

CHAPTER II

Forest Ecology and Management

Chapter Goals

Goals of the chapter are to describe

- The major forested regions and types of forests in Illinois
- The major factors influencing forest composition and structure in Illinois
- Patterns of succession in Illinois forested ecosystems
- Forest cycles: nutrients, water, carbon, oxygen
- Benefits of forests
- The differences and meanings of preservation and conservation in forest ecology and management
- Major threats to the health of Illinois forests
- Ecological goals of forest management
- The benefits of urban forests and their management

Introduction

Forest ecology is the study of the components and functions of forest ecosystems: communities of organisms interacting with each other and with their physical environment. Forest ecosystems consist of many components including bacteria, fungi, insects and other arthropods, plants, birds, mammals, reptiles, amphibians, climate, soil, water and air. Forest ecosystems differ from others in that they are dominated by trees. Each biological and physical component plays a role in the function and health of a forest.

Forest ecology is not rocket science. In fact, it is much more complicated. Consider the fact that a volume of forest soil about the size of a sugar cube may contain from 6,000 to 10,000 different types of bacteria. Most of these bacteria are virtually unknown to science, detected only by the structure of their DNA extracted from soil and analyzed using techniques of molecular biology. This large number of bacterial types does not include other soil microbes such as fungi, protozoa, algae, and viruses. On top of this, organisms found in the soil component of the forest ecosystem alone include nematodes, earthworms, millipedes, mites, moles, salamanders, and many others. We certainly do not understand all of the interactions among forest organisms and their environments for even a single forest stand, let alone a forest type. But many ecological patterns of forests have been established by science. It is part of human nature to seek patterns, after all, and those patterns of forest structure, function and change that have been determined serve as the basis for protecting and managing forests.

Forest Classification and Regions

The broadest regional classification recognized by plant geographers and other scientists is a **biome**. A forest biome is a zone where predictable tree, plant and animal communities exist resulting from the effects of climate, soil, the presence or lack of moisture and other physical variables.

In North America, biomes include tundra, boreal forest, **broad-leaved temperate deciduous forest**, desert, prairie, mixed evergreen and deciduous forest, tropical, montane, temperate and tropical rain

forest and Mediterranean scrub. The temperate deciduous forest biome of North America occupies most of the eastern part of the United States and a small strip of southern Ontario and Quebec. Temperate deciduous forests comprise 14% of the world's forests and are dominated by broad-leaved deciduous trees.

The retreat of the last major glacial front from central and northern Illinois began 20,000 years before present. The ancestors of our current Illinois broad-leaved deciduous tree species migrated northward from **refugia**, or refuges, in which they sheltered from the harsh, ice age climate. Fossil records suggest that these refuges were in the southern and southeastern part of North America in the lower reaches of river valleys flowing into the Atlantic Ocean and Gulf of Mexico, as well as in coves of the bluffs of the southern reaches of the Mississippi River. Fossils of an extinct species of spruce have been found in the lower Mississippi valley from this time, probably because the river cooled its floodplain area with torrents of glacial melt water in the summers. This likely created a cool, misty environment for the spruces, relegating broadleaved deciduous species of the lower Mississippi River drainage to warmer, sheltered upland areas.

The broad-leaved temperate deciduous trees migrated northward and expanded beyond their refuges as the climate warmed, joining with and separating from a variety of tree associates during their continental migrations. To the north a narrow zone of tundra occurred near the retreating glaciers, and pine and spruce forests covering large areas retreated northward with the warming climate. The migrations were spurred by the warming of the current interglacial period and have culminated today in the widespread, eastern, temperate deciduous forest biome. Precipitation in the temperate deciduous forest biome ranges from 28 inches per year in the northwestern section of the biome to 60 inches in the southeastern part. In most areas the precipitation is evenly distributed throughout the year. Frost occurs throughout this biome and summer and winter are distinct seasons.

Illinois is within both prairie and temperate deciduous forest biomes. At the time of European settlement temperate deciduous forest covered 40% of what is now Illinois, mainly in the south, in areas of rough terrain that glaciers did not impact, and along river systems (Figure 1). Tall grass prairie ecosystems of the prairie biome dominated the rest of the area.

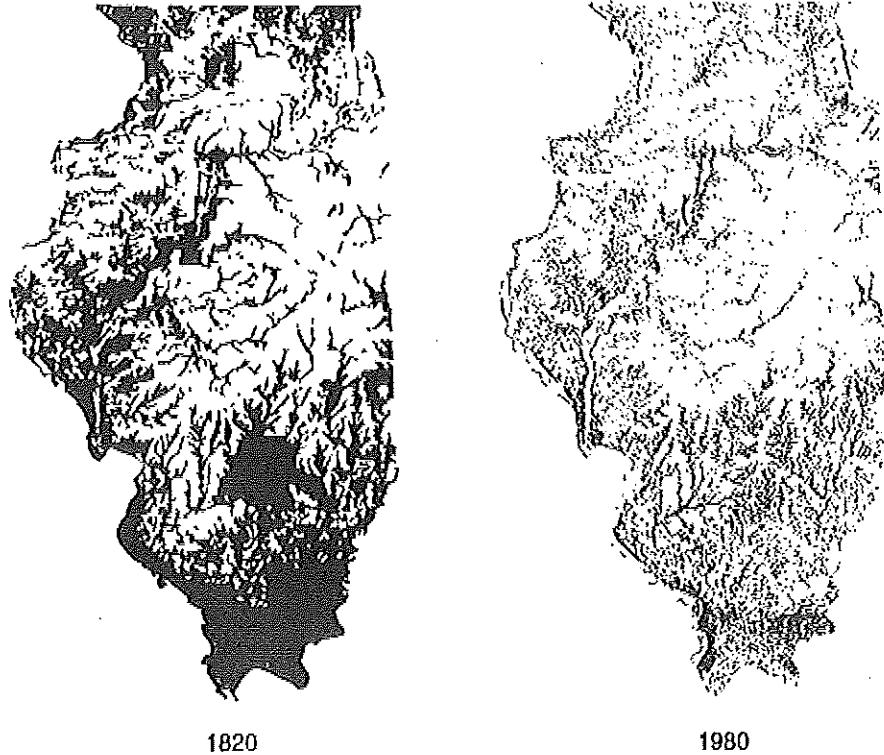


Figure 1. Forests in Illinois, 1820 and 1980

Source: *The Changing Illinois Environment: Critical Trends. Volume 3: Ecological Resources.* Illinois Natural History Survey, 1994.

Because the temperate deciduous forest biome covers such a large geographic area, differences in climate, soils, topography and other factors have led to the recognition of eight major forest regions within the biome. This diversity is often reflected in more detailed classifications at smaller scales called **ecoregions**. Ecoregions are defined by similarities in plant and animal species, climate, soils, and the general topography of the landscape. Ecoregions exist at three levels of definition: domains, divisions, and provinces, from largest to smallest, respectively. A method for naming these forest ecoregions is to list the dominant tree species that characterize these distinct elements of the temperate deciduous forest biome. In Illinois the most widespread major region within the eastern temperate deciduous forest biome is the oak-hickory forest region. Illinois also contains elements of the maple-basswood forest region and the beech-maple forest region.

These regions are not totally uniform in forest composition. Within these regions are smaller areas with unique types of forests, sometimes with affinities to neighboring regions, such as oak-pine forest stands in

the Illinois Ozarks, cypress-tupelo swamps of the Cache River bottoms, larch bogs in northeastern Illinois, and white pine-northern hardwood stands of northern and northwestern Illinois. Other important types of forest in Illinois include those of extensive floodplains and wetlands that vary in composition from north to south and with topographic features within the floodplains and wetlands themselves. **Forest associations**, even at the smallest scale, are often named for their dominant tree species.

Another ecological classification system is the **Natural Divisions of Illinois** (Schwegman 1973) which includes 14 bioregions plus Lake Michigan (Figure 2). These fifteen natural divisions of Illinois are defined by both biological and geological characteristics. This classification scheme is based upon geographic regions having similar topography, soils, bedrock, plants, and animals. Natural Divisions are an important classification system for recognizing biological variation across Illinois. Illinois Department of Natural Resources (IDNR) staff members and other professionals have organized regional needs, objectives and strategies in the IDNR Comprehensive Wildlife Conservation Plan, organized around the Natural Divisions of Illinois <http://dnr.state.il.us/orc/Wildliferesources/theplan/final/>.

Summarized in the next section are distinctive features of Illinois Natural Divisions (Schwegman 1973), including their forest types derived from the IDNR Comprehensive Wildlife Conservation Plan. The physical part of the forest descriptions often includes topographic terms such as upland, floodplain, beach, dune, terrace, flat or slope, often mixed with water regime descriptors, such as **xeric** (dry) upland forest, **mesic** (moist) slope forest, or **hydric** (wet) swamp forest. The forest descriptions also refer to soil features such as acidity (pH below 7.0), texture (i.e. gravel, sand, clay, loam) or temperature (i.e. alagic soils that are cold during the summer because they are underlain by ice in rock formations such as fissures). Biotic components of the forest descriptions can include compositional information such as dominant tree species (i.e. cypress-tupelo) and forest structure (i.e. barrens, savanna, open woodland). The same topographic term for a forest might be used in different locales, but in each locale different dominant tree species with different ranges, soil requirements, and climatic tolerances could occur. For example, minor upland forest associations in northern Illinois might include uniquely northern species such as paper birch and eastern white pine, while minor associations occurring in similar topographic and soil situations in southern Illinois upland forests might include black oak and shortleaf pine. Note how different combinations of topographic, moisture, soil, forest structure and dominant tree information are used to describe the forests of each Natural Division.

