overcrowded young stands developed from dense natural reproduction.

DOMINANT THINNING

Dominant thinning, or selection thinning, involves the removal of trees in the dominant crown class in order to favor the lower crown classes. This method is suitable only for limited purposes.

- The most common dominant thinning applications are in the management of tolerant conifers, where the objective is to grow as many trees as possible to medium-size for the production of pulpwood, poles, or other small diameter wood products.
- This thinning system is not applicable to quality hardwood management.

FREE THINNING

Free thinning is the removal of trees to control stand spacing (density) and favor desired crop trees, using a combination of thinning criteria without strict regard to crown position. In application, this method is a free combination of selected concepts and techniques garnered from any of the other four thinning methods. Thinnings of this type are sometimes applied as the initial thinning in previously untreated natural stands in preparation for a more systematic future program. Skillful employment of this system can be used to manage and maintain stands of mixed composition, density, or age.

Figure 16-11: A mechanical row thinning in a pine plantation in which every third row of trees has been removed. The opening in the canopy should close in a few years.

SOME OPERATIONAL CONSIDERATIONS RELATIVE TO THE TIMING AND INTENSITY OF THINNING OPERATIONS

- The timing and intensity of each thinning depends on landowner objectives, stand composition and structure, stand condition and health, and other past and planned management activities. A tentative schedule should be developed, indicating the projected timing and intensity of each thinning.
- The intensity of thinning refers to the proportion of the stand removed in a particular thinning.
- As intensity increases, frequency usually decreases.
- Target stocking levels are determined based on optimizing stand growth and yield for a specific forest cover type. Stocking guides (see Figure 16-12) define the lower and upper limits of stand density on a given site. The lower limit (see Figure 16-12, B-line) is normally used to guide thinning applications. Regular reduction of stand density to the lowest level at which full occupancy is maintained should result in the most rapid diameter growth that can be maintained without reduction in total volume yields.
- Initial thinnings normally begin when crowns begin to touch each other. Precommercial thinning (TSI) requires an investment, but can increase net returns over the rotation. It is typical, however, to postpone the initial thinning until an immediate profit can be produced.
- Normally, a thinning is indicated when 1) the live crown ratios of crop trees begin to decline, 2) the diameter growth of crop trees begins to decline, 3) stand density increases to near or above specified upper limits delineated in stocking charts, and/or 4) sufficient timber volume accumulates to support a harvest.
- The effects of thinning are temporary. After each thinning, the remaining trees grow taller, diameters increase, crowns expand, and canopy gaps close.
- Thinning every five to 15 years, is a recommended general guideline for commercial thinnings.

It is important to control logging damage when thinning. Logging wounds can predispose the remaining trees to disease and decay. Thinnings are meant to increase resistance to damage (insects, disease, wind, etc.), however, they can also temporarily predispose stands to damage, especially where trees are not particularly vigorous or strong.

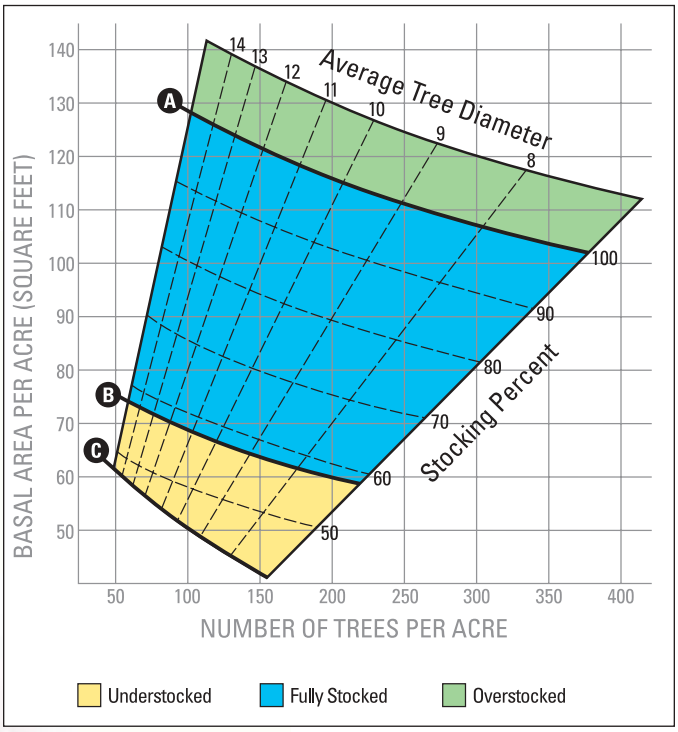


Figure 16-12: Stocking guide/chart for upland central hardwoods displaying the relation of basal area, number of trees, and average tree diameter (the tree of average basal area) to stocking percent. The area between A-line and B-line indicates the range of stocking where trees can fully utilize the site. C-line shows the limit of stocking necessary to reach the B-line level in 10 years on average sites. Similar guides are available for each species.

