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Forest Service

Northeastern Area
State and
Private Forestry

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Northeastern Forest Regeneration Handbook

A Guide for Forest Owners, Harvesting Practitioners, and Public Officials

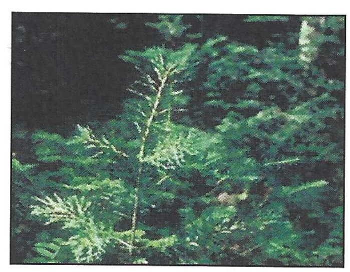
Table 3. Environmental changes anticipated under various silvicultural systems

Silvicultural system	Anticipated environmental changes
Forest preserve	No immediate changes anticipated from human activity.
Single-tree selection	Small, scattered canopy gaps. Slight increase in filtered sunlight to forest floor. Minimal forest floor disturbance.
Group selection	Gaps in canopy of a width equivalent to the average height of the stand or more. Almost full sunlight conditions near the middle of gaps. Some disturbance of the forest floor in gap areas, minimal disturbance in the surrounding area.
Shelterwood system	Significant and evenly distributed disturbance of the upper canopy. Light and temperature increase at the forest floor. Moisture increases in the upper layers of the soil may be observed in the first one or two growing seasons following treatment. Disturbance to the forest floor is readily observable. Some mineral soil will be exposed and mixed with organic material.
Silvicultural clearcut	The entire upper canopy is removed, allowing 100 percent full sunlight conditions at the forest floor. Temperatures at and near the forest floor will increase dramatically. Low temperatures will also be more extreme. Wind conditions will be more variable. Soil moisture increases will be observable in the first several growing seasons.
Reserve tree	Most of the upper canopy is removed, creating light conditions intermediate to a shelterwood and clearcut. Temperatures at and near the forest floor will increase moderately. Wind conditions will be more variable. Disturbance to the forest floor is readily observable with some mixing of mineral soil with organic material. Soil moisture will increase for several growing seasons

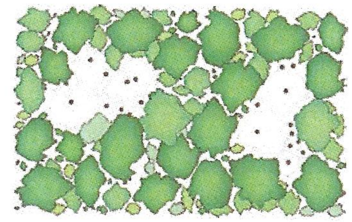
Protecting Soil and Water

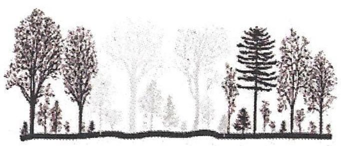
Protecting the soil to ensure good water quality during any forest management practice is a moral obligation, good business practice, and in most places, a legal requirement. Every forest management activity must be conducted in a manner that does not result in excessive detrimental disturbances to the forest soil. Soil disturbance associated with poorly constructed roads and trails creates the potential for erosion and sedimentation. A variety of techniques called water quality best management practices (BMPs) should be designed by foresters, implemented by loggers, and maintained by landowners to ensure that soil disturbance does not lead to erosion problems.

Properly conducted harvesting operations will not only control the amount of sunlight reaching the forest floor, but leave the stand with soil conditions that are ideal for promoting successful regeneration. Examples of good practices to protect forest soils include restricting harvesting equipment to designated skid trails, closing harvests during spring and early summer when soils are saturated, planning skid trails to minimize soil disturbance and maximize efficient operations, regularly inspecting harvesting operations to ensure crews follow guidelines, and installing water control structures during and after harvest to minimize sedimentation.



GROUP SELECTION OR PATCH CUTTING





Group selection or patch cutting

A variant of the traditional selection system is the group selection system, which removes small groups of trees rather than individual trees. The larger openings encourage regeneration by a greater diversity of species. Group selection compares with small-scale and localized high-intensity disturbance, such as multiple tree fall gaps associated with a microburst wind event, an ice storm, or, perhaps, pockets of insect or disease mortality. It is a hybrid method incorporating some of the features of both the single-tree selection and silvicultural clearcutting methods.

This approach does not select individual trees or distribute the intensity of the harvest evenly throughout the stand, but rather removes groups of trees. This method is suitable for certain habitat enhancement and can also be used to create a multiple-aged condition. Poorly formed and less valuable trees are cut and removed along with the commercially marketable ones.

