



-Balance in the Forest- **Forest Management Systems**

Adapted from the on-line Teachers Guide
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MICHIGAN STATE
UNIVERSITY
EXTENSION

FOREST MANAGEMENT SYSTEMS

Selection
Clearcutting
Shelterwood
Regeneration
Plantations
Tree Planting

There are three main "***silvicultural systems***" used in Michigan. The names come from the "***regeneration method***" that is used. Each system has numerous variations.

- 1) Clearcutting**
- 2) Shelterwood**
- 3) Selection**

Each of these systems has two or three main goals.

- 1) Production of outputs. Timber is usually a principle output.**
- 2) Establishment of tree regeneration.**
- 3) Improve the quality of the existing stand.**

There are a host of other forestry practices that are not part of a silvicultural system. They include practices such as pruning, salvage, wildlife habitat modifications, etc. For more information about "outputs", see the "***Multiple Use***" chapter.

Each silvicultural system produces either an "***even-aged stand***" or an "***uneven-aged stand***". Even-aged means that most of the tree ages are +/- 20 percent of the average age. Uneven-aged might mean two or three age classes or an "***all-aged***" where a suite of ages are appropriately represented from seedlings to mature trees.

Silvicultural systems are selected and modified as biological, economic, and social factors are applied. Each can be modified to meet variable sets of objectives. Forest management is flexible but quite intentional, and requires professional evaluation to obtain full benefits from the forest. Generally speaking, better quality sites provide more management options than low quality sites. Northern hardwoods on fertile soils will have many possible management routes. On the other hand, there are not many management alternatives with jack pine growing on a sandy outwash plain, or black spruce in a swamp.

The Michigan Society of American Foresters have prepared a Forest Management Guidelines booklet, available through their website [www.michigansaf.org].

Silvicultural System: A planned series of treatments for tending, harvesting, and re-establishing a stand.

Silviculture: The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis.

- Society of American Foresters, 1998

Shade Tolerant Trees

A northern hardwood (sugar maple, basswood, and beech) stand is typically managed under a **"selection system"**, because the constituent tree species are capable of reproducing in partial shade and high quality logs are produced by controlling light conditions. A portion of the trees are harvested with an eye to improving future stand conditions. Near a high-use recreation area, harvest volumes may be lower but the stand entered more frequently. The distribution of harvest might be spread evenly throughout a stand, or may be concentrated on groups of trees producing large "gaps" in the canopy that will encourage regeneration of more light-loving tree species. These "canopy gaps" may also meet certain wildlife habitat objectives. On a poor to medium site (for northern hardwoods) that has difficult and expensive access, the stand might be clearcut and managed on an even-aged basis for lower quality material. The selection system is an *uneven-aged* silvicultural system.

Michigan Forest Type	Selection	Shelterwood	Clearcutting
Northern Hardwood	Yes	Yes	Maybe
Aspen	No	No	Yes
Oak-Hickory	Maybe	Yes	Maybe
Swamp Hardwood	Yes	Yes	Yes
Cedar	Yes	Yes	Maybe
Red Pine	No	Maybe	Yes
Jack Pine	No	No	Yes
Balsam Fir	No	Maybe	Yes
Black Spruce	No	No	Yes
Paper Birch	No	Yes	Yes
White Pine	Yes	Yes	Maybe
Balm-of-Gilead	No	No	Yes
Tamarack	No	No	Yes
White Spruce	No	Maybe	Yes

Silvicultural systems are applied based on local conditions, mostly biological characteristics. Shade intolerant types (i.e. aspen, jack pine) must be managed by some form of clearcut in order to secure regeneration. Shade tolerant systems have more options, depending on many considerations. Northern hardwoods are normally managed under a selection system. Also, each forest type typically has a diversity of tree species. Forest types are listed in order of frequency, from the greatest number of acres to the least number of acres.

