

SILVICULTURAL SYSTEMS

INTRODUCTION

A silvicultural system is a planned process designed to tend immature trees and establish new trees in a forest stand. The type of silvicultural system selected depends on many factors. These may include the owner's objectives for the woodlot, the environmental conditions, and the tree species present and desired for the future.

TYPES OF SILVICULTURAL TREATMENTS

Intermediate treatments are applied to established immature forests to improve them. They may be undertaken to remove poor-quality trees; to remove undesirable tree species (weeds); to thin the stand and increase the growth rate of residual (or leave) trees; to remove large, poor-quality trees that are shading smaller, good-quality trees; to remove insect- or disease-infested trees; or to salvage timber damaged by insects, disease, fire, or extreme weather.

One type of intermediate treatment popular among landowners is crop tree management. Crop trees are enhanced by removing other trees whose crowns touch or extend above or below their crown. This provides the crop trees with more sunlight, moisture, and nutrients, allowing them to grow more rapidly.

Regeneration or reproduction treatments are applied to mature stands that are ready for harvest. These treatments remove the large trees as efficiently as possible while creating environmental conditions favorable for the establishment of a new crop of trees. Concern for the immediate regeneration of new trees is the most significant difference between silviculture and exploitative logging. To encourage sun-loving species like yellow-poplar in the new stand, the owner and the forester might select an even-aged system. To encourage species like maple that grow well in the shade, an uneven-aged system might be selected. Species like northern red oak regenerate well in partial shade; systems that include gradual removal of the large trees favor oak.

COMMON REPRODUCTION SYSTEMS

Even-aged Systems

These systems result in stands of trees that are about the same age. They all became established at approximately the same time and mature together. As the trees develop, they are naturally or artificially thinned to provide the remaining trees with more sunlight and nutrients.

- *Clearcutting*

How? All the trees are removed at the same time.

Why? Clearcutting usually is used in stands having abundant, good-quality seedlings in the understory or when abundant sprouting can be expected from the cut stumps.

Clearcutting is a particularly good method to use when regenerating species, such as yellow-poplar, that grow best in full sun. It is also a good choice for regenerating chestnut oak and white oak on drier sites.

- *Seed Tree*

How? All but a handful of widely scattered mature trees that serve as a source of seed are removed. Seed trees must be of high quality and desirable species. A second cutting will remove all of the “seed trees” as soon as the new seedlings are 5-10 feet tall.

Why? The seed tree system is often used when seedlings are not abundant in the understory before cutting. This method may be a particularly good choice if you are trying to establish pine or other light-seeded species, such as yellow-poplar, in the new stand.

- *Shelterwood*

How? The large trees are removed in stages over a period of years. Generally, one-third to one-half of the mature trees are removed initially. This lightens the understory but leaves a reserve of mature trees to serve as a source of seed and to partially shade the ground. A second cutting will remove all of the mature trees as soon as the regeneration reaches 5-10 feet tall.

Why? The shelterwood system can be used to encourage oak and other species that grow well in partial shade. The partial cutting allows oak seedlings to become established. The well-established seedlings will grow rapidly after the second cut.

Uneven-aged Systems

These systems will result in stands that include trees of various sizes and ages. They become established and will mature at different times. Treatments create and maintain conditions in which trees of various ages occupy about the same amount of space in the stand. This is called a balanced structure.

- *Single-tree Selection*

How? Single trees of all sizes and ages are removed from throughout the woodlot every 10 to 25 years. These cuttings open space in the crown canopy, allowing new seedlings to become established and also enhancing growth of remaining trees by reducing crowding.

Why? Single-tree selection is a good choice for regenerating such species as red maple, sugar maple, and beech, which can survive in a heavily shaded understory. This also may be a good system to use if you would like to maintain a canopy of larger trees at all times.

- *Group Selection*

How? Small groups of trees of all sizes are removed from throughout the woodlot every 10 to 25 years. Scattered openings that range in size from one-fifth to one-half acre (100 -160 feet wide) are created. In addition, single immature trees are cut between the group openings to reduce crowding among the remaining trees.

Why? Group selection may be a good choice for maintaining a canopy of larger trees while regenerating species that do better in full or partial sunlight. However, depending upon the size of the openings created, expect such species as the maples and beech to eventually dominate when group selection is used.

Other Systems

- *Patch Cutting*

How? Patch cutting combines elements of even-aged and uneven-aged systems. Openings of $\frac{1}{4}$ to 5 acres are created in the stand annually or at specific intervals. Each opening (or patch) is even-aged; however, the stand will consist of a mosaic of patches of different ages.

Why? Patch cutting can be used to regenerate sun-loving species while maintaining the canopy over some of the stand at any given time.

- *Two-aged System*

How? Two separate age classes are maintained at all times. One is relatively young and the other much older. To initiate the system, a heavy cutting removes about one-half of the mature trees. This creates a very open stand with wide spacing between the remaining trees. A new age class becomes established beneath the older trees. After 40 to 60 years, the oldest trees will be removed and the younger ones heavily thinned to a wide residual spacing.

Why? This system can be used to regenerate species that will not grow well in partial shade while maintaining some larger trees on the property at all times.

Shade and Competition Tolerance

Tolerance is measured by a tree's capacity to survive low overhead light and intense root competition. A tolerant species can establish itself under the canopy of a less-tolerant species or even beneath its own canopy - like sugar maple seedlings under a full canopy of sugar maple - and responds rapidly to release. An intolerant species can become established only in the open or in large openings in the crown canopy. Intermediate species can tolerate partial but not full shading for extended periods. Choose a silvicultural system that creates a favorable environment for the species preferred for the new stand.

The following chart lists tree species according to their capacity to tolerate shade and root competition.

TOLERANCE TO SHADE AND ROOT COMPETITION BY SPECIES

Very Tolerant	Tolerant	Intermediate	Intolerant	Very Intolerant
eastern hemlock	red spruce	eastern white pine	eastern redcedar	tamarack
balsam fir	black spruce	slash pine	red pine	jack pine
Atlantic white-cedar	white spruce	baldcypress	pitch pine	longleaf pine
eastern hophornbeam	northern white-cedar	yellow birch	shortleaf pine	willows
American hornbeam	red maple	sweet birch	loblolly pine	quaking aspen
American beech	silver maple	American chestnut	Virginia pine	bigtooth aspen
American holly	boxelder	white oak	black walnut	cottonwood
sugar maple	basswood	northern red oak	butternut	gray birch
flowering dogwood	persimmon	black oak	hickories	black locust
	buckeye	American elm	paper birch	osage-orange
		hackberry	yellow-poplar	
		magnolias	sassafras	
		white ash	blackgum	
			sweetgum	
			American sycamore	
			black cherry	
			honeylocust	
			catalpa	
			Kentucky coffeetree	