Red Pine Management Guide
A handbook to red pine management in the North Central Region

This guide is also available online at:

http://ncrs.fs.fed.us/fmg/nfgm/rp

A cooperative project of:

North Central Research Station
Northeastern Area State & Private Forestry
Department of Forest Resources, University of Minnesota
Management Examples
Management Examples

This section provides red pine management examples to assist in achieving your management objectives. For further guidance on management objectives or for determining the condition of your stand, visit the Key red pine management questions section on this page.

Once you have settled on your objectives and determined the condition of your stand, it is time to decide on the silvicultural system(s) for meeting your land management objectives. Here we offer two examples of different land management objectives: a financially focused example and an ecologically focused example. As the name suggests, the first example is for situations where the landowner's primary interest is income. The second example is for situations where the primary interest lies in maintaining or enhancing stand structure and components that favor native plant and animal diversity. Nested within each example are interpretations of treatments to aid users interested in multiple objectives, such as financially focused management that promotes wildlife habitat or ecologically focused management that also generates meaningful economic returns.

Key red pine management questions

The key questions in formulating a specific set of treatments or silvicultural system are listed below. By answering these questions, you are in a good position to compare what you have and your options with the management examples listed at the end of these questions.

What are your primary management objectives?

Are you interested primarily in income potential, wildlife habitat and biodiversity (i.e. ecological objectives), recreation, or some combination? The specific silvicultural treatments used and how they are implemented will be determined by your answer.

Do you want to establish a new stand on an existing site or do you have an already existing stand?

If you are contemplating starting a new stand, then follow the example beginning at year zero (planting or time of initiation time)

If you have an existing stand, then follow the example beginning at the current age of your stand

Is your stand primarily red pine or is it a mixed species stand?

Pure

Mixed
**In which stage of development is your stand?**

- **Seedling/sapling stage**
- **Pole size stage**
- **Mature stage**

**What is the density of your stand?**

- **Low Density**
- **Medium Density**
- **High Density**

**What is the site quality of your stand?**

Site quality is typically described in terms of the average height of the dominant and codominant trees at an index age. Thus site index 55 refers to sites where red pine typically grows to a height of 55 feet in 50 years. More productive sites are typically taller at 50 years of age. Fortunately, tree height growth is independent of stand density, except at very high densities. Consequently, it is a widely used indicator of site quality and potential productivity. If you do not know your site index please look it up in the Site Index Curves provided. For most economic analysis, it is only important to identify the site quality to the nearest 5-10 feet, e.g., 55, 65, etc.

**Determining Site Index**

To determine site index, locate the age of your stand on the x-axis of Figure 1. Then go straight up to the height of your stand. There are 7 curves in this graph. The highest curve is for a site index of 70, then 65, 60, 55, 50, 45 and 40. The location of your stand with respect to these curves will identify your site index. For example, if your age and height point is close to the curve for site index 65, then your site index is approximately 65. If your points are between the 55 and 60 site index curve, then your site index is approximately 57.5, but 58 or even 60 is probably close enough for most purposes.
If you are having a hard time following this, recall that red pine grows best on well drained coarse soils, including old fields (assume those are site index 65 or 70). Occasional coarse yet well drained and fertile soils will show site indices exceeding 70 and even higher than 75. Poorly drained soils typically have site indices in the 40-45 range. Sandy soils typically have site indices in the 50-60 range. On wet sites you will simply not find red pine except as an isolated tree on a patch of high ground.

In other cases, roots of red pine on sandy soils may reach a shallow water table in 5-10 years; then expect show rapid growth for several decades. Stands aided by early competition control may also grow faster in terms of height than expected. Finally, stands on shallow soils may show an early (age 30-50 years) slowing of height growth, despite rapid early growth. In other words, the site curves are a helpful description of typical height growth patterns, but there are exceptions. Silviculturalists call such variation evidence of polymorphic height growth patterns.
Source: Gevorkiantz, S.R. 1957. USDA Forest Service. Lake States Forest Experiment Station Technical Note 484.
**Financially focused management example**

This example is for forest landowners interested in managing a new or existing red pine stand with the primary objective of maximizing financial returns from producing timber. Traditionally red pine stands established for timber production have been managed under even-aged silvicultural systems where the standing crop of trees is composed of a single age class. Establishing an even-aged stand typically involves site preparation and planting and this is especially true with red pine. Once the stand is established, removing the vegetation that is adjacent to the trees you are managing is necessary to avoid competition for nutrients, sunlight and water by undesirable species. Thereafter, thinning (both precommercial and commercial) is required to capture tree mortality (before it naturally occurs) and maximize use of available nutrients, light, and water by the largest and most valuable trees.