Trees That Require Full Sunlight

Aspen is an excellent example of a tree species that can only be regenerated under full-light or near full-light conditions. **"Clearcutting"** provides not only the full light to drive photosynthesis, but also warms the soils and eliminates leaf-origin hormones. These conditions stimulate dormant buds on the parent root systems and aspen suckers may grow in densities of 20-30 thousand per acre (a "typical" mature forest may have 400-600 trees per acre). Longer-lived species in the parent stand might be left to encourage regeneration of other tree species or to maintain certain wildlife habitat features, such as food trees, den trees, or shelter from weather. Retaining variable densities of trees within a clearcut might also serve to mimic certain natural processes and reduce the poor visual characteristics of a clearcut. Clearcutting is an *even-aged* silvicultural system. A **"seed tree"** system is a variation of clearcutting that leaves a few trees per

acre as a seed source. This was typically done with red and white pine but was not a particularly successful method of regeneration. It is no longer a common practice in Michigan.

Red pine has infrequent seed years and produces limited amounts of viable seed. It requires full sunlight for good growth and is one of the most productive timber species in Michigan. As a result, red pine is often planted after an area has been clearcut, thinned a number of times, and then eventually clearcut and replanted. This process takes about 60-120 years, depending upon the stand objectives, although red pine might live to be 150-200 years old. This time period is called the "**rotation**". Alternatively in certain areas, rotations can be extended to provide a more mixed species forest with more old growth characteristics. Such a stand might also be eligible for prescribed burning practices to reduce certain insect problems and stimulate natural red pine regeneration.

Clearcutting often has a bad reputation for two reasons;

- 1) it has been used improperly, and
- 2) it has a dramatic visual effect.

Nevertheless, it is a valuable silvicultural system and is necessary to maintain a balance in landscape diversity and human needs. See the end of this chapter for more about clearcutting.

Trees With Variable Tolerances of Shade

Northern red oak and paper birch require lots of sunlight but can tolerate of partial shade, especially during their early years. These species often occur on drier soils, which can impede seedling survival if they become excessively dry. Removing the parent forest (overstory) in stages promotes successful seed germination and seedling establishment under the protective cover of a partial canopy, followed by harvest of the remaining parent forest to provide full sunlight for optimum growth of the next generation. This two or three stage silvicultural system is called a "**shelterwood system**". It is an even-aged silvicultural system.

<i>HARVEST SYSTEM CONTRAST</i>		
<u>Clearcut</u>	<u>Factors</u>	<u>Selection</u>
<i>Low</i>	<i>Shade Tolerance</i>	<i>High</i>
<i>Early</i>	<i>Successional Stage</i>	<i>Late</i>
<i>High</i>	<i>Regeneration Potential</i>	<i>High</i>
<i>Lowest</i>	<i>Harvest Cost</i>	<i>Highest</i>
<i>Type Dependent</i>	<i>Revenue Flow</i>	<i>Every 10-15 Years</i>
<i>Good</i>	<i>Game Habitat</i>	<i>Poor to Medium</i>
<i>Poor</i>	<i>Visual Quality</i>	<i>High</i>
<i>High</i>	<i>Disturbance</i>	<i>Low</i>
<i>Lowest</i>	<i>Soil Damage Potential</i>	<i>Highest</i>
<i>Highest</i>	<i>Water Runoff Potential</i>	<i>Lowest</i>

Shelterwood differs from the selection system and clearcutting in the amount of forest harvested in the first removal. Generally speaking, more trees are harvested than with

a selection system but fewer trees than a clearcut. Enough forest cover is retained to "nurse" the new regeneration of trees but not but threaten it with excessive shade. Most tree species benefit from having the ground "roughed up" to expose many patches mineral soil. Access to the soil is required by many tree species immediately after the seeds germinate. Leaf litter and organic layers can prevent successful regeneration of such species.

A "**progressive shelterwood**" moves like a wave through a forest, usually in the direction from which the prevailing winds come. Behind the "wave" is new regeneration. In front of the wave is the mature forest. The wave itself, is the forest that has had one or two harvests. The more dense mature forest helps to protect trees in the "wave" from blowing over. Trees that are temporarily retained in a shelterwood are often more windfirm. They may also be more valuable for timber or wildlife reasons and may benefit from a few years of more open-forest conditions.

