

FOREST ECOSYSTEMS

An **ecosystem** is all the interacting populations of plant communities, animals, and micro-organisms occupying an area, plus their physical environment. The problem with defining an ecosystem usually comes in trying to decide where one ecosystem ends and another begins. There will always be a certain degree of interaction between adjacent ecosystems; even a forest and a lake exchange frogs, swallows, and autumn leaves.

The selection of the desired or appropriate scale to set the boundaries of an ecosystem is critical. Whether you consider the watershed scale or the individual branch of the tree, both have unique characteristics of habitat, carrying capacity, limiting factors, range of tolerance, and biodiversity.

The essential component of a forest ecosystem is a tree. A tree is a large, woody, perennial plant, usually with a single stem. The classification of trees is primarily based on the sexual structures of plants. For example, pines and cypress are **gymnosperms** because they have “naked” seeds that are not enclosed in an ovary. The seeds are borne on cones, thus giving rise to the name conifer. Oaks, hollies, and maples are **angiosperms** because their seeds are encapsulated in an ovary. Classification of trees is discussed in greater detail later. The critical adjective in the definition of a tree is woody. It is the essence of what makes a forest. Two characteristics of trees, strength and durability, allow some tree species to be large and long-lived.

Unlike grasslands, forest ecosystems are unique because of their height. This three-dimensional quality or vertical stratification creates the habitat — the environment in which the life needs of the organisms and their community are supplied.

The stratification effect creates overstory, understory, shrub, and herbaceous layers that form microclimate gradients providing niches for many species. Trees leaves are the site of **photosynthesis**. The food chain begins with trees absorbing carbon dioxide, water, and minerals to be converted to sugar with the by-product of oxygen. The strength of the wood is thus durable over time. In most forests, over 95% of the biomass is in woody tissue. This material is both shelter and food for an array of organisms — woodpeckers, wood ants, centipedes, etc. This wood — live, dead, erect or standing snag — supports a variety of food chains for a series of plants, animals, bacteria, and fungi.

The forest habitat must provide food, water, shelter, and space. The type, amount, and condition of these components determine the carrying capacity of a forest ecosystem. The carrying capacity varies due to certain limiting

factors. For example, some of the limiting factors in Florida forests include presence of fire and disturbances — naturally occurring disease or hurricanes, and human-caused like compaction or clear-cutting.

SUCCESSION

All plants and animals live in an environment to which they are specifically adapted. As environmental conditions change, so do the species of animals and plants. The process by which plant communities gradually change over a period of time is called ***succession***. The stages of succession, beginning with bare land, can take many decades to reach the ***climax stage***. When a forest is in the climax stage, succession essentially stops. A climax forest community is stable, contains trees that only perpetuate themselves, and may persist for hundreds of years.

To illustrate the various stages of succession, we will examine the changes that take place following the abandonment of a cultivated field. The first plants to occupy the field are weeds and grasses. These plants are called ***pioneer species***. Within three to five years, a few small pine trees become established. These trees are hardy and are able to withstand full sunlight and effects of the weather. As they colonize the area they begin to provide shade. Pioneer weed and grass species are unable to flourish with additional shade and are gradually replaced with shade-tolerant weeds and grasses.

After 10 to 15 years, shrubs and young trees become the dominant species. Weeds and grasses have been mostly eliminated due to decreasing amounts of sunlight. Eventually, individual trees grow above the shrub level. These trees receive more sunlight and rapidly out-compete shrubby plants. Later, older pines reach sexual maturity and develop cones. Their seeds are spread to other areas of the field. Deer and other wildlife routinely wander throughout the area seeking food and shelter. As pines continue to grow, they shade the forest floor and eventually create suitable conditions for hardwood trees. Young oaks and hickories appear and additional animal species feed on acorns and nuts. This aids in seed dispersal. Assuming fire is absent, hardwood trees continue to develop within the pine forest.

Thirty years passed before the cultivated field turned into a pine-type forest. But in nature, communities are constantly changing.

Hardwoods slowly replace the pines. In time, oaks and hickories may be more numerous than pines. Shade from broad-leafed trees is too much for young pines to survive. In addition, pine seeds released from cones are unable to penetrate the heavy leaf litter on the forest floor and fail to germinate. With successional changes in plant communities, the types of wildlife visiting these communities also changes.