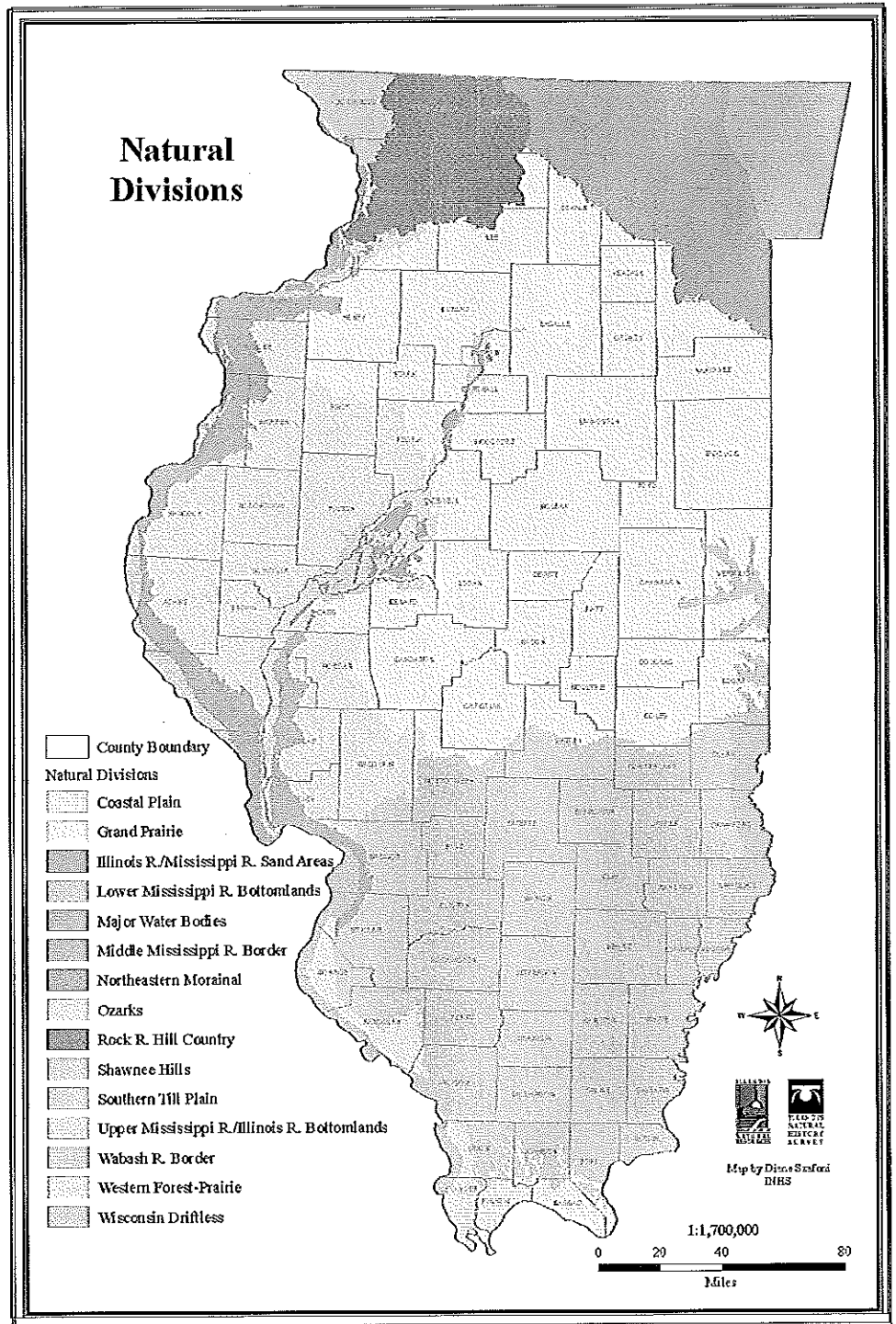


Figure 2

Frequently Used Forestry and Natural Resource Terms for Landowners of Oklahoma



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F-5022

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One challenge faced by landowners when trying to make a management decision concerning forest land use is understanding the terminology used in forestry. Without a good working vocabulary, a landowner cannot make well-informed decisions.

Confusion over meanings is often a problem for the forestry professional as well. Misunderstandings often arise concerning what a specific management procedure entails, what is involved in setting up a sale, how timber is measured, or terminology used in prescribed burning, etc. Many of these misunderstandings could be avoided if the landowner and the professional forester used the same terminology.

On the following pages are definitions for terms frequently used in forestry and other natural resource management disciplines (*words italicized* within a definition are defined elsewhere in this glossary). These definitions should help the landowner communicate with public, private, and industrial foresters and other natural resources professionals, with the end result being more informed decision making.

acre: An area of land, 43,560 square feet in any shape; also, the equivalent of a square 209 feet on a side, a circle with a radius of 117.75 feet, approximately 1.5 football fields, 10 square *chains*, 160 square *rods*, or 4,480 square yards.

ad valorem: In property taxation, the tax that is assessed as a percent of the appraised value of the property. It is classified as a management cost when calculating expected returns on a forestry investments.

age class: An interval, commonly 10 or 20 years, into which the age range of trees is divided for classification purposes; for example, trees ranging in age from 21-40 years fall into a 30-year age class.

allowable cut: The maximum volume of wood that can be harvested during a given period, without exceeding the forest's net growth during that period.

area-sensitive species: A species of animal that requires a large area of continuous, non-fragmented habitat of a similar successional stage.

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aspect: The direction towards which a *slope* faces. Aspect is important in hilly or mountainous terrain and affects site quality and species composition. The southerly and westerly facing aspects are generally drier and less productive than the northern and eastern facing aspects.

backfire: Any *prescribed burn* against the wind for the purpose of reducing fuels, creating a blackline buffer, etc. See OSU Extension Circular E-927, *Using Prescribed Fire in Oklahoma*.

basal area: Cross sectional area of a tree, in square feet, measured at breast height, 4.5 feet above the ground. Used as a method of measuring the volume of timber in a given stand, or the relative density of a stand.

bedding: A raised mound on which *seedlings* are planted. A site preparation method used in the southeastern United States where surface drainage is poor. Bedding can be controversial when used in *wetlands* where section 404 of the Clean Water Act might be violated.

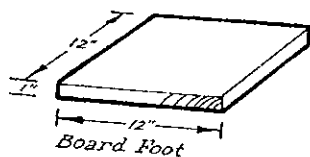
best management practices (BMPs): Techniques recommended in the management of timber harvesting and road construction that result in minimal impact on streams, soils, water quality, and wildlife. Examples are leaving *streamside management zones*, and installing *waterbars*, *broad-based dips*, etc. See OSU Forestry Extension Report #5, *Best Management Practices for Forest Road Construction and Harvesting Operations in Oklahoma*.

biodiversity: The variety of living organisms. Biodiversity is generally recognized as occurring on 3 levels: species, community, and landscape diversity. The term should not be confused with total number of species.

blue-stain: Discoloration in the sapwood of pine. Causes discoloration in the production of paper. At one time this was thought to be a serious defect in lumber; now it is used as high-quality interior finish.

board foot: A unit for measuring wood volumes equaling 144 cubic inches, commonly used to measure and express the

amount of wood in a tree, sawlog, or individual piece of lumber. For example, a piece of wood 1 foot by 1 foot by 1 inch or a piece measuring 1 foot by 2 inches by six inches both contain 1 board foot of wood.



bole: The main trunk of a tree.

bolt: A short piece of *pulpwood*, usually from 2 to 8 feet long.

broad-based dip: A surface drainage structure specifically designed to drain water from a road while vehicles maintain normal travel speed. See OSU Forestry Extension Report #5, *Best Management Practices for Forest Road Construction and Harvesting Operations in Oklahoma*.

browse: Buds, shoots, twigs, and leaves of woody growth that are fed upon by livestock and wild animals.

buck: To cut a *log* into specified lengths.



butt: The base of a tree or *log*.

cant: A *log* that is squared on two or more sides.

capital gains: Profit on the sale of an asset such as timber, land, or other property held for 1 year or longer. Capital gains taxation rate (capped at 28 percent) is advantageous over taxation at ordinary income rates, which can be as high as 39.6 (as of the date of this publication.)

catface: A wound on a tree or *log*, usually caused by sideswiping by equipment or by wildfire.

chain: A unit for measuring distance. A chain is 66 feet in length. An *acre* contains an area equal to 10 square chains. A section of land is 80 by 80 chains square or 640 acres.

chaining: A method of removing brush from a site by dragging a chain between two tractors.

chip-n-saw: 1) A process that makes small *logs* into *cants*, converting part of the outside of the log into chips. *Cants* are then sawed into lumber; 2) small pine logs 7 to 10 inches in *d.b.h.* to a 5-inch top.

clearcutting: A harvest and regeneration technique which removes all the trees (typically down to 4 inches in *d.b.h.*) on an area in one operation. Clearcutting is commonly used with *shade-intolerant* species like loblolly and shortleaf pine, which require full sunlight to reproduce and grow well. Clearcutting produces an *even-aged* stand. See OSU Extension Facts #5028, *Even- and Uneven-Aged Forest Management*.

clinometer: A hand instrument used in measuring the heights of trees and percent *slope*.

codominant: Describes trees with medium-sized crowns

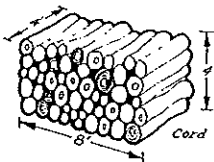
forming the general level of the canopy cover. Tree canopies receive full light from above but are crowded on the sides and thus receive comparatively little light from the sides.