A greater diversity of regenerating species can result if the patches created are large enough to permit full sunlight to reach the forest floor in part of the patch, creating conditions in which shade-intolerant species can compete. A good rule of thumb for shade-intolerant species is to make the minimum opening twice as wide as the surrounding trees are tall, resulting in openings that are at least a half-acre in size. Smaller openings (¼ acre) may be sufficient for midtolerant species or to release saplings (e.g., white pine, sugar maple, red oak) established during previous harvests. During each harvest designed to create new groups, some tending or thinning of previously established groups should occur.

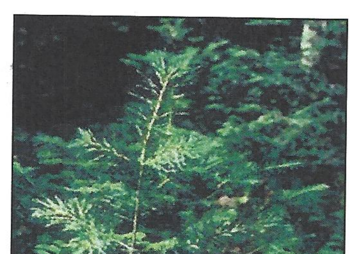
A forest managed using the group selection method will soon resemble a quilt of multiaged and multisized trees. Crucial to the long-term success of group selection is careful placement of the skid trails and roads. A well-designed road system not only lowers harvesting costs, but also provides the landowner with a trail system for recreational use.

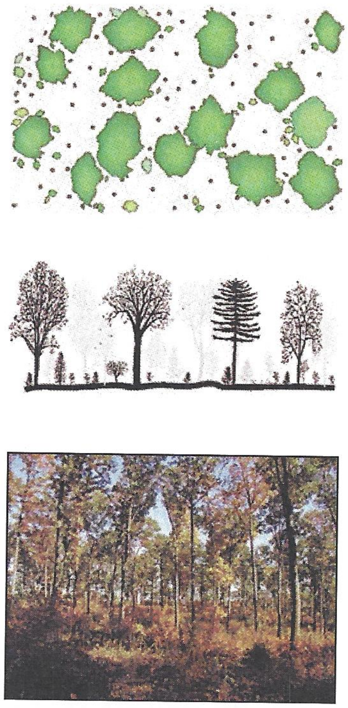
Advantages

Allows regeneration of shade-intolerant species without clearcutting if patches are large; provides the landowner with periodic income; provides a variety of habitats, from early to late successional; harvest schedules can be adjusted for market conditions.

Disadvantages

Resulting patchwork forest increases management costs; patches may be too small for midtolerant or intolerant species that require abundant sunlight; deer may concentrate feeding in recent patches; residual trees near patch edges may be susceptible to damage.





Shelterwood system

Shelterwood System

As its name implies, this method regenerates a new forest under the temporary shelter of older trees. The shelterwood system is similar to disturbances in which only a scattering of overstory trees remains alive. Examples of these disturbances include overgrazing by cattle, a moderate wildfire, or species-specific insect or disease mortality.

Residual trees should be selected from those that had been the most dominant stems in the preharvest forest in order to provide a seed source and moderate the climate for the new stand, which becomes established over a number of years and will become the next even-aged forest. Simultaneously, the residual overstory benefits from extra growth and increases in value until it, too, is removed. The landowner derives relatively substantial income from each of the harvests. A period with no timber income will follow the final overstory removal (see Silvicultural Clearcutting on page 38), however, until the new forest is old enough for commercial thinning.

The shelterwood regeneration method can be applied over two or three harvest stages, depending on physical, biological, and economic factors. This method dovetails well with recreational and habitat objectives. The initial harvests create an increasingly park-like tableau of majestic trees canopied over a carpet of new regeneration and wildflowers.

Landowners and foresters should pay attention to the presence of an established understory during the initial harvest. Forests that were thinned late in development may have an existing layer of unplanned-for small trees of less desired species and interfering vegetation in the understory. If present, these trees will begin to grow faster in response to the increase in light and soil moisture and will become the next forest. If the smaller trees are predominantly desired species, no understory treatment is needed. If the smaller trees are mostly undesirable species, some application of low disturbance is paramount. Low disturbance treatments might include fire, controlled grazing, or herbicides.