Hardwoods have replaced pines 50 to 75 years later. Animal species once associated with early successional stages are gone. Long-lived hardwoods shade the forest floor and little change is noticeable as these trees continue to create conditions that fulfill their own needs. This area is now considered a climax community and remains in this state until a disturbing force such as fire, hurricane, or human influence causes succession to begin anew. See Figure 4.1.

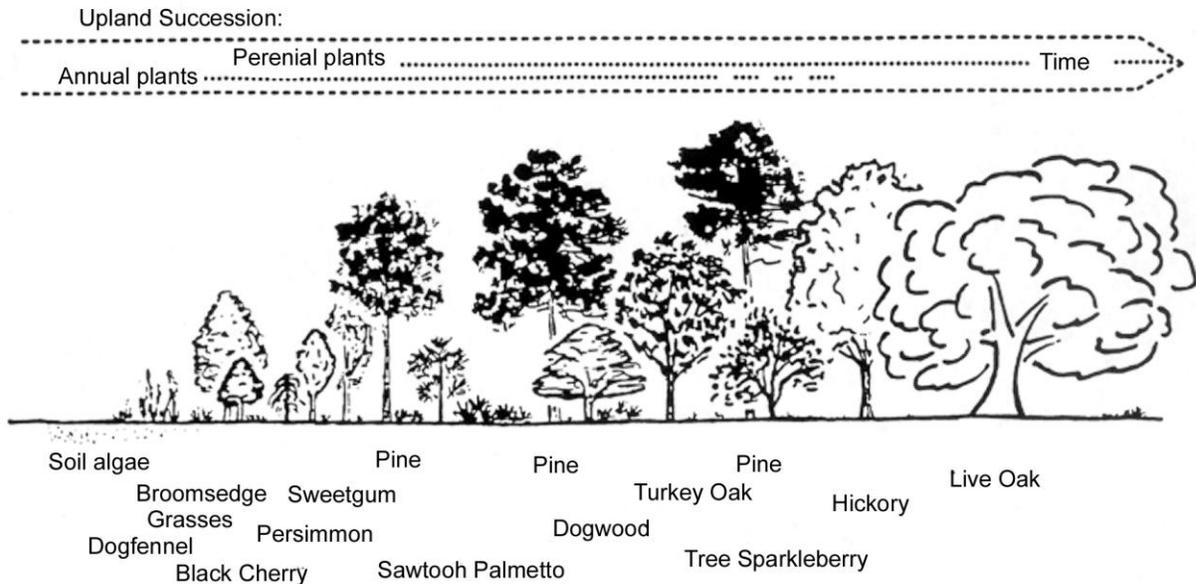


Figure 4.1 Vegetative communities change with time; this change is called succession.

Two other concepts are important in understanding forest ecosystems and their interrelationships to other ecosystems: range of tolerance and biodiversity.

A forest ecosystem has a range of tolerance which consists of the minimum and maximum environmental conditions necessary for an organism to survive. These include climate conditions, soil conditions, fire, and water conditions. These growth factors are discussed later in the text. Within this range of tolerance, certain adaptations are developed over time to help species compete successfully and survive in an ecosystem. An **adaptation** is an inherited characteristic of an organism that enables it to function more effectively in its environment. An excellent example of adaptation is the coloring of the pine barrens tree frog against the trunk of a longleaf pine. The frog is almost invisible to the untrained eye.

The differentiation of habitat and the vertical separation that occurs within a forest ecosystem develops a variety of ***niches***, or special places, uniquely suited to a given species. For example, the insect fauna often change dramatically from top to bottom in a forest. These niches give rise to biological diversity. This variety within living things and their habitats is particularly important in Florida. Forest ecosystems destroyed by urbanization due to population growth in Florida are a challenge to be met by the environmental citizens of tomorrow — our Envirothon students of today.

INFLUENCES ON FOREST GROWTH

Florida has wide variations in geology, topography, climate, soils, and vegetation. Each factor influences others and all factors influence the type of tree species that can survive in the area. For instance, geology and topography influence soil characteristics, soil characteristics influence topography and vegetation, and so on.

Topography (or land configuration) in Florida is not rugged, but portions of the state are somewhat rolling. A physical relief map of the state will show the hills of the northern panhandle, the vast flat areas of northeast, central, and south Florida, the sandhills of the central Florida ridge, the lowlands of the Everglades, and the valleys forming the state's major river systems. Soils in Florida vary with topography.