Improvement Cutting

Improvement cutting is the removal of less desirable trees of any species in a stand of poles or larger trees, primarily to improve composition and quality. Trees are removed to encourage the growth of more desirable trees within or below the main canopy. Trees considered for removal include inferior species, poorly formed trees, overmature individuals, and injured or unhealthy trees. Potential crop trees should be a preferred species and relatively well-formed, vigorous, and healthy.

Improvement cuttings are widely needed and commonly practiced. They usually are applied to stands that have been unmanaged, neglected, or poorly managed. The intent is to remove undesirable material, and set the stage for productive management to accomplish landowner objectives. In most cases, stand improvement can be completed in one to three operations. In cases where the current stand is of such poor quality that rehabilitation is untenable, the preferred choice is to initiate regeneration to develop a vigorous, new stand.

Figure 16-13: An improvement cut in this upland hardwood stand removed overtopping, undesirable trees, thus "releasing" small poletimber from competition that reduces growth rate.

Salvage and Sanitation Cutting

Salvage cutting is done to remove dead, damaged, or dying trees resulting from injurious agents other than competition. The goal is to recover economic value that would otherwise be lost. Salvage operations are done for profit, with the intent of utilizing damaged trees and minimizing financial losses. Salvage should be conducted as soon as possible following a damaging event. Dead trees deteriorate rapidly during the first growing season after death. Severe stand damage will require the implementation of regeneration methods.

Presalvage cutting involves removal of valuable trees at high risk of injury or mortality from damaging agents. The method attempts to anticipate damage by removing vulnerable trees that are in imminent danger of being damaged or killed.

Sanitation cutting removes trees that are a threat to stand health by stopping or reducing the actual or anticipated spread of insects or disease. It is precautionary protection implemented to reduce the spread of damaging organisms, or in anticipation of attacks to prevent or delay the establishment of damaging organisms. Sanitation cuttings eliminate trees that are present or prospective sources of infection for insects or fungi that might attack other trees. The removal of trees must actually interrupt the life cycle of the organisms sufficiently to reduce their spread to other trees.

Pruning

Pruning is a silvicultural technique, typically applied to improve timber quality and value. It is the removal, close to the branch collar or flush with the stem, of side branches and multiple leaders from a standing tree. Branches are removed because they form knots, which are a common defect of lumber, and reduce timber value. The retention of large, dead branches low on the trunk is particularly counterproductive. Multiple leaders are removed to improve stem form. Sometimes, pruning is applied to control disease, or improve aesthetics or accessibility.

Pruning is expensive. Only the best quality crop trees on good sites should be selected for pruning. It is most commonly applied to conifer plantations of species which are poor natural pruners, but which can significantly increase value by producing clear lumber (e.g., white and red pines). Pruning can enable more aggressive thinning strategies, if the promotion of natural pruning is no longer a concern. Combining pruning and aggressive thinning can facilitate the production of increased value in a shorter period of time, by stimulating rapid healing of wounds and promoting the production of clear wood.

Some operational considerations relative to pruning are:

- Careless, poorly implemented pruning can cause tree injury. Avoid excessive green pruning of live branches.
- The best time to remove a branch is just before death or within several years thereafter.
- Pruning should occur in young stands before the lower branches become relatively large. Removing large (greater than one to two inch diameter), live branches can damage quality.
- Pruning is best done in the dormant season – fall to late-winter is best.
- The first pruning should be in young, vigorous poletimber, following early initial thinning.
- Candidates for pruning should be the most vigorous, healthy, dominant (tallest), and largest diameter crop trees for the dominant age class – the very best individuals.
- Before implementing, identify the minimum tree specifications and the maximum number per acre. Typically 50 to 200 crop trees are pruned per acre, generally in two to three operations.
- A typical final objective as a result of pruning is a clear trunk to 17 feet; prune at least to nine feet. Each pruning is done to the topmost whorl of dead branches or into the lower portion of live crown. The ratio of live crown to tree height after pruning should exceed 50 percent.
- Cuts should be made close to the branch collar or flush with the stem – no splinters or broken stubs. Do not tear or loosen bark around a branch stub. Combining hand and pole saws provides an effective and economical choice. Other tools and machines are available, and may be preferable depending on species, limb characteristics, and pruning height.