The overstory is harvested in two or three clearly defined stages scheduled several years apart. The number of overstory removal stages, and the interval between them, are scheduled according to the desired regeneration species mix. If, for example, a three-stage shelterwood system is applied in a stand at 10-year intervals, the overstory trees will be harvested over a 20-year timeframe and the new forest will be almost 20 years old by the time the final cut is made.

The goal of a shelterwood is to develop advanced regeneration of desired species. Advanced regeneration is older seedlings with large, well-established root systems that allow the seedlings to be competitive with other vegetation when the overstory is removed in the final harvest. New seedlings of many species, especially oaks, have poor height growth even in full sunlight until they have become advanced regeneration (Brose and others 2008).

Advantages

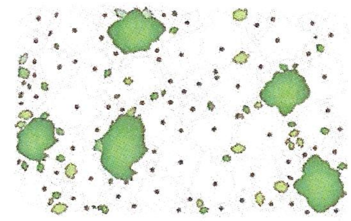
Can increase midtolerant (e.g., oak) regeneration; increased volume growth of residual trees can maintain stand volume growth; least dramatic even-aged silvicultural system; possible genetic improvement in regeneration; damage to residual sawtimber usually minimal; increased vertical structure; regular periodic income to the landowner during harvest stages; some residual trees can be retained beyond the final harvest to maintain large and mature trees in the stand.

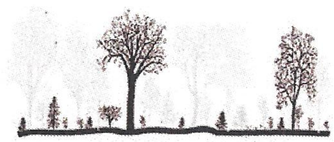
Disadvantages

High skill required for successful implementation; requires market for smaller trees; stands on thin or poorly drained soils may have significant loss of residual trees to windthrow; residual trees may lose quality due to epicormic branches (water sprouts); delay in implementing successive stages (harvests) can lead to loss of midtolerant species and damage to new regeneration.

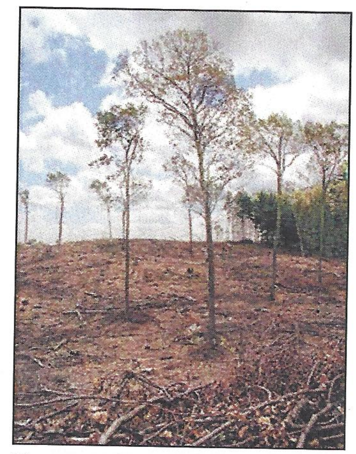
White pine shelterwood

Reserve Tree





The reserve-tree method, a hybrid between a clearcut and a shelterwood system, is more esthetically pleasing in that not all of the overstory vegetation is removed. Borrowing an idea from the shelterwood system, a few trees are left scattered in the stand to provide vertical structure and a potential source of seed. The residual trees should be chosen from the healthiest trees in the stand, those likely to survive for another hundred years. The main difference between the reserve-tree method and a shelterwood system is that this method is a very high-intensity, but one-time (low frequency) disturbance event. All of the remaining vegetation is removed at once, and the new forest will be even aged. The reserve trees are kept to maintain some of the esthetic quality, provide some vertical structure heterogeneity, and potentially provide some seed. The reserve trees are generally kept until the next stand matures and is ready for its first commercial harvest. The new forest will be a mixture of species similar to that found in a silvicultural clearcut. Some habitat enhancement value from retaining these large scattered trees can be realized as well.



Reserve tree

Advantages

Esthetically more pleasing than a clearcut; provides regeneration conditions similar to a clearcut (i.e., beneficial for midtolerants and intolerants); reserve trees will be very large at end of next rotation; provides roost trees for raptors and other birds; reserve trees serve as a supplemental seed source, especially for pine and yellow-poplar.

Disadvantages

Reserve trees are susceptible to windthrow and lightning damage (and lost volume); crown breakage of reserve trees can damage smaller regeneration; large crowns of reserve trees may damage other trees during next harvest operation; no income for 30 to 40 years.

White oak seedling

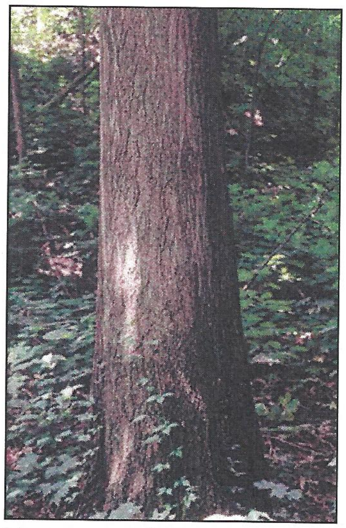
OAK (*Quercus* spp.)