competition: The struggle among adjacent trees for growth requirements such as sunlight, nutrients, water, and growing space. Competition goes on among both the roots and crowns of trees in the same stand.

controlled burning: See *prescribed burning*.

coppice: A regeneration method in which the forest stand regenerates primarily from stump and root sprouts after *clearcutting*.

cord: A stack of wood that has a gross volume of 128 cubic feet. A standard cord measures 4 feet by 4 feet by 8 feet, and should contain approximately 80 cubic feet of solid wood. Also, by weight, a cord of pine is 5200-5350 pounds; a cord of hardwoods is 5600-5800 pounds.



corridors: Travel routes that allow animals to migrate between areas of similar successional stage, for example, a *streamside management zone*. Corridors provide cover during movement, thus minimizing predation, and ensuring gene exchange between populations.

cost share: A subsidization, by different governmental agencies and some private industries, of *site preparation*, reforestation, *timber stand improvement*, wildlife and fisheries management, and water quality expenses. Some federal programs are the Forestry Incentives Program (FIP), the Conservation Reserve Program (CRP), and the Stewardship Incentive Program (SIP).



crook: An abrupt bend in a tree or *log*; a defect.

crop tree: A tree identified to be grown to maturity for the final harvest cut. Usually selected on the basis of its species, its location relative to other trees, and its quality.

cruise: An inventory of forestland that includes the location, volume, species, size, age and quality of timber.

cull: A tree or log that is unmerchantable because of defects; a tree or log that is picked out for rejection or relegated to another use because it does not meet certain specifications.



cutover: Land that has previously been logged.

cutting unit: An area of timber designated for harvest.

deck: A location where *logs*, *pulpwood*, or chips are loaded for transport from the woods.

defect: *Crook*, *conk*, *decay*, *split*, *sweep*, or other injury that decreases the amount of usable wood that can be obtained from a *log* or tree.

den tree: A tree that provides shelter and protection for wildlife. These trees often have cavities adequate for concealment or nesting.

diameter breast height (d.b.h.): The diameter of a tree at 4.5 feet above ground level on the high side of the tree.



diameter limit cut: A harvest where all *merchantable* trees above a specified *d.b.h.* or stump diameter are removed. This type of harvest often results in *high grading* where only poorly formed and *cull* trees are left in the stand.

diameter tape (D-tape): A tape measure specially graduated so the diameter may be read when the tape is placed around a tree stem or *log*. One inch on a diameter tape equals 3.14 inches on a standard tape.

dibble; planting bar: A long-handled, tapered spade used to make a narrow, relatively deep slit, suitable for planting seedlings.

direct seeding: Spreading seeds over the forest seedbed, usually from the air, to supplement or replace natural seed fall.

discount rate: The minimum annual *rate of return* that is acceptable for investment.

dominant trees: The tallest, most vigorous trees in a forest stand; larger-than-average trees with well developed crowns, which receive sun exposure on all sides.

Doyle log rule: A *log rule* used in the Eastern and Southern United States. It underestimates the volume of small *logs* and overestimates large *logs*.

ecology: The study of plants and animals in relation to their physical and biological surroundings.

ecosystem management: An approach to *forest management* that seeks to include economic, ecologic, and social components.

edge: The boundary where two or more different types of vegetation or successional stages meet. Edges attract many different wildlife species because a variety of food, cover, and other habitat requirements are arranged close together. Edge can be detrimental to some *area-sensitive species*.



even-aged stand: A stand of trees in which there are only small differences in age, usually within 20 percent of *rotation* age. See OSU Extension Facts #5028, *Even- and Uneven-Aged Forest Management*.

feller-buncher: A timber harvesting machine that severs the tree, holds it upright in a collector arm, then lays it down in a pile with other felled trees for transport.

financial maturity: The point in time in which the growth or increase in value of a financial asset (such as a tree) falls below the *discount rate*.

financial rotation: The *rotation* length of tree crops determined solely by financial considerations in order to obtain the highest monetary return over time.

fire-adapted: A plant species or plant community that is adapted to and maintained by periodic fires. For example, shortleaf pine saplings will sprout from the root collar if injured by fire, whereas loblolly pine saplings are killed.

firebreak: Any natural or constructed barrier utilized to segregate, stop, and control the spread of fire or provide a control line from which to work.

forest fragmentation: "Islands" of forest habitat that are disconnected from other forests by agricultural lands, transmission lines, roads, developments, etc. This phenomenon is thought to be particularly detrimental to *area-sensitive species* of animals that need large expanses of uninterrupted forests for foraging, breeding, nesting, etc.

forest management: The practical application of scientific, economic, and social principles to the administration and management of a forest to accomplish specified objectives.

forest type: A class of forest defined by the vegetation growing on the site; also defined as the actual or potential capabilities of forest or forestland. Examples in Oklahoma include the oak-hickory type, cross-timbers (post oak and blackjack oak) type, and shortleaf pine type.

gallery: A passage or burrow that bark beetles have excavated in the cambium of a tree for feeding or egg-laying purposes.



girdle: To encircle a tree with an ax or saw cut to sever the bark and cambium layer and kill the tree.

grading: Evaluating and sorting trees, *logs*, or lumber according to quality and intended use.

group selection: A method of regenerating *uneven-aged* stands in which trees are removed and new *age classes* are established in small groups. The maximum width of an opening in a group selection cut can vary depending on *shade tolerance* of the species but is approximately twice the height of mature trees in the stand. See OSU Extension Facts #5028, *Even- and Uneven-Aged Forest Management*.

growing stock: All live trees in a forest or stand, including *sawtimber*, *pulpwood*, *saplings*, and *seedlings*, that continue to put on growth.

head fire: A fire spreading, or set to spread, with the wind. See OSU Extension Circular E-927, *Using Prescribed Fire in Oklahoma*.

heavy fuels: Fuels of large diameter, such as logging slash, downed logs, and large branchwood, that ignite and burn more slowly than flash (fine) fuels. See OSU Extension Circular E-927, *Using Prescribed Fire in Oklahoma*.

herbicide: Any chemical preparation used to kill or inhibit the growth of certain plants.

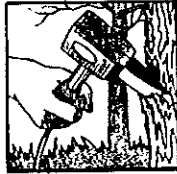
high grading: The practice of harvesting only the biggest and best trees from a stand and leaving only the poorest to dominate the site.

horizon: Any layer of soil that can be distinguished from adjacent layers by physical, chemical, or biological characteristics, for example, color or soil structure.

hunting lease: A legally binding agreement in which a landowner leases specific hunting rights to an individual or a group. The rights should be stated in contract form and usually give the individual(s) access to the land area during a specified time period to harvest designated game species within legal bag limits. See OSU Extension Facts #5032, *Lease Hunting Opportunities for Oklahoma Landowners*.

increment borer: A hollow, auger-like instrument used to bore into the tree trunk (at *d.b.h.*) to remove a cylindrical cross section (core sample) of wood. It is used to determine growth rates and age.

injection: The single stem killing of unwanted trees by application of specific registered *herbicides* under the bark. The removal of undesirable trees improves the site by reducing competition for light, moisture, and nutrients.



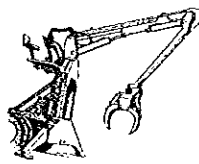
intensive forest management: Utilization of a wide variety of silvicultural practices, such as planting, *thinning*, fertilization, release, harvesting, and genetic improvement, to increase the capability of the forest to produce fiber.

intermediate trees: A class of trees in a stand with small, crowded crowns below (but extending into) the general canopy level. These trees receive a little sunlight from above and none from the sides and are often slow-growing.

international log rule: A method of estimating tree volume through a *log rule* that assumes taper and which is generally considered the most accurate log rule in the southeast.

J-Root: An improperly planted seedling that takes a J-shaped configuration in the planting hole. Such seedlings often die prematurely, grow poorly, or are susceptible to windthrow.

knuckleboom loader: A hydraulically operated machine with a loading boom that has a mechanical action imitating the human arm.



logging costs: The total costs of felling, *bucking*, *skidding*, loading, and hauling associated with harvesting forest products.

log rule: A table intended to show the amounts of lumber that can be sawed from *logs* of different sizes under various assumed conditions. See OSU Extension Facts #5021, *Measuring Woodland Timber*.

longwood: Stemwood delivered to the mill in lengths of 10 feet or longer.

lump-sum sale: The sale of specified timber on a specified area for a sum of money that is usually agreed upon and payable in advance. See OSU Extension Facts #5035, *Selling Your Timber*.

log: A merchantable stem of wood, usually cut to a length of 8, 10, 12, 14, or 16 feet with a minimum small-end diameter inside bark (*d.i.b.*) of 8 inches for hardwood, 6 inches for pine. See OSU Extension Facts #5021, *Measuring Woodland Timber*.

lop: To chop or saw branches, tops, or small trees after felling. These pieces, or debris, are usually left on the ground to decompose.

mast: (hard) The fruit of trees such as oak, beech, hickory, and also the seeds of pines which are considered as food for different kinds of wildlife such as squirrels, turkey, and deer; (soft) the berries of such plants as serviceberry, dogwood, plums, farkleberry, blackberry, raspberry, etc., also considered as wildlife foods.

mature timber (maturity): The stage at which a tree or other plant has attained full development, particularly height, and is in full seed production; the stage at which a tree crop or stand best fulfills the main purpose for which it was maintained, e.g. produces the best possible supply of specified products or will no longer earn a specified rate of return in the future.