SOIL FACTORS

The major characteristics in discussing soil are texture, fertility, drainage, slope, and acidity. Each of these characteristics should be considered when developing management plans for a particular forest species. For instance, during the late 1950s and early 1960s, thousands of acres in Florida's sandhills were planted in slash pine, a species naturally found in moist areas. Now some of these areas are being converted to longleaf pine; a species better suited to dry soils.

Soil directly affects the tree by anchoring it and by serving as a growth medium. In addition to being a reservoir for moisture, soil provides all the essential elements for tree growth except oxygen and carbon which is supplied by the air. Soil characteristics, such as texture, structure, chemical composition, depth, and position, influence tree growth by affecting the supply of moisture and nutrients available to it.

Soil drainage is influenced by soil texture, elevation, and slope. Poorly drained soils are not usually recommended for pine trees. Trees such as

bald cypress may be better suited. Poorly drained areas may also limit heavy equipment access for tree harvesting or site preparation.

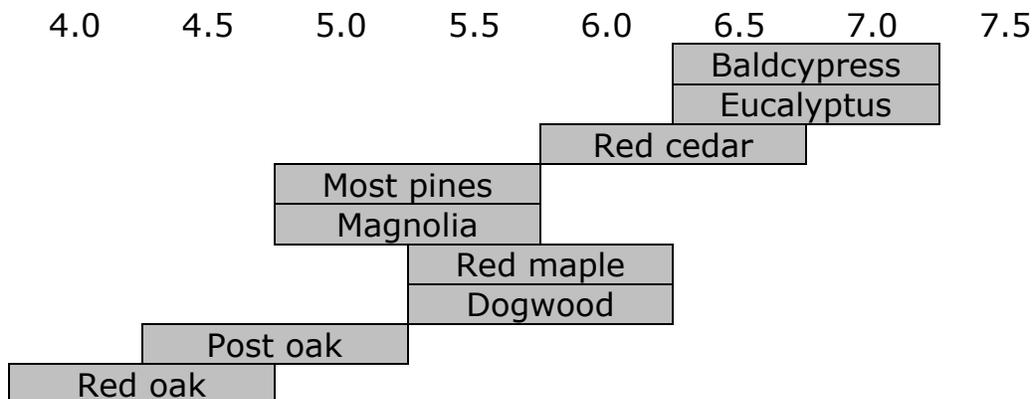
Soil texture describes the distribution of different sized soil particles (sand, silt, clay). Sandy soils are usually dry and support trees that are drought-tolerant. Sand pine and longleaf pine usually dominate these sites. However, sand near the surface does not always indicate dry soil. A **hardpan** of clay or limestone rock within six feet of the soil surface can drastically affect tree growing conditions. A hardpan is an impermeable or semi-impermeable layer that can hold water near the soil surface.

The amount of **organic matter** found on the surface affects a soil’s fertility. This layer contains most nutrients required by trees. If organic matter is removed or washed away, the fertility of the soil drops.

Slope affects the drainage, available moisture, erosion, and nutrient content of forest soils. Water running down a steep slope will erode the soil and wash nutrients from the top of the slope, transporting them to the bottom, where they accumulate. This is why bottomlands are generally more fertile than hilltops.

The soil’s **pH** is a measure of a soil’s alkalinity or acidity. Soils with restricted drainage, such as pine flatwoods, are typically acidic, a result of decaying vegetation in a flooded environment. A low or **acidic** pH can restrict a tree’s ability to absorb certain soil nutrients such as phosphorus. A high or **alkaline** pH can restrict a tree’s ability to absorb iron. In some cases, the forester might consider applying soil amendments (sludge, lime, urea, etc.) to the soil in order to raise or lower pH. This practice can be costly and must be carefully considered before implementing.

Table 4.1. Preferred soil pH for various trees (acidity/alkalinity)



How to Examine Forest Soils

Soils are examined to determine which tree species are best suited for particular sites. When a site is selected, it is examined using the following steps:

1. Examine the amount and quality of the organic material on the soil's surface. If there is none, this may indicate the area has been (1) burned and the material removed or (2) the soil has been turned over, filled, or disturbed in some manner.

When the organic matter in a soil is well decomposed, it usually indicates a moist, fertile site. If there are thick layers of undecomposed forest litter, it usually indicates a drier, less fertile site with some potential for later wildfire losses.

2. Examine the uppermost layer of mineral soil. Squeeze the soil between your fingers and notice the texture. Refer to the soil texture table to determine the effects of the soil texture on soil conditions.