Oak species, including northern red, black, scarlet, white, and chestnut, are widespread in forests throughout the Northeast. Oaks are disturbance-dependent species; most of our oak forests arose on lands that were burned or clearcut in the late 1800s to early 1900s. These large, majestic trees can live for several centuries, especially northern red and white oaks. Mature trees can reach over 120 feet tall with diameters of 2 feet or more. Northern red oak is one of the most valuable timber trees.

Uses

Wood Products

Veneer, fine furniture, cabinets, railroad ties, pallets, firewood, and flooring. White and chestnut oak are used to make barrels and ship hulls.



Veneer and fine furniture are just two of the many wood products made from northern red oak.

Wildlife

Many species feed on acorns, including white-tailed deer, turkeys, squirrels, chipmunks, and blue jays. White and chestnut oak acorns, because of their lower tannin content, are usually eaten before the acorns of other species.

Esthetics

The massive trunks and wide-spreading branches typical of oaks lend the forest a gnarly, primeval sense of permanence. The leaves of scarlet and northern red oak often create a second peak in fall color during late October.

Regeneration

Seed Dispersal

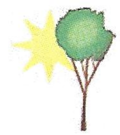
Oaks produce large seed crops at 2- to 10-year intervals. The large acorns that are dispersed by animals germinate in the spring.


Reproductive Modes

Successful oak reproduction develops from stump sprouting and advanced regeneration (older seedlings with large, well-established root systems). Mixing acorns into mineral soil during the initial shelterwood harvest increases acorn survival and germination success.

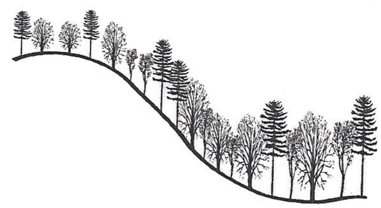

Light Requirements

Although oak seedlings can grow in partial shade, overstory removal (final stage shelterwood, clearcutting, or patch cutting) is eventually required to achieve the full sunlight conditions necessary for seedlings to develop into mature trees.



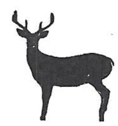

Site Requirements

Northern red oak grows on good to average quality sites common to middle and lower slopes. Black and white oak grows on middle slopes with average site quality. Chestnut and scarlet oak grow on low-quality sites on upper slopes and ridgetops.

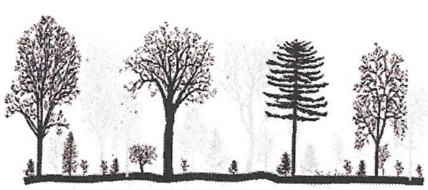


Special Considerations

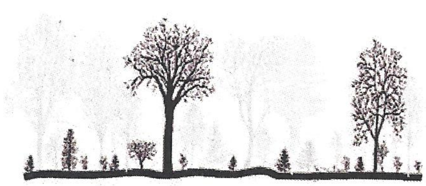
Oaks need protection from browsing where deer herds are large. Where interfering plants are a problem, herbicides or prescribed burning can enhance seedling height growth and survival.



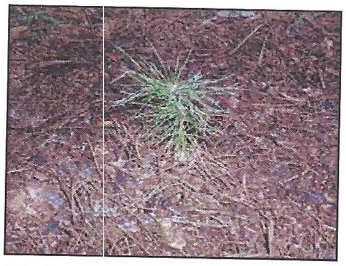

Best Methods to Successfully Regenerate Oak



Shelterwood system



Reserve tree


White pine seedling

Eastern White Pine (*Pinus strobus*)

Eastern white pine can grow on sites ranging from dry ridgetops to swampy valleys. In 1710, the British Parliament passed the White Pine Act to protect the large trees they needed for ship masts. Although largely ineffective, this was one of the first acts that set colonists and New England on a collision course with the British Empire.