MBF (thousand board feet): A unit of measure for tree volume or sawed lumber; log rules (*Doyle*, *Scribner*, *International 1/4*) should always be specified.

merchantable: The part of a tree that can be manufactured into a saleable product.

multiple use: Land management for more than one purpose, such as wood production, water conservation, wildlife conservation, recreation, forage production, aesthetics, or clean air.

nonindustrial private forest land (NIPF): Forestland owned by a private individual, group, or corporation not involved in wood processing.

natural regeneration: The renewal of a forest or stand either by natural seeding or vegetative reproduction (stump or root sprouts) by trees on the site.

net present value: A comparison of cost and revenues that have been discounted back to the present time, thus rendering revenue directly comparable in time to costs. All discounted costs are summed and subtracted from discounted revenues.

opportunity cost: The value of the best alternative (usually expressed as an interest rate) forgone by devoting resources to a particular project.

over mature: The stage of the life cycle of a tree or stand characterized by a decline in vigor, health, or growth rate.

peeler log: A log considered suitable in size and quality for producing *veneer* for plywood.

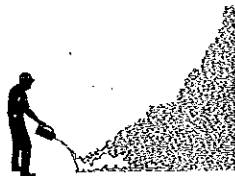
plantation: A forest established by planting. It is usually made up of a single species.

poles/pylon: Any considerable length of round timber of saw-log size with the straightness and taper suitable for supporting transmission lines or for supporting piers.

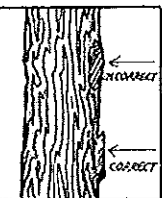
poletimber stand: A stand of trees whose diameters range from approximately 5 to 9 inches.

precommercial thinning: The elimination of trees in a submerchantable-size stand (trees too small to be sold for forest products) to increase the growth rate of residual trees.

prescribed burning: The controlled use of fire to achieve *forest management* objectives. Prescribed fire can be used to prepare seed beds for natural pine regeneration, reduce hazardous fuel levels, control unwanted vegetation, improve visibility, and improve wildlife habitat. See OSU Extension Circular E-927, *Using Prescribed Fire in Oklahoma*.



pruning: Removing live or dead branches from standing trees to improve wood quality.



pulpwood: Wood to be converted into pulp for the manufacture of paper, fiberboard, or other wood-fiber products. Pulpwood-size trees are usually 4 to 9 inches in *d.b.h.* or are too poorly formed to make lumber.

regeneration cutting: A harvesting technique that provides for tree/forest reproduction, such as *clearcutting*, *seed-tree*, *shelterwood*, and *selection cutting* methods.

rate of return (ROR): The compound rate that invested funds increase in value.

residual stand: The part of a stand of growing stock retained after an intermediate cutting, such as *thinning*, or a partial cutting.

rod: A linear measure of 5.5 yards or 16.5 feet.

rotation: The planned number of years between the regeneration of a stand and its final cutting at a specified stage of maturity. The length of a rotation varies by species, environmental conditions, and market forces. See OSU Extension Facts #5028, *Even- and Uneven-Aged Forest Management*.

sanitation/salvage cut: A cultural procedure where dead, damaged, or susceptible trees are removed to prevent the spread of pests or pathogens and to promote forest health.

sapling: A small tree, usually 0.6 - 3.5 inches in *d.b.h.*

sawtimber: Those trees fit to yield saw logs, which are of suitable size and quality for producing lumber cut by a saw to any dimension; usually 10 inches in *d.b.h.* or larger for pine, 12 inches for hardwood. See OSU Extension Facts #5021, *Measuring Woodland Timber*.

scarify: To disturb the forest floor and topsoil in preparation for *natural regeneration*, *direct seeding*, or planting.

Scribner log rule: A method of estimating tree volume that makes liberal allowances for slabs and disregards taper.

seed-tree harvest: Removing nearly all trees from the harvest area at one time, but leaving a few scattered trees to provide seed for a new forest stand. Usually, 6 to 12 trees per acre that are 14 inches or greater in *d.b.h.* are retained. These are removed later, after sufficient regeneration is established. See OSU Extension Facts #5028, *Even- and Uneven-Aged Forest Management*.

shade intolerant: A tree relatively incapable of developing and growing normally in the shade of, and in competition with, other trees.

shade tolerant: A tree's capacity to develop and grow in the shade of, and in competition with, other trees. Examples of highly shade tolerant species are flowering dogwood and American beech.

shelterbelt: A strip of living trees and/or shrubs maintained mainly to provide shelter from wind, sun, and snow.

shelterwood cut: *Regeneration cutting* method carried out over 2 or more operations, designed to establish a new crop of seedlings under the protection of the old trees (generally, 30 to 50 mature, seed-bearing trees per acre are left after the first cut). Harvests are usually 5 to 10 years apart, resulting in an *even-aged* stand. See OSU Extension Facts #5028, *Even- and Uneven-Aged Forest Management*.

silviculture: The art, science, and practice of establishing, tending, and reproducing forest stands with desired characteristics, based on knowledge of species characteristics and environmental requirements.

single-tree selection: An *uneven-aged* reproduction cutting method in which the trees are selected from all *d.b.h.* classes for harvest or retention based on individual tree merits. See OSU Extension Facts #5028, *Even- and Uneven-Aged Forest Management*.

site index: A relative measure of productivity of a given site to grow a particular species. Site Index is based on the height of the dominant trees of a particular species at either 25 or 50 years of age.

site preparation: Any process that reduces competing vegetation or logging debris to make it easier to plant or to improve conditions favorable for seedling growth and survival. The major kinds of site preparations include: mechanical, chemical (*herbicides*), and burning to kill competing vegetation.

skidding: The transportation of trees or parts of trees by trailing or dragging from stump to landing by log skidder or horses.

slope: A measure of steepness, or the degree of deviation of a surface from the horizontal, measured as a numerical ratio, percent, or in degrees.

snag: Any dead, dying, or *den trees* suitable as a nest or roost site for a cavity nesting animal. Most birds prefer snags that are at least 10 inches in *d.b.h.*, and the larger, the better.



soil series: The basic unit of soil classification, consisting of soils that are alike in all major profile characteristics except texture of the surface layer.

species evenness: An index of the number of individuals of a species in a given area.

species richness: An index of the total number of species in an area.

stocking: A subjective estimation of the number of trees occupying the site as compared to the desired number (i.e., overstocked or understocked).

streamside management zone (SMZ): A strip of land of varying size and shape maintained for protecting a sensitive area such as a stream. See OSU Extension Facts #5034, *Riparian Forest Buffers*.



stumpage: The monetary value of a tree or group of trees as they stand in the woods uncut (on the stump). Often, this value is paid by a mill to a landowner or logger as a delivered log price less logging and transportation costs. See OSU Extension Facts #5035, *Selling Your Timber*.

succession: The change in species composition and structural arrangement over time. For example, an abandoned farm in a temperate climate, if left undisturbed by fire, man, or catastrophic weather events, would gradually go through different stages of vegetative cover and become a mature forest over time.

suppressed trees: One of the 4 major crown classes; specifically, trees with crowns entirely below the general level of the crown cover receiving no direct light either from above or from the sides; also known as overtopped.

sweep: Curve in a stem or *log* as distinct from an abrupt bend as defined by a *crook*. It is generally a response to environmental conditions (strong winds) rather than genetics.



thinning: Generally, a partial harvest in an immature stand to reduce the number of trees per *acre* and encourage the remaining trees to grow faster and produce higher quality wood.



timber marking: The selection and identification, usually with paint, of those trees to be harvested or retained.

timber stand improvement (TSI): Applying cultural practices, such as *precommercial thinning* or *prescribed fire*, that improve the quality of a forest stand and achieve the desired stocking and species composition.

tree length: The entire tree, excluding the unmerchantable top and limbs. Highly mechanized logging crews often *skid*, load, and transport to mill in tree length form.

uneven-aged stand: A stand composed of 3 or more age classes. See OSU Extension Facts #5028, *Even- and Uneven-Aged Forest Management*.

veneer log: A *log* of high quality and desirable species suitable for conversion to veneer. Logs must be large, straight, of minimum taper, and free from defects.

volume table: A table showing, for one or more species, the volume contents of trees or logs based on *d.b.h.* and *merchantable height*.

water bar: A diversion ditch or hump in a trail or road for the purpose of diverting surface water runoff into roadside vegetation, duff, ditch, or dispersion area to minimize soil movement and erosion. See OSU Forestry Extension Report #5, *Best Management Practices for Forest Road Construction and Harvesting Operations in Oklahoma*.

watershed: The total land area draining into a given stream, river, lake, or reservoir; also known as a catchment area.

wetlands: Areas that are flooded or saturated by surface or ground water at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. See OSU Extension Facts #5034, *Riparian Forest Buffers*.

wildlife habitat: An area where animals live, naturally or otherwise, with relation to all the environmental influences affecting it. There are five major components: food, water, cover, space, and arrangements.

windbreak: A small-scale *shelterbelt* or other barrier, natural or artificial, maintained to deflect the wind.

windfall: A tree or trees blown down by the wind; also known as windthrow.

wolf tree: A tree of poor growth form (often a single tree growing in the middle of a field). It may have wildlife and aesthetic value.



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UNIVERSITY OF WISCONSIN-MADISON

Department of Forest Ecology and Management • School of Natural Resources

No. 78

November, 1996

Forest Succession

Jeff Martin and Tom Gower

Succession is the natural replacement of plant or animal species, or species associations, in an area over time. When we discuss forest succession, we are usually talking about replacement of tree species or tree associations.