Below are the steps/treatments chosen in developing an even-aged red pine stand through site preparation, planting early growth, thinning, to final harvest (rotation age), with the option of growing the stand beyond the rotation age. The information provided includes the specific silvicultural treatments to be used and the associated stand growth and development results, economic returns, and links to aid users interested in developing wildlife habitat and/or enhance the land’s recreational potential. Additional silvicultural treatments that might be applied are also described. Finally, a group of tables with stand growth and development results are included at the end of the example for the common site indices and planting intensities in the North Central region.

**Stand establishment (0-10 years of age)**

- Site preparation assuming old field or recently harvested stand and including mechanical scarification of the site to control weeds.
- Planting in May including 3-0 bare root seedlings spaced 10ft x 10ft resulting in 436 planted trees per acre.
- Grass and woody competition control in second year with late summer spot (within 3 feet of seedling or broadcast application of herbicide if needed (for example if planting on a site previously occupied by vigorous aspen or other hardwoods).  

**Intermediate treatments (10-30 years of age)**

- No treatment
  - Note possible treatments include further mechanical competition control of overtopping species, thinning, and pruning.
  - Overtopping species typically include aspen.
  - Thinning may be by rows, say every third row, with thinning frequency chosen to maintain at least 60 percent of the tree length (height) in live crown. If competition has already reduced the live crown to less than 60 percent of tree height, you have waited too long, reducing the physiological capability of the tree to respond. Any thinning in such cases should be gradual, reducing the number of trees by no more than 1/3 per decade. There may not be a market for these small size thinnings (posts, poles, pulpwood, chips), thus such thinnings are typically called precommercial.
  - Pruning may be up to 9 feet in height (i.e., given eventual one foot stump), this means removing branches for the first half of the eventual first 16ft log, where much of the tree value is likely to reside. However, pruning should not reduce the percentage of the tree length in live crown below 60 percent.
Intermediate treatments (30-80 years of age)

- Thinning at age 30 to promote growth of the remaining trees and capture early income. Such thinnings are typically called commercial.
- Thinning repeated at age 50 to promote growth of the remaining trees and capture income.
  - Note possible treatments include pruning to the top of the first log (19 ft including 1 ft stump) the tree value is likely to reside. However, pruning should not reduce the percentage of the tree length in live crown below 60 percent.

Mature stand treatments (80+ years)

Final harvest at age 80, followed by regeneration efforts as described above for stand establishment.

This example assumes that:

1) the species composition of the stand is predominately red pine,
2) there has been successful establishment of the stand beyond early competition, drought, fire, and animal damage; and
3) there have been no intermediate to advanced age problems causing unusual mortality or affecting tree quality (e.g., insect and disease problems, storm or animal damage).

If your stand grows and survives according to these assumptions, the stand will closely approximate the growth and development results, product yields and economic returns in the tables viewable on the Red Pine Management Guide web site at: http://ncrs.fs.fed.us/fmg/nfmg/rp/mgt/finance_based.html

If your stand does not grow and survive according to the tables, then the actual growth and development and economic returns will be less than those in the example. For example, if you were unsuccessful in controlling competition, the results will be slower growth, increased mortality, and possibly a highly mixed species stand with numerous shrub species in the understory. There are many compensating factors with these assumptions, but a rough approximation is that the yields will decline as the percentage of hardwood species increases. Thus if competing aspen or other hardwood trees ultimately comprise 20 percent of the stand, assume that yields will decline approximately 20 percent. Of course, if such species occupy more than half of the area, it may no longer be considered a red pine stand.

Wildlife Habitat

Wildlife habitat is the place, natural or otherwise, where wildlife normally live and develop. There are a number of ways to enhance the wildlife habitat in your red pine stand through silvicultural treatments as well as human-made structures. The following information and links will aid you in enhancing the wildlife habitat in your red pine stand.

Stand Characteristics

Stand structure: Many wildlife species will feed in one vegetation layer and nest, or find shelter, in another. Creating diverse vertical and horizontal structure in your red pine stand through variable density thinning and/or selection or retention harvesting will provide a mosaic of vegetation layers which will accommodate a wide variety of wildlife species. For more information on these silvicultural treatments see the red pine Managing for ecological objectives section.

Aggregate retention harvest in a red pine stand (Palik)
**Edge creation:** Edge is the transition area between two habitat types, such as a young red pine stand adjacent to a retained patch of mature red pine. Some wildlife species prefer the interior of one habitat type, such as a dense forest or open field while others require more than one habitat to survive. Creating edge habitat through silvicultural treatments in your red pine stand can satisfy these habitat requirements for many wildlife species.