Table 4.2. Surface soil texture

Surface Texture	Water-Holding Capacity	Tree Species to Manage
Sand*	Poor	Longleaf pine, sand pine
Silt	Good to excellent	Slash pine, loblolly pine
Clay	Excellent	Loblolly pine

*Provided that a change in soil structure does not occur within 5 feet

3. Examine the soil color. A rule of thumb is, the darker the soil, the more fertile it will be. Table 4.3 lists the relationship of topsoil conditions to color.

Table 4.3. Topsoil conditions

Color	Topsoil Condition					Tree Species to Manage
	Organic Matter Amount	Erosion Factor	Aeration	Available Nitrogen	Fertility	
Dark (black, brown, grey)	Excellent	Low	Excellent	Excellent	Excellent	Slash pine
Moderately dark	Good	Medium	Good	Good	Good	Slash and, longleaf pine
Light to pale (brown to yellow)	Low	High	Low	Low	Low	Longleaf and sand pine

4. Use the soil augur or sampling tube to examine subsurface conditions and measure the depth at which any of the following occur:
 - Obvious changes in soil texture
 - Mottling, streaking, or flecking by other colors
 - Moisture or saturation of the soil
5. Refer to the tree species selection table (Table 4.4) to determine a recommendation for this particular soil.

Table 4.4. Tree species selection

Depth to a Hard Clay Layer, Clay Mottling, or Evidence of Water	Tree Species to Manage
Less than 6 inches	Cypress
6 inches to 3 feet	Slash pine
3 to 5 feet	Slash pine, longleaf pine
5 to 8 feet	Longleaf pine
Greater than 8 feet	Sand pine

THE TREE

Any discussion of forestry and forests would be incomplete without a look at the major forest component, the tree itself. A **tree** is defined as a woody perennial plant with a single trunk, a well-defined crown, and reaching at least 8 feet in height. A shrub is usually less than 8 feet high and may have multiple stems or branches that originate at or near the ground line.

Roots

Roots absorb water, nutrients, and oxygen, all of which the tree must have to carry on its life processes. Roots also help to anchor the tree against wind and water.

Rooting characteristics vary with the species, soil texture, and moisture. Most trees have a main supportive **taproot** that penetrates deep into the soil. However, in wetter areas, the taproot may be virtually non-existent, due to the readily available surface moisture and the lack of oxygen in the water-logged soil; this is one reason trees in wet areas are more likely to blow over than trees on drier ground.

Another component of the root system is the **feeder roots**. These are also known as the surface or lateral roots and generally absorb most of the nutrients and moisture. Feeder roots grow from both the trunk and the taproot and are primarily found within the top few inches of soil. The entire root system generally extends out from the trunk to the outermost reaches

of the tree's canopy. This outer perimeter is commonly referred to as the ***drip line***.

Most broadleaf trees have roots with many ***root hairs*** which absorb water and nutrients. Pines, on the other hand, have roots with few root hairs and rely primarily on beneficial fungi called ***mycorrhizae*** to assist in water and nutrient absorption.

Tree roots, like other parts of the tree, require oxygen to aid in food absorption, respiration, and growth. When the soil surrounding the tree becomes flooded or extremely compacted, the roots can die from lack of oxygen, resulting in the death of the entire tree. Some trees, such as the baldcypress, tolerate flooding over their roots indefinitely; it is thought that the cypress knees may contribute to this ability.

Trunk

The tree trunk, also called the stem or bole, supports the crown. The trunk allows water and nutrients to go from the roots to the crown and transports food from the trunk crown back to the roots.

The ***xylem*** (zy'-lum) is the woody portion of the tree. It consists of two types of wood, the ***sapwood*** and the ***heartwood***. The sapwood is the living outer portion of the xylem that is the active water- and nutrient-conducting tissue. Water and nutrients absorbed by the roots are transported upward through the tube-like cells of the sapwood to the leaves. Part of the upward movement of the water is due to pressure built up in the roots, part is due to water surface tension, and part is due to capillary action, the same process by which a lamp wick draws kerosene. Part of the energy for water transport is due to the pumping actions of the