Each stage of succession creates the conditions for the next stage. Temporary plant communities are replaced by more stable communities until a sort of equilibrium is reached between the plants and the environment. The following sequence is usually observed if sufficient time passes and no disturbance occurs:

<u>Plant Community</u>	<u>Description</u>		
Grass-forb:	Forbs, grasses and shrubs dominate the site. Seedlings may be present.	Sapling-pole:	Trees eventually overtop and out-compete the forbs and shrubs. The intolerant trees continue rapid height growth while the tolerant trees occupy their respective niche.
Shrub-seedling:	Trees tend to share and then begin to dominate the site. The intolerant species (see Forestry Fact No. 79, Tolerance of Tree Species) grow rapidly and dominate over tolerant species.	Young:	Growth is still rapid. Tree-to-tree competition may be severe resulting in competition caused mortality. Any intolerant individuals that drop behind may die and their growing space may be occupied by tolerant trees.
		Mature:	Competition caused mortality continues. Both intolerant and tolerant trees may share the main canopy. In mixed conifer stands there may be a distinct layering of intolerants and tolerants.
		Climax:	A relatively stable plant community which has a dominant plant population suited to the environment. Tolerant species dominate the site and the climax species will reproduce successfully under their own shade. These species will maintain the community under the current climatic conditions. Intolerant trees cannot reproduce.

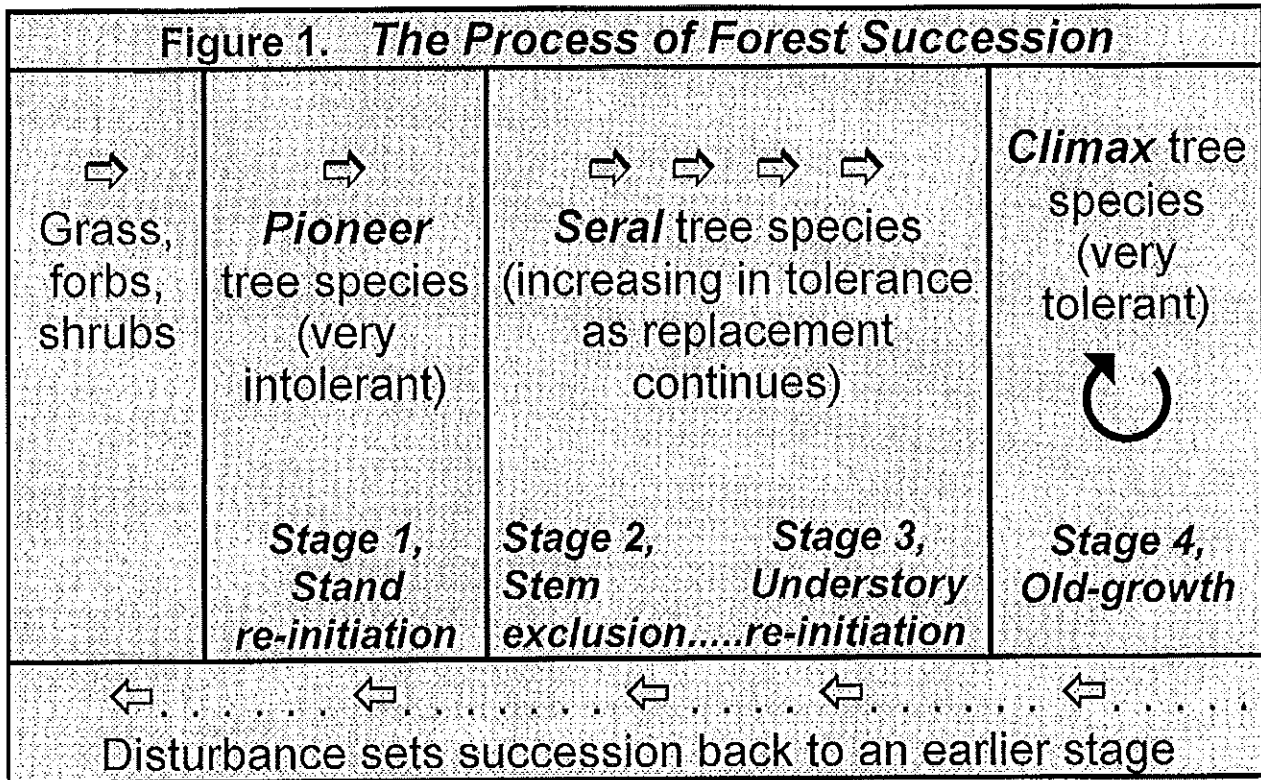
Disturbance

The rate of natural succession is affected whenever a disturbance such as fire, a windstorm, pests or management activities occurs on the site. The more severe the disturbance, or the more often disturbances occur, the slower will be the natural process of succession.

Following a major disturbance, **pioneer species**, such as aspen or jack pine, will become established in open areas under full sunlight. Eventually, in the absence of further disturbance, these pioneer species will be replaced by **seral species** that will

occupy the site through a series of successional stages, leading ultimately to a plant community comprised of **climax species**.

Forest successional stages are closely tied to the tolerance of various tree species (see Forestry Fact No. 79, Tolerance of Tree Species, for more information). For example, very tolerant species such as sugar maple, beech and hemlock are climax species on many sites in Wisconsin where they are capable of normal growth. However, sugar maple does not typically grow on dry, sandy soils



and therefore cannot replace jack or red pine on such sites.

Other Stand Changes

In addition to the well-studied changes in species composition during succession, there are other changes, in the structure and function of the stand, that are also taking place. Although the changes are subtle and continuous, ecologists have developed relatively simple stand development classification systems to classify forests according to their stage of succession. Figure 1 illustrates the four basic stages of stand development recognized for even-aged forests, and shows how they relate to the typical forest plant communities.

Stand re-initiation denotes the beginning of succession. Woody and foliage biomass steadily increase during this stage. Another important characteristic of this stage is that resources that influence tree growth (e.g. light, water and nutrients) are abundant relative to the other stages of stand development.

The second stage, **stem exclusion**, marks the onset of intense inter- and intraspecies competition for limiting resources, resulting in mortality or self-thinning. Foliage mass reaches a maximum near the onset of this second stage - this is noteworthy because foliage is the tissue that carries on photosynthesis and is the primary tissue regulating the growth of the forests. Foliage mass remains relatively stable or decreases by 10-30% in the older stages of stand development and this decline may be responsible for decreased forest growth in older forests (see the next section).

The third stage, **understory re-initiation**, is characterized by renewed growth of the understory in response to gaps in the canopy caused by tree mortality.

The fourth stage is referred to as **old-growth**; managed forests seldom reach this stage because the growth of these forests is often 10-70% less than young forests in the stand re-initiation or stem exclusion stages.

Succession and Nutrition

Foresters and ecologists have long-known that the growth of forests decreases as they age; however, the causes for the age-related decline have remained a mystery until recently. What is emerging is an interesting story that suggests the decline in forest growth, and other age-related functional changes, are because of the changes in stand structure.

Most notable is the dramatic changes in the nutrient cycles of forests during succession because of the changes in litter quality. Except for forests growing in heavily polluted areas, forests derive the bulk of their annual requirement of nutrients from minerals released from decomposing leaves, branches, stems and roots.

During the early stages of succession a high proportion of the litter is comprised of leaf tissue which, compared to branches and stems, is more easily decomposed by decomposers because of its greater nutrient concentration. In the later stages of succession however, the annual production of tissue falling to the forest floor is comprised of more woody tissue (e.g. branches and stems resulting from the self-thinning stage). Woody tissue decomposes slower than foliage by a factor of 10 to 100, resulting in nutrients being sequestered (locked up) for decades in the branches, twigs and stems.

Numerous studies have shown that nitrogen may limit growth in mature conifer forests while several recent studies suggest that calcium and potassium may limit growth of mature northern hardwood forests. The steady decline in nutrient availability during succession adversely affects leaf photosynthetic rates and causes trees to grow more fine roots and less foliage and stem wood.

A second possible cause for the decline in tree growth during succession is related to greater constraints of transporting water to the top of the tree and end of the long branches in mature trees. Just as it is more difficult to suck water through a long versus short straw, trees have a more difficult time providing water to the very tops of the canopy of mature trees. To compensate for the inefficient plumbing, large trees have a more conservative water balance. If water transport up the stem cannot keep pace with water loss from the canopy (this process is called transpiration) the tree suffers irreparable water stress. Therefore, to avoid permanent damage mature trees restrict the opening of the pores on leaves (stomata) where carbon dioxide is absorbed into the leaf for photosynthesis, and water is lost from the leaf to the atmosphere.

In summary, it seems likely that nutrient and water transport constraints may be responsible for the decline in tree growth during succession and both of the constraints are directly or indirectly related to changes in the structure of the forest during succession.

Impact on Forest Management

Understanding forest succession is very important when we make forest management prescriptions. On some sites it is often easier to work with the natural progression and maintain one of the late successional stages than it is to maintain an early stage.

When harvests are prescribed, heavier cuts cause, in general, greater disturbance to the natural succession process than do light selection cuts. Therefore, if you are hoping to regenerate certain species naturally following a harvest, it is important to know what successional stage these species typically occupy; and, what type of harvest will generate the desired conditions for stand establishment.

What can woodland owners do to minimize the decline in forest growth in aging stands? The most obvious solution is to reduce the rotation length of the forest. Another option might be to fertilize the forest to prevent a nutrient limitation; however, this approach is not inexpensive and in many cases would not be cost-effective. Finally, landowners can minimize the reduction in growth by managing forests such as northern hardwoods (sugar maple, yellow birch, basswood and hemlock) on an uneven-aged basis. Uneven-aged management, while not appropriate for all species, does maintain a balance of healthy, vigorous trees and a smaller number of mature trees.