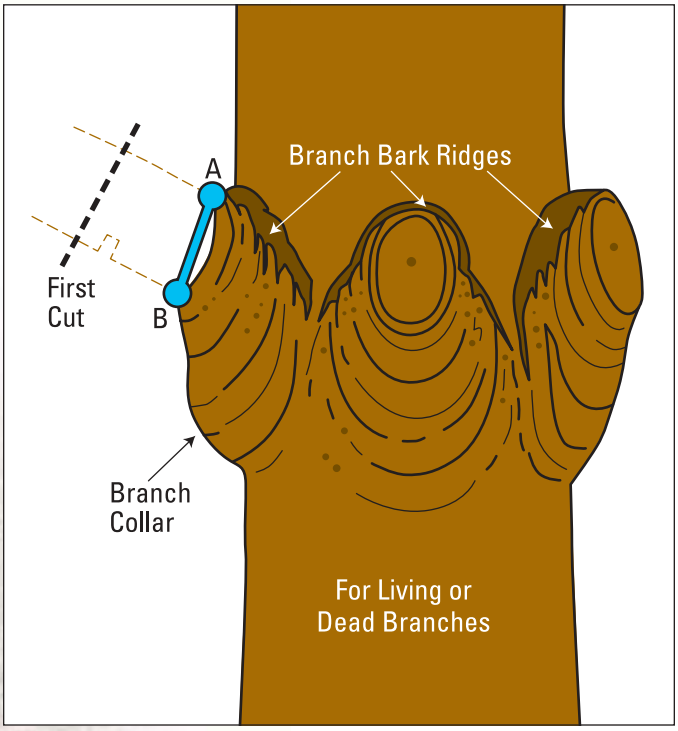


Figure 16-14: When pruning, leave the branch collar. Cut from point "A" to point "B."

POST-OPERATIONAL ACTIVITIES

- Rehabilitate landings, skid trails, and access roads to mitigate soil erosion, rutting, and compaction.
- Monitor and control any new infestations of non-native invasive species. Clean equipment before moving from any infested site to an area that is free of invasives.
- Careful records should be kept of intermediate treatments in order to assess the growth response, economic viability, and the need to refine future thinning schedules.

Figure 16-15: A dense thicket of non-native invasive honeysuckle on one side of a property fence. Honeysuckle on the near side was cut, and the stumps were treated with herbicide.

Figure 16-16: Seeding can be as easy as spreading grass seed by hand as this landowner is doing on his freshly-graded woods road. Use non-invasive species and certified weed-free seed.

Figure 16-17: Retaining slash on skid trails is an effective way of reducing soil compaction and rutting from use of heavy logging machines.

RESOURCES FOR ADDITIONAL INFORMATION

CROP TREE MANAGEMENT IN EASTERN HARDWOODS

Perkey, A. W., Wilkins, B. L. & Smith, H. C. (1993). *Crop tree management in eastern hardwoods.* NA-TP-19-93. USDA Forest Service. Morgantown: NESPF.

THE DICTIONARY OF FORESTRY

Helms, J. A. (Ed.). (1998). *The dictionary of forestry.* Society of American Foresters.

INTERMEDIATE CUTTINGS IN FOREST MANAGEMENT

Huebschmann, M. & Martin, J. (1987). *Intermediate cuttings in forest management.* Wisconsin Woodlands G3398. University of Wisconsin Extension.

THE PRACTICE OF SILVICULTURE (7TH ED.)