**Species Composition:** Many forest dwelling animals have a preferred food. This may be the pollen from a particular wildflower or the seed from a specific tree species. To accommodate the foraging needs of the widest range of wildlife species, encourage native plant and tree species diversity through silvicultural treatments such as retention harvests and variable density thinnings which preserve fruit bearing trees, open the canopy and provide light to understory plants.

Care should be taken to avoid the spread of invasive and exotic species which can be a major threat to native plant diversity and can affect wildlife habitat by displacing more desirable and beneficial native species. In addition, native species such as goldenrod, big leaf aster, sweetfern, willows, raspberries and blackberries should be avoided as they harbor insects and disease which may stress or kill red pine.

**Decadence:** Retaining decadent trees (live trees with heart rot, standing dead trees, and fallen, decaying trees) during harvest and/or creating such trees within your red pine stand will provide habitat for a variety of cavity-, hollow-, and crevice-nesting wildlife. Decadent trees support insect communities that are prey for a variety of wildlife species, they provide hunting perches for birds of prey, they partition the forest floor (reducing competition between species) and they provide travel ways and cover. When creating or leaving decadent trees in your red pine stand, it is important to consider the potential insect and disease problems which may occur as a result. Dead and dying trees can become infested with Ips bark beetles which may affect the healthy residual trees. As well, Armillaria root disease is found in declining older trees and the fungus can kill trees outright and make them more susceptible to bark beetles and wood boring insects. Where available, some of these concerns can be avoided by retaining decadent hardwood trees and by leaving hardwood logs within the stand or by moving them from surrounding areas.
Human-made structures

**Nest boxes:** Provide nesting sites for many species of birds and small mammals. These boxes range from small rectangular structures which attract a single animal such as a flying squirrel, to large elaborate houses with many housing compartments which attract community species like the purple martin.

**Bird feeders:** Feeders come in a variety of shapes and sizes and are made of many different materials. Before making or purchasing a bird feeder, determine which species are using your stand and which species you would like to attract and then purchase the appropriate type of feeder and feed.

**Rock piles:** Provide moist, shaded substrate for reptiles and amphibians and escape cover for small mammals.

**Brush piles:** Provide escape cover for a variety of small mammals, ground-nesting birds, reptiles and amphibians. They are typically made of dead branches and brush and are most beneficial along edges and near food sources.

Recreational Values

Red pine stands have the potential to offer a variety of recreational opportunities depending on their age, density, and species mix. To provide access into your red pine stand consider laying out harvest roads to accommodate trail development. These trail networks provide arteries throughout your stand which can be used for a variety of recreational activities such as hiking, wildlife viewing, cross-country skiing, snowmobiling, off-road biking and ATV riding. Furthermore, they provide easy access for future thinning and harvesting operations. Without such trails, dense red pine stands can be difficult to penetrate and view.
Ecologically focused management example

This example is for forest landowners interested in maintaining or enhancing native plant and animal species diversity, including game and non-game habitat, and the forest's aesthetic values. The example describes the development of a red pine stand which has a more ecologically diverse structure and species composition than stands that are managed primarily for financial objectives. Red pine stands managed according to traditional even-aged silviculture typically do not develop diverse structure and species composition. Only recently, as a result of society's interest in ecology and the environment, have land management strategies suggested the use of practices that promote multi-aged and mixed species forests. These suggestions promote complex stand structure and composition that are dominated by species typically managed using even-age methods. A number of these alternatives and techniques are described below along with information on the specific treatments that may be used and an interpretation of how they may affect economic returns.

Prior to harvesting an existing stand

- Identify legacy structures and conditions that will be carried into the new stand. Mark red pine leave trees for retention, both singly and in aggregates. Mark large snags for retention and designate live trees that will be left for snag recruitment. Look for opportunities to retain tree species other than red pine. Protect large dead logs on the forest floor. Look for opportunities to protect intact patches of forest floor and understory plant communities, usually associated with aggregate patches of leave trees. Note that if you retain significant numbers of overstory trees during harvest and subsequent new cohort establishment, your stand will develop a two-age class structure. Caution should be exercised when attempting to regenerate new red pine under or near mature overstory red pine due to potential problems with shoot blight diseases.