Forest Stewardship

Terminology

Stewardship draws on various disciplines—including ecology, forestry, wildlife biology, and even recreation. Some of the terms used in discussions of forest stewardship may be unfamiliar to you. The following descriptions will help you better understand forest stewardship practices and aid in communications between you and natural resource managers. As you work with resource professionals in managing your land, you will gain a deeper understanding and appreciation of the forest resource and its complexity.

Aesthetics—forest value, rooted in beauty and visual appreciation, affording inspiration, contributing to the arts, and providing a special quality of life.

Afforestation—the establishment of forest trees by planting or seeding an area not previously forested.

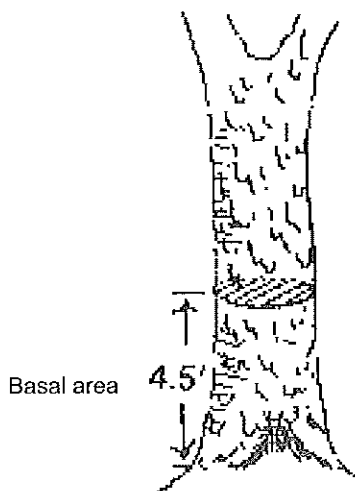
Agroforestry—a cultivation system combining agriculture and forestry where trees and crops are interplanted; not common to Pennsylvania.

Allegheny hardwood type—a portion of the northern hardwood forest in Pennsylvania, of which black cherry, white ash, and tulip poplar are major components.

Area sensitive species—plants or animals with very specific habitat requirements that are susceptible to population decline when their habitat is altered.

Aspect—the orientation of a slope with respect to the compass; the direction toward which a slope faces; north facing slopes are generally cooler than south facing slopes.

Basal area—a measurement of the cross-sectional area of a tree trunk in square feet at breast height. Basal area (BA) of a forest stand is the sum of the basal areas of the individual trees, and is reported as BA per acre.



Biological diversity—the variety of plants and animals, the communities they form, and the ecological functions they perform at the genetic, stand, landscape, and regional levels.

Biological maturity—the point in the life cycle of a tree at which there is no net biomass accumulation; the stage before decline when annual growth is offset by breakage and decay.

Biological simplification—the reduction of biological diversity that results from altering the environment in ways that favor, either directly (i.e., through management) or indirectly (i.e., through pollution), certain species over many others.

Biomass—the total weight of all organisms in a particular population, sample, or area; biomass production may be used as an expression of site quality.

Biome—the largest ecological unit, distinguished by an extensive complex of terrestrial communities, corresponding to a particular climatic zone or region, and associated with an environmental region such as the northern coniferous forest, the Great Plains, the tundra, or as in Pennsylvania, the eastern temperate hardwood biome.

Board foot—a unit of wood 1 inch thick, 12 inches long, and 12 inches wide. One board foot contains 144 cubic inches of wood.

Bole—the main trunk of a tree.

Browse—portions of woody plants including twigs, shoots, and leaves used as food by such animals as deer.

Buffer strips—forestland left relatively undisturbed to lessen

visual or environmental impacts of timber harvesting, usually along a road or waterway.

Canopy—the upper level of a forest, consisting of branches and leaves of taller trees. A canopy is complete (or has 100 percent cover) if the ground is completely hidden when viewed from above the trees.

Carrying capacity—the maximum amount of animal or plant life that a particular forest environment can support indefinitely without ecosystem degradation, given the limitations of food, shelter, competition, predation, and other available resources; usually expressed in terms of an individual species.

Clearcutting—a harvesting and regeneration technique that removes all the trees, regardless of size, on an area in one operation. Clearcutting is most often used with species like aspen or black cherry, which require full sunlight to reproduce and grow well, or to create specific habitat for certain wildlife species. Clearcutting produces an even-aged forest stand.

Commercial forestland—see *timberland*.

Community—a collection of living organisms in a defined area that function together in an organized system through which energy, nutrients, and water cycle.

Conservation—the wise use and management of natural resources.

Consumptive activities—forest uses which involve the removal of something from the site (hunting, fishing, timber harvesting). Non-consumptive activities include hiking, bird watching, and nature study.



Clearcutting

Corridor—a strip of wildlife habitat, unique from the landscape on either side of it, that links one isolated ecosystem “island” (e.g., forest fragment) to another. Corridors allow certain species access to isolated habitat areas, which consequently contributes to the genetic health of the populations involved.

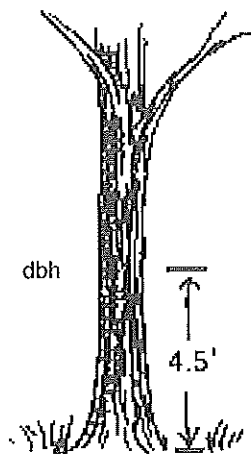
Covert—a geographic unit of cover for wildlife (usually game); for example, a thicket or underbrush sheltering grouse or deer.

Crop tree—a term traditionally reserved to describe a tree of a commercially desirable species, with the potential to grow straight, tall, and vigorously. However, a crop tree can be one selected for nontimber purposes (varying with landowner objectives), such as mast production or den tree potential.

Crown class—an evaluation of an individual tree’s crown in relation to its position in the canopy and the amount of full sunlight it receives. The four recognized categories are: dominant (D), codominant (C), intermediate (I), and overtopped or suppressed (S). (See figure above.)

Cull—a tree of such poor quality that it has no merchantable value in terms of the product being cut. However, a timber cull tree may have value for wildlife or aesthetics.

dbh—diameter at breast height, or 4.5 feet above ground level. The abbreviation generally is written without capital letters and without periods.



Crown classes

Deforestation—the unintentional or intentional conversion of land use from forest to nonforest. Associated with nonrenewable timber harvesting practices in ecologically sensitive areas, such as tropical rainforests.

Den tree—a tree with cavities in which birds, mammals, or insects such as bees may nest (also known as cavity tree).

Diameter-limit cut—a timber harvesting treatment in which all trees over a specified diameter may be cut. Diameter-limit cuts often result in high-grading.

Disturbance—a natural or human-induced environmental change that alters one or more of the floral, faunal, and microbial communities within an ecosystem. Timber harvesting is the most common human disturbance. Windstorms and fire are examples of natural disturbance.

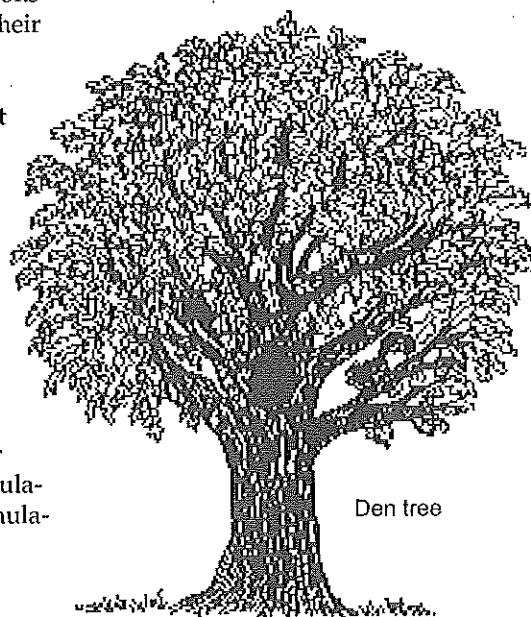
Ecology—the study of interactions between living organisms and their environment.

Economic maturity—the point in the life cycle of a tree or stand when harvesting can be most profitable, i.e., when the rate of value increase of an individual tree or stand falls below a desired alternative rate of return.

Ecosystem—a natural unit comprised of living organisms and their interactions with their environment, including the circulation, transformation, and accumulation of energy and matter.

Ecotype—a genetic subdivision of a species resulting from the selective action of a particular environment and showing adaptation to that environment. Ecotypes may be geographic, climatic, elevational, or soil related. Red maples and northern red oaks are both adapted to moist soils, but can also be found on drier sites where the genetic difference is their enhanced ability to retain water.

Edge—the boundary between open land and woodland or between any two distinct ecological communities. This transition area between environments provides valuable wildlife habitat for some species, but can be problematic for sensitive species, due to increased predation and parasitism.





Even-aged stand

Emergent wetlands—a class of wetland dominated by grasses, sedges, rushes, forbs, and other rooted, water-loving (possibly broad-leaved) herbaceous plants that emerge from the water or soil surface; marshes are an example.

Endangered species—species in danger of extinction throughout all or a significant part of their range. Protection mandated by the United States Endangered Species Act, 1973.

Even-aged stand—a group of trees that do not differ in age by more than 10 to 20 years or by 20 percent of the rotation age.

Extirpation—the eradication of a species from a portion of its natural range.

Forest—a biological community dominated by trees and other woody plants.

Forest interior dependent species—animal species that depend upon extensive areas of continuous, unbroken forest habitat to live and reproduce, and are susceptible to higher rates of predation and population decline when interior forest habitat is fragmented or disturbed.

Forest recovery—the complex natural process by which floral, faunal, and microbial communities respond to disturbance in the forest ecosystem. More resilient ecosystems respond rapidly to disturbance, returning to the pre-disturbance ecological state within a relatively short time period (perhaps decades as opposed to centuries).

Forest types—associations of tree species that commonly occur because of similar ecological requirements. Pennsylvania's three major forest types are oak-hickory, northern hardwoods, and Allegheny hardwoods.

Forested wetland—an area characterized by woody vegetation over 20 feet tall where soil is at least periodically saturated with or covered by water.

Fragmentation—the segmentation of a large tract or contiguous tracts of forest to smaller patches, often isolated from each other by nonforest habitat. Results from the collective impact of residential and commercial development, highway and utility construction, and other piecemeal land use changes.