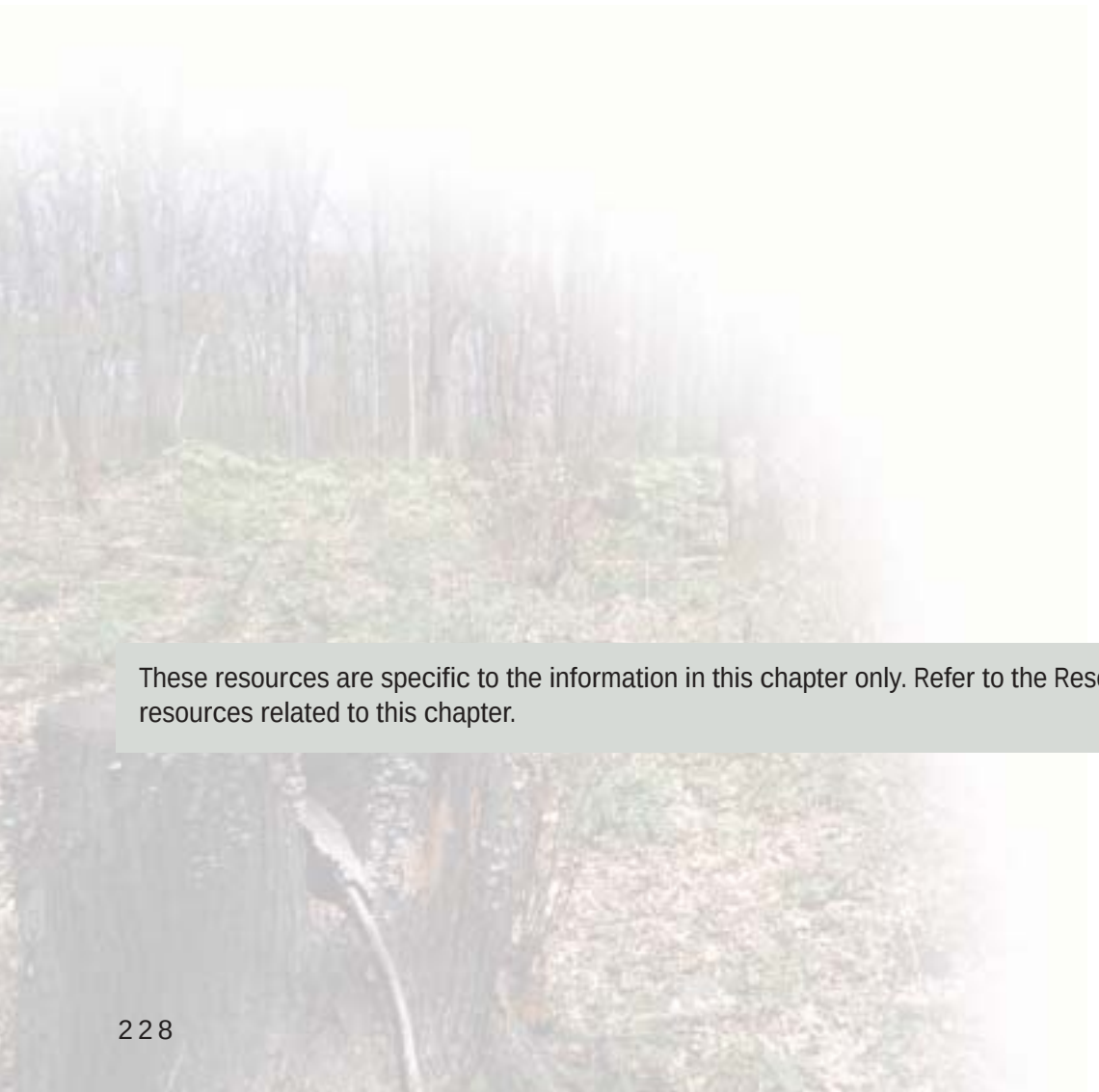
Smith, D. M. (1962). *The practice of silviculture (7th ed.)*. New York: Wiley.

SILVICULTURE: CONCEPTS AND APPLICATIONS

Nyland, R. D. (1996). *Silviculture: Concepts and applications.* New York: McGraw-Hill.

SILVICULTURE AND FOREST AESTHETICS HANDBOOK, PUBL. NO. 2341.5

Wisconsin Department of Natural Resources. (2002). *Silviculture and forest aesthetics handbook*. Madison: Wisconsin Department of Natural Resources.



These resources are specific to the information in this chapter only. Refer to the Resource Directory for additional resources related to this chapter.