Tree Regeneration

A forest management system is not good silviculture unless there is a plan for regeneration. In Michigan, tree regeneration is not usually a problem. However, obtaining the *desired mix* of regeneration often requires considerable forethought and expertise. "**Natural regeneration**" is obtained by creating optimum conditions for trees to reproduce using their own methods. "**Artificial regeneration**" involves the planting of trees, often preceded by specific site preparation practices.

Most of our forest types are easily regenerated naturally using the silvicultural systems outlined above. That means that *we do not have to plant trees for every tree we harvest!* At least not in Michigan. Correctly manipulated, nature will produce far more regeneration than planting could ever hope to obtain. Planting is also expensive and difficult work. These resources can be better expended in other ways. Trees regenerate naturally using at least one of three strategies. **Seeds** are the most obvious strategy. All trees produce seeds, but may use other techniques, sometimes more commonly. **Sprouts** may grow from stumps after a trees dies or has been harvested. Red oak, red maple, and basswood are typical stump-sprouters. **Suckers** may grow from parent root systems. Members of the genus *Populus* (aspens, cottonwood, poplars, balm) usually from dense thickets of sprouts after the parent dies.

Do we plant trees in Michigan? Oh yes! About 30 million trees are planted each year, about three trees for every person in the state. Not all tree species respond well to silvicultural systems. These "difficult" species are usually trees that are highly adapted to catastrophic events such as fires or windstorms, or have peculiar seed production patterns that are difficult to predict and properly time with harvest. The most commonly planted tree species in Michigan is red pine. It is a valuable timber species but is difficult to regenerate naturally. Michigan also plants a lot of white spruce and jack pine. In the Upper Peninsula, a highly production strain of European larch (similar in

appearance to our tamarack) is being planted on appropriate sites. Planting may be used to replace an existing stand or to convert one forest type to another. For example a poor quality hardwood stand growing on a pine site may be clearcut, AND then planted to pine. For more information about tree plantations, see the ***Tree Planting*** chapter.

CLEARCUTTING! IS IT NECESSARY?

Clearcutting is a subject of considerable controversy throughout the nation as well as in Michigan. However, it is a legitimate forest management tool that has specific applications to meet particular objectives.

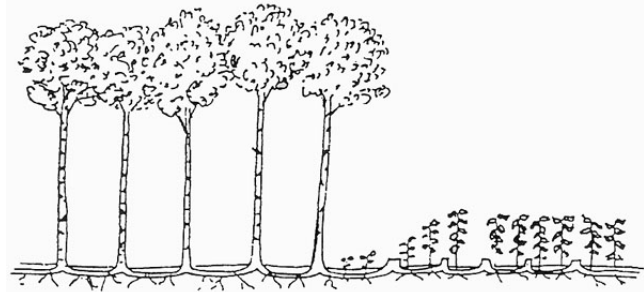
1. What is Clearcutting?

Clearcutting is a method of timber harvest and regeneration. It involves cutting all or most of the trees in an area at one time.

Clearcutting is *not* what is done to develop a new subdivision or strip mall!

Any timber that might be sold (which would be a good thing) from such a

development is . . . well . . . development or land use change, not forestry. Many people dislike the loss of forests for development, and such deforestation *is* an issue in Michigan, but clearcutting for forestry is a practice that *regenerates* the forest.



2. Why is it done?

Clearcutting is used as a method of regenerating or rejuvenating certain kinds of trees that cannot tolerate shade. It is also used when a forest type conversion is planned, often from low quality hardwoods to pine, on sites best for pines.

3. But why not cut only the larger ones and leave the little ones?

Almost all the trees in these shade-intolerant forests are the same age. The small ones are not necessarily young ones. Second, trees vary in their ability to grow up under the shade of other trees. Sugar maple and balsam fir, for instance, will grow well under shade, while jack pine and aspen grow very poorly in shaded situations.

4. Is clearcutting the best way to harvest all kinds of timber?

No. Although clearcutting is appropriate in some types of forests, methods that leave various numbers of trees standing are preferred and practiced in most other situations. Clearcutting may not be the best practice on certain types of soils, slopes, or other factors, even though the timber types would benefit.