This large, majestic species can live for 300 to 400 years or more. Mature trees can reach heights of 150 feet with diameters approaching 3 feet.

Uses

Wood Products

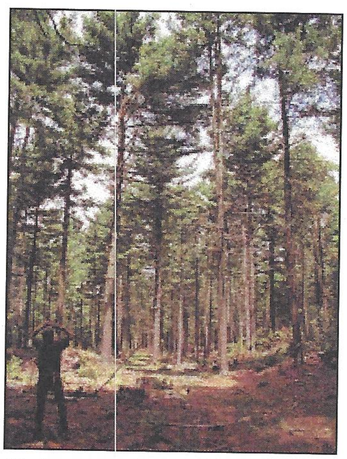
Furniture, lumber, bark mulch, and ship masts.

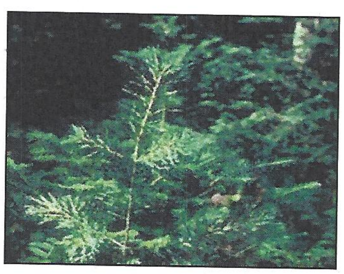
Wildlife

Red-breasted nuthatches eat pine seeds and nest in tree cavities. Red squirrels also eat pine seeds by methodically dismantling the cones.

Esthetics

Mature eastern white pine stands, with their massive boles soaring high above, inspire a sense of awe and reverence, especially when the wind whispers through the needles. The green of scattered pines accents fall colors and provides a reminder of life during the monochrome months of winter.


Mature eastern white pines inspire a sense of awe and reverence.

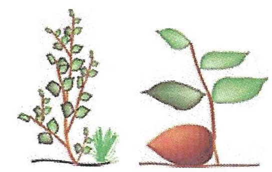


Regeneration

Seed Dispersal

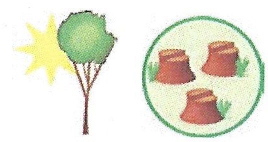
Eastern white pine produces large amounts of seeds at 3- to 10-year intervals. The seeds are dispersed by the wind in the fall. Forgotten squirrel caches contribute to the dissemination of seeds and may be a partial explanation for white pine seedlings appearing in oak stands.

Reproductive Modes



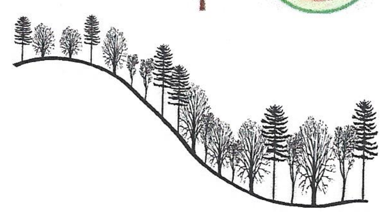
Successful eastern white pine reproduction can be achieved from seedlings in large openings or clearcuts where a seed source is abundant and some mineral soil is exposed. Advanced regeneration is more important when using multiple-aged stand management. Where advanced regeneration is absent, regeneration success is increased by timing harvests to coincide with a heavy seed year. White pine cones take 2 years to mature; the presence of immature cones signals the potential of a subsequent seed year. Disturbing the forest floor to expose mineral soil also increases germination success.

Light Requirements



Although eastern white pine seedlings can grow in partial shade, overstory removal (final stage shelterwood or clearcutting) is eventually necessary for seedlings to develop into mature trees.

Site Requirements

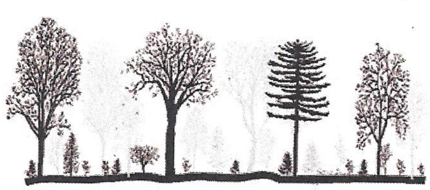


Eastern white pine can be found in every type of site, from deep sands to swamps. Regeneration success is best, however, on sites that are droughty for some period during the year.

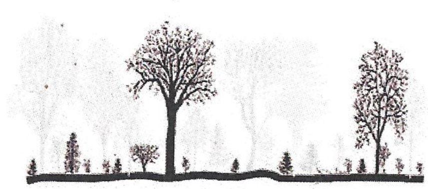
Special Considerations

Eastern white pine seedlings need protection from wildfire and, occasionally, deer browsing. Ideally, regeneration should be established under a partial-shade overstory to reduce pine weevil damage.

Best Methods to Successfully Regenerate Eastern White Pine



Shelterwood system



Reserve tree