Genotype—growth or development characteristics dependent on genetic information. The genetic constitution of an organism or a species in contrast to its observable characteristics.

Girdling—a method of killing unwanted trees by cutting through the living tissues around the bole. Can be used instead of cutting to prevent felling damage to nearby trees. Girdled trees can provide cavities and dead wood for wildlife and insects.



Girdling

Guild—species similar in their habitat needs as well as their response to habitat changes (e.g., ovenbird and woodthrush). One species in a guild is often used to

represent the others when developing a stewardship management plan.

Habitat—the geographically defined area where environmental conditions (e.g., climate, topography, etc.) meet the life needs (e.g., food, shelter, etc.) of an organism, population, or community.

High-grading—a type of timber harvesting in which larger trees of commercially valuable species are removed with little regard for the quality, quantity, or distribution of trees and regeneration left on the site; often results when a diameter-limit harvest is imposed.

Horizontal structure—the spatial arrangement of plant communities; a complex horizontal structure is characterized by diverse plant communities within a given geographic unit.

Improvement cut—any cutting treatment used to alter species composition and tree spacing to realize ownership objectives. Thinning is a type of improvement cut.

Indicator species—species with such specialized ecological needs that they can be used for assessing the quality, condition, or extent of an ecosystem on the basis of their presence and density, or the accumulation and effect of materials in their tissues.

Land ethic—the principles and values guiding our use and treatment of the land. Forest stewardship is a land ethic. (See *stewardship*.)

Management plan—a document prepared by natural resource professionals to guide and direct the use and management of a forest property. It consists of inventory data and prescribed activities designed to meet ownership objectives.

Mast—all fruits of trees and shrubs used as food for wildlife. Hard mast includes nutlike fruits such as acorns, beechnuts, and chestnuts. Soft mast includes the fleshy fruits of black cherry, dogwood, and serviceberry.

Maturity—see *economic maturity* and *biological maturity*.

Multiple use and value—a conceptual basis for managing a forest area to yield more than one use or value simultaneously. Common uses and values include aesthetics, water, wildlife, recreation, and timber.

Neo-tropical birds—birds that breed in the northern hemisphere during summer months, and winter in tropical regions (e.g., woodthrush or barn swallows). One-third of Pennsylvania's breeding birds are neo-tropical migrants.

Niche—the physical and functional location of an organism within an ecosystem; where a living thing is found and what it does there.

Non-industrial private forestland (NIPF)—forestland owned by a private individual, group, or corporation not involved in wood processing.

Old-growth—forests that approximate the structure, composition, and functions of native forests prior to European settlement. They vary by forest type, but generally include more large trees, canopy layers, standing snags, native species, and dead organic matter than do young or intensively managed forests.

Patch—a small area of a particular ecological community surrounded by distinctly different ecological communities, such as a forest stand surrounded by agricultural lands or a small opening surrounded by forestland.

Patch dynamics—the process of recolonization by plant and wildlife species following the creation of a patch. Small patches and ones close to a source of plant and animal species will be recolonized faster than larger, more isolated patches.

Phenotype—outward appearance or physical attributes of an organism resulting from both the effects of the environment and genetic makeup.

Pole stand—a stand of trees with dbh ranging from 5 to 9 inches.

Population—a group of individuals of one plant or animal taxon (species, subspecies, or variety).

Preservation—a management philosophy or goal which seeks to protect indigenous ecosystem structure, function, and integrity from human impacts. Management activities are generally excluded from "preserved" forests.

Rare species—species which exist only in one or a few restricted geographic areas or habitats or occur in low numbers over a relatively broad area.

Reforestation—the re-establishment of forest cover by natural or artificial means on areas recently supporting forest cover.

Regeneration—the replacement of one forest stand by another as a result of natural seeding, sprouting, planting, or other methods; also young trees which will develop into the future forest.

Regeneration cut—a timber harvest designed to promote and enhance natural establishment of trees. Even-aged stands are perpetuated by three types of regeneration cuts: seed tree, shelterwood, and clearcutting. Uneven-aged stands are perpetuated by selecting individual or small groups of trees for removal (e.g., the selection system).

Release—removal of overtopping trees to allow understory or overtopped trees to grow in response to increased light.

Residual stand—trees remaining following any cutting operation.

Riparian zone—an area adjoining a body of water, normally having soils and vegetation characteristic of floodplains or areas transitional to upland zones. These areas help protect the water by removing or buffering the effects of excessive nutrients, sediments, organic matter, pesticides, or pollutants.

Rotation—the planned time interval between regeneration cuts in a forest.

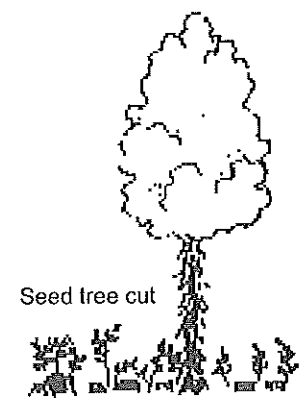
Salvage cut—the removal of dead, damaged, or diseased trees with the intent of recovering value prior to deterioration.

Sapling—a small tree, usually defined as being between 2 and 4 inches dbh.

Sawlog—a log large enough to yield lumber. Usually the small end of a sawlog must be at least 6 to 8 inches in diameter for softwoods and 10 to 12 inches for hardwoods.

Second growth—the forests re-established following the removal of virgin (i.e., previously unharvested) or old-growth stands. Most of Pennsylvania's forests are either second or third growth.

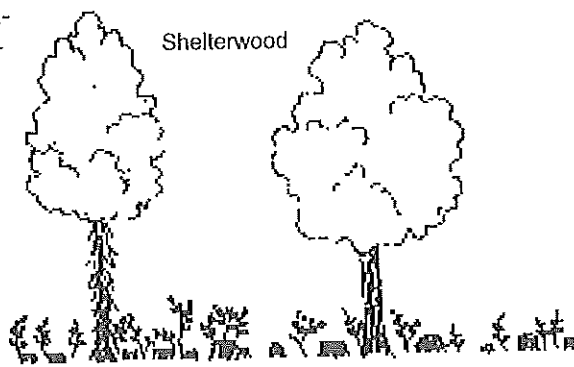
Seed tree cut—a regeneration cut where mature trees are left standing in a harvested area to provide seed for regeneration of the cut-over site.



Seedling—a young tree originating from seed that is less than 4 feet tall and smaller than 2 inches in diameter at ground level.

Selection cut—a regeneration cut designed to create and perpetuate an uneven-aged forest. Trees may be removed singly or in small groups. A well-designed selection cut removes trees of lesser quality and trees in all diameter classes along with merchantable and mature high-quality sawlog trees. Should be differentiated from "select" or "selective" cuts, which often equate to high-grading.

Shelterwood—a regeneration cut designed to stimulate reproduction by removing all overstory trees. This is achieved by a series of cuts over several years. Gradual reduction of stand density protects understory trees and provides a seed source for stand regeneration.



Silviculture—the art, science, and practice of establishing, tending, and reproducing forest stands.

Site—the combination of biotic, climatic, topographic, and soil conditions of an area; the environment at a location.

Site quality—the inherent productive capacity of a specific location (site) in the forest affected by available growth factors (light, heat, water, nutrients, anchorage); often expressed as tree height at a given age.

Slash—branches, tops, and cull trees left on the ground following a harvest. Although some of this material can be used for firewood, slash may be arranged in brush piles to provide wildlife cover. Left scattered, slash can protect seedlings and sprouts from deer browsing and reduce soil erosion.

Snag—a standing dead tree with few branches, or the standing portion of a broken-off tree. Snags may provide feeding and/or nesting sites for wildlife.

Species—a subordinate classification to a genus; reproductively isolated organisms that have common characteristics, such as eastern white pine or white-tailed deer.

Species richness—the number of species present in a community or a defined area.

Spring seep—a class of wetland created by groundwater emerging on lower slopes in small pools

surrounded by vegetation. These create snow-free zones critical for wildlife feeding during winter.

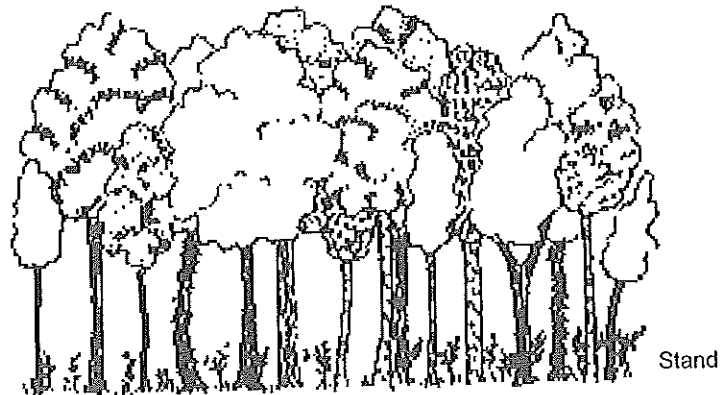
Stand—a grouping of vegetation sufficiently uniform in species composition, age, and condition to be distinguished from surrounding vegetation types and managed as a single unit. (See figure.)

Stewardship—the wise management and use of forest resources to ensure their health and productivity for the future with regard for generations to come.

Stream management zones—areas adjacent to waterbodies where unique management strategies are applied to protect water quality and maintain stream temperature through shading. Zone width is normally 50 feet, but varies according to site.

Stumpage—the commercial value of standing trees.

Succession—the natural series of replacements of one plant community (and the associated fauna) by another over time and in the absence of disturbance.



Sustained yield—historically, a timber management concept in which the volume of wood removed is equal to growth within the total forest. The concept is applicable to nontimber forest values as well.