Stand establishment (0-10 years of age)

- Site preparation assuming old field or recently harvested stand and including mechanical scarification of the site to control weeds. In a recently harvested stand, consider varying the intensity of scarification to include areas where the soil and forest floor are not disturbed. This will facilitate development of mixed-species stands, if regeneration of other tree species is present, and provide areas where the forest floor and understory vegetation remain intact. Protect leave trees, snags, and dead and down logs from damage during site preparation.
- Planting in May using 3-0 bare root seedlings. Plant using variable spacing (variable density) and an irregular pattern (e.g., spiral, non-parallel rows). Consider planting mixtures of site appropriate species and/or seeding species other than red pine into the new stand.
- Grass and woody competition control as needed to establish red pine and other planted tree species seedlings (as in the even-age management example). Care should be taken to allow establishment and development of other woody species that may be naturally regenerating in the stand and to avoid damage to patches of understory vegetation that have been retained within aggregates of overstory trees.

Intermediate treatments (10-30 years of age)

Note: as with the even-aged management example, possible treatments include mechanical competition control of overtopping species, thinning, and pruning.

- Overtopped red pine may be released. However, do not indiscriminately remove all stems of other tree species, such as aspen, as these add to the species diversity of the regenerating stand.
  - If your red pine are planted in rows, consider varying thinning in a non-systematic way, for example, by not thinning all trees in a row and randomly varying the number of rows...
that are skipped (not thinned) from one to four. The objective to begin moving the stand towards a more heterogeneous spatial structure. As with the even-aged example, thinning should be implemented in a way that maintains at least 60 percent of the tree length (height) in live crown.

Other considerations regarding early thinning and pruning, as given in the even-age example, also apply.

**Intermediate treatments (30-80 years of age)**

- Thinning at age 30 to promote growth of the remaining trees and capture early income. Such thinnings are typically called commercial. Variable density thinning (VDT) should be used to create more heterogeneous stand conditions. VDT will create variation in canopy cover, tree density, and understory plant community development. Do not discourage establishment of additional tree species in gaps created through VDT.
- Thinning may be repeated at age 50 to promote growth of the remaining trees, further enhance spatially variable structure (canopy cover, density, understory plant communities), and capture income.
- Consider underplanting more shade tolerant tree species under heavier canopy cover and less tolerant species in gaps created with VDT.
- Snag and dead and down wood loadings may be increased at this time to enhance wildlife habitat. Consider creating snags artificially through girdling, herbicide injections, or other means. Larger trees may be dropped to increase the number of logs on the forest floor.
- Prescribed surface fire can be used to control understory woody competitors, such as hazel, create spatially variable understory plant communities (if the burning is spatially variable in intensity), and potentially induce decline and mortality (snag creation) in some trees.
- Once a stand is established, and producing seed (approximately age 40), canopy gaps created with VDT may encourage the development of additional age classes of red pine. However, success will depend on soil/site treatments to expose mineral soil and mechanical or herbicide control of competition. Such treatments will encourage natural regeneration. Simply opening up gaps without control of grass, brush and competing tree species will likely fail.

**Mature stand treatments (80+ years)**

- Red pine is a long-lived species, with life expectancies approaching 300 years. Thus, extended rotations, of 150 years or more should be considered. With periodic thinning, growth can be maintained in trees that are well over 100 years of age. Treatments in older stands could include periodic (every 15-20 years) thinning to enhance growth of remaining trees.
- If the stand is harvested, focus on legacy management, as in the beginning of this example.
- Alternatively, you may decide to harvest a larger portion of the mature cohort of trees, but also retain a significant number of trees. This would be followed with new cohort planting, seeding, or natural regeneration. This would create a two-cohort stand. Additional future regeneration harvests, with partial overstory retention, could lead the stand to a multi-cohort (multi-aged) structure. Caution should be exercised when attempting to regenerate new red pine under or near mature overstory red pine due to potential problems with shoot blights diseases (see red pine health section). Consider alternation of pine species dominance (e.g., regenerating white pine near mature red pine) to minimize shoot blight infection.
- Underplanting, snag and dead and down log creation, and prescribed fire, for the reasons outlined above, are treatment options.
Enhanced economic returns

In general, wood volume production over a rotation is improved by thinning early, frequently and lightly to capture mortality and concentrate growth on the largest and most valuable trees. In this region 1-2 thinnings are common with red pine management. Pruning to the top of the first log (19ft) will enhance sawlog and veneer bolt product potentials, especially for the anticipated 100 largest trees per acre. Fertilization is also an option. Reducing woody competition (brush) can also reduce logging costs. However, economic returns are a complex function of investment choices and levels, costs, timing of treatments, interest rates, and product values. For more information, see the red pine Economic section. In addition, we encourage use of the Red Pine Economic Analysis model provided in this section.