5. When is clearcutting appropriate?

Let's look at two of Michigan's largest timber types and how clearcutting helps their growth.

Aspens (popples). There are two species of aspens native to Michigan; quaking aspen and bigtooth aspen. They are among nature's "pioneer trees". That is, they are trees that will start new forests after fires, floods, windstorms, or other disturbances. Aspens tend to grow in groups called clones that are supported by a common root system. These interlaced roots will send up new sprouts, called suckers, if the trees are cut when alive and vigorous. The sprouting is stimulated by two factors; the warming of the ground by the sun due to the removal of shade, and the absence of sprout-suppressing chemicals produced in the tops of the aspen trees.

Thus, clearcutting provides two essential stimuli for development of a vigorous, new aspen stand. The cleaner the cut, the better it works. Small-diameter stems of maple and oak, if left, will develop wide spreading crowns and shade out the young aspen underneath, so they must also be cut if the objective is to start a new aspen forest.

Jack pine is another pioneer species. This one commonly occupies some of the driest, sandiest sites in Michigan. Few other tree species can survive on these sites, while jack pine can develop into commercially valuable stands. For this reason, it may be the only choice available in many areas in northern Michigan.

Jack pine's place in the ecological scheme of things is to restock areas after forest fires. Its cones contain a resin, which prevents them from releasing their seeds. The cones stay in the tree tops for many years where they will open if a fire sweeps through the stand. The heat melts the resin but usually passes through too quickly to burn the cones. After the fire, the seeds fall on the freshly burned earth, a perfectly prepared seedbed. The fire has prepared the seedbed, released the seeds and destroyed the overhead shade all in one pass.

Clearcutting mimics the effects of the fire by removing the shade and scuffing the ground to prepare the seedbed. The cones will also reach high enough temperatures to melt the resin if they are within one foot of the ground. If this natural seed source does not regenerate the stand, seedlings are planted.

6. Why is it important to regenerate aspen and jack pine?

Aspen and jack pine are preferred by deer, grouse, and other wildlife as places to live and as sources of food. Timber harvest provides more than half of the wood products and jobs that are important to Michigan's people and economy.

7. What other kinds of trees are clearcut?

Clearcutting may be useful in several other situations.

Oak, particularly on poor soils, may be clearcut (1) if trees are mature and enough young trees 3 feet or more in height are present to establish a new forest, or (2) if trees are mature and enough stump-sprouting is anticipated to create a new oak forest, or (3) if other tree species would be planted on the site, or (4) to make openings for wildlife habitat.

Red pine, if trees are mature and a new forest would be established by planting or by young trees already present.

Spruce, fir, and cedar may be clearcut in strips or patches that are small enough to allow seeds to blow in from nearby trees. If deer densities are high, cedar regeneration will probably be unsuccessful.

8. If clearcutting has so many benefits, why is it controversial?

Because it is shocking to see areas abruptly changed from dense forest to treeless openings. The logging debris is unsightly, even in a well-handled job. Because the new trees take a few years to become noticeable, it is perceived as wanton destruction rather than planned renewal. Often young aspens and oaks are not recognized as trees, but are thought of as "brush". This also contributes to the misconception that clearcutting fails to regenerate forests.

9. Can the negative aspects be mitigated?

Yes. The visual effects of clearcuts can be softened by varying the shape and by leaving certain trees or groups of trees within the clearcut opening. Many clearcuts can be made into pleasing temporary vistas in this way. Changing people's perception of clearcutting can only be done through education.

10. Are we cutting more than we can sustain in Michigan?

No. Forest surveys done by the U.S. Department of Agriculture Forest Service have shown that we are growing nearly twice as much as we are cutting. Timber harvest is monitored by the Forest Service and the Department of Natural Resources to avoid over-cutting. Michigan's forests are still recovering from the cutting practices of the previous century and we cannot allow that kind of over-harvest to happen again. Regular forest inventory and planning assures that Michigan's public forests will be sustained for future generations.



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