Thinning—removal of trees to encourage growth of other selected individual trees. May be commercial or pre-commercial.

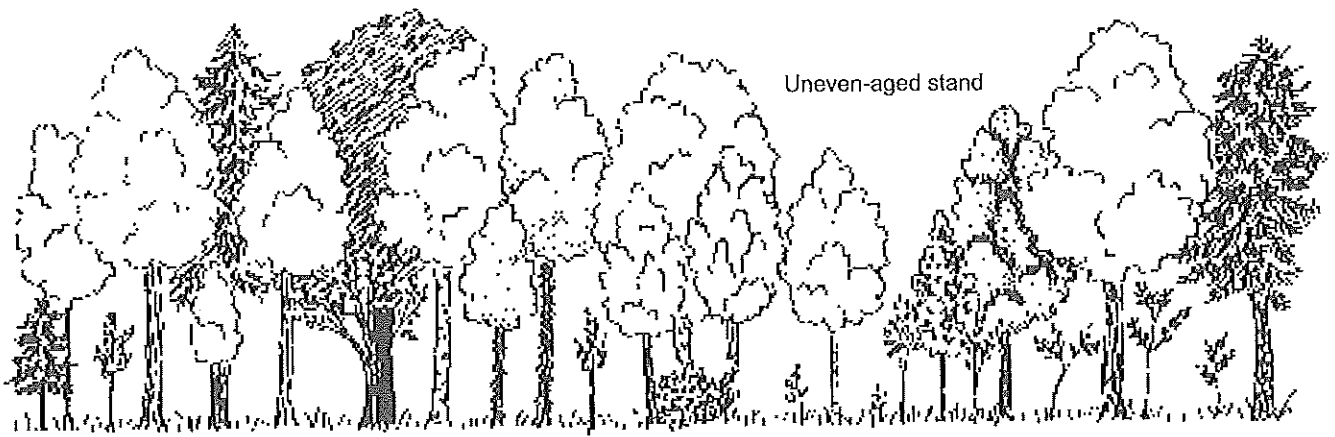
Threatened species—a species likely to become endangered in the foreseeable future, throughout all or a significant portion of its range, unless protected.

Timber cruising—the process of estimating the quality, quantity, and characteristics of trees in a forest.

Timberland—forestland producing or capable of producing crops of industrial wood (more than 20 cubic feet per acre per year), and not withdrawn from timber utilization. Formerly known as commercial forestland.

Timber stand improvement (TSI)—a combination of intermediate treatments designed to improve growth and composition of the forest; often spoken of as TSI.

Tolerance—a characteristic of trees that describes the relative ability to thrive with respect to the growth factors (light, heat, water, nutrients, anchorage). For instance, a "shade tolerant" species may thrive at low light levels.



Understory—the smaller vegetation (shrubs, seedlings, saplings, small trees) within a forest stand, occupying the vertical zone between the overstory and the herbaceous plants of the forest floor.

Uneven-aged stand—a group of trees of various ages and sizes growing together on a site. (See figure.)

Urban forestry—the professional management of natural resources in and around urban areas, including trees and associated vegetation, wildlife, and open space.

Vernal or autumnal ponds—a class of wetland characterized by small, shallow, temporary pools of fresh water present in spring and fall, which typically do not support fish but are very important breeding grounds for many species of

amphibians. Some species are totally dependent upon such ponds; examples are spring peepers and mole salamanders.

Vertical structure—the arrangement of plants in a given community from the ground (herbaceous and woody shrubs) into the main forest canopy; a complex vertical structure is characterized by lush undergrowth and successive layers of woody vegetation extending into the crowns of dominant and codominant trees. (See *crown class*.)

Virgin forest—a forest that has never been harvested or altered by humans.

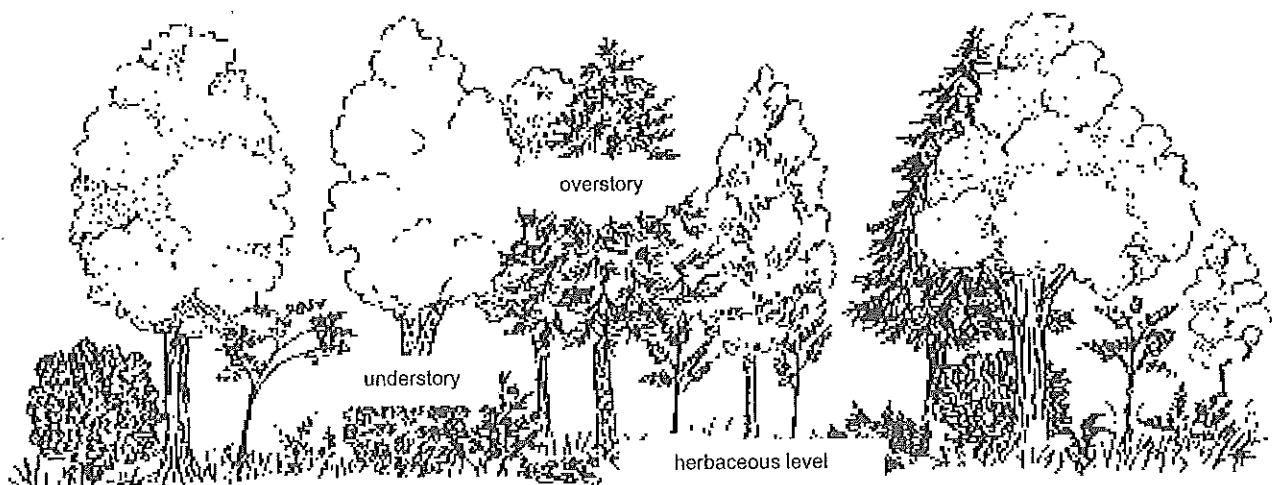
Watershed—a region or area defined by patterns of stream drainage. A watershed includes all the land from which a particular stream or river is supplied.

Wetlands—areas which are either transitional between land and water (where the water table is at or near the land surface) or areas of land which are covered by shallow water (such as marshes, swamps, bogs, and fens). Although only 2 percent of Pennsylvania remains as wetlands today, these areas fulfill an essential role in our landscapes by maintaining water quality, stabilizing shores and stream banks, controlling floods and erosion, and providing critical habitat to many plant and animal species.

Wolf tree—a large, excessively branchy tree which occupies more space in the forest than surrounding trees. Wolf trees have high wildlife and aesthetic value, but little if any timber value.

Woodland—see *forest*.

Vertical structure



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Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

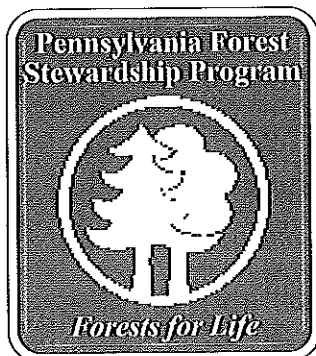
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Issued in furtherance of Cooperative Extension Work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and the Pennsylvania Legislature. T. R. Alter, Director of Cooperative Extension, The Pennsylvania State University.

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Cover illustration by Doug Pifer. Other illustrations by Nancy Pywell.
Printed on recycled paper.

emerald ash borer
***Agrilus planipennis* Fairmaire**

This borer, native to Asia, was first identified in North America in 2002 feeding on ash trees in Michigan. Larvae feed in the phloem and outer sapwood, producing galleries that eventually girdle and kill branches and entire trees. It appears to feed only on ash and in Michigan has killed green, white, and black ash. Dieback of the tree canopy may be the first symptom of borer attack. Vertical splits occur in the bark due to callus formation. Within two to three years of infestation, the tree is often killed. Trees of various sizes (from small sapling to sawtimber-sizes) and conditions are killed including trees that are stressed or apparently healthy.

Adult beetles are slender, elongate, and about 7.5 to 13.5 mm long. The body is brassy or golden green overall, with darker, metallic, emerald green wing covers. Larvae reach a length of 26 to 32 mm, are cream-colored and flattened. The 10-segmented abdomen has a pair of brown, pincer-like appendages on the last segment.

Adults emerge in May and June and females soon begin depositing eggs on bark of trunk or branches. Eggs hatch in 7 to 10 days and larvae chew through the bark into the cambium. They feed on phloem and outer sapwood for several weeks producing S-shaped galleries packed with fine frass. Full-grown larvae overwinter in a shallow chamber in the sapwood, pupate in the spring, and adults emerge through D-shaped exit holes that are 3 to 4 mm in diameter. The borer appears to have a one year life cycle.

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red oak borer

Enaphalodes rufulus (Haldeman)

This is a major pest of red oaks, accounting for millions of dollars in losses from defects and degrade in lumber. Valuable shade trees in parks and cities are sometimes attacked, but are rarely killed.

Adult borers are longhorned beetles. Their antennae are very long, almost doubling their 1 -inch (25 mm) body length. Their rust brown color blends well with the bark surface, and they are rarely seen. The pale, robust larvae have very small legs on the thorax.

The first signs of attack resemble the fine frass produced by ambrosia beetles. As the larvae bore into the tree, sap begins to extrude from the attack points (see photo on front side). Within the tree, tunnel diameters gradually increase from pinhole size to about 1/2 inch (12 mm) in diameter as larvae grow. Tunnels are 6 to 10 inches (15 to 25 cm) long and are often accompanied by discolored and decaying wood. They are usually within 6 inches (15 cm) of the pith.

The red oak borer has a 2year life cycle. Eggs are laid in midsummer in roughened areas or near wounds, and larvae tunnel under the bark for the first year. In the second year, the more damaging wood tunneling commences. Prior to pupation, the larvae chew round exit holes through which they later emerge as adults.

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