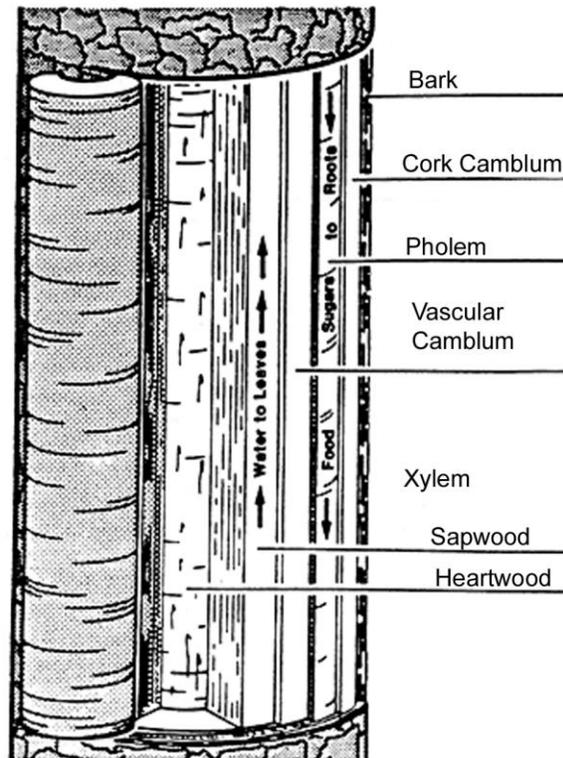


Figure 4.2. The trunk of the tree supports the crown and also transports fluids and nutrients to and from the leaves and the roots.

xylem cells, which are interconnected from root hair to leaf tip. See Figure 4.2.

The heartwood is inactive or dead sapwood and is formed as the tree matures. Heartwood is often darker in color than sapwood due to an accumulation of chemicals and nutrients, and its main function to the rest of the tree is support. The heartwood is often resistant to decay and is usually more valuable than the sapwood. Some tree species, such as pine, have heartwood and sapwood that are sometimes difficult to tell apart.

Further examination of the xylem (both heartwood and sapwood) reveals a series of **annual rings**. As the name suggests, a tree grows new rings each growing season. Each ring consists of a light band and a dark band of distinctly different types of wood. The lighter colored, less-dense wood in the annual ring is called **springwood** or **early wood**.

Later in the season, growth slows down, resulting in a darker, more-dense wood called **summerwood** or **late wood**. Foresters determine the tree's age and growth rate by counting and measuring annual rings. A wide annual ring indicates an excellent growth year, while a narrow ring indicates a poor year and may be due to such factors as insects, disease, competition from other trees, or weather conditions. See Figure 4.3.

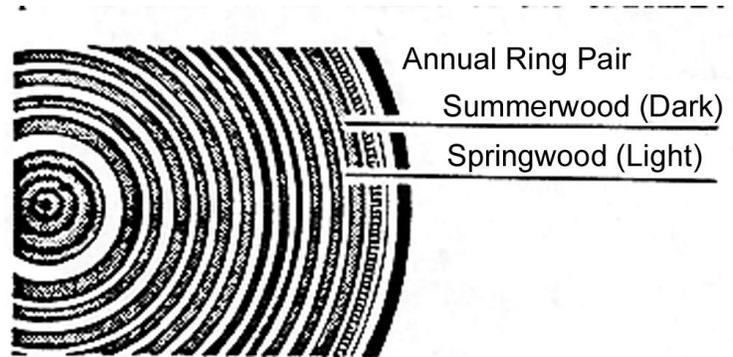


Figure 4.3. Annual rings consist of two separate rings — a light ring and a dark ring, grown each year.

The annual diameter growth of the tree stem occurs in the **cambium**, also called the vascular cambium. In this zone, the cambium cells divide and differentiate into xylem cells on the inside of the cambium and **phloem** cells to the outside of the cambium.

The phloem (FLOW-em) is the “inner bark” of the tree and contains the tissue that conducts food manufactured in the crown to the rest of the tree. Phloem cells resemble xylem cells, but they do not accumulate as wood. They exist as a narrow band of spongy tissue just inside the bark. If this tissue is completely severed around the entire circumference of the tree, the flow of food to the roots is cut off. The roots soon die, thereby killing the tree. The severing of the phloem tissue around the trunk is called **girdling**.

Bark

The **bark** is the protective, waterproof covering on the outside of the trunk. It consists of dead cells that arise from a separate **cork cambium**. Some tree species have a highly active cork cambium and are characterized by tight, unbroken bark. An example is the American hornbeam (also called blue beech). Other trees have cork cambiums that do not keep pace with the diameter growth from the vascular cambiums. The result is a deeply fissured or cracked bark, or bark that breaks into plates. Slash pine is a prime example of this type of bark.

Bark prevents the tree from drying out and helps protect it from insects and diseases, freezing, and damage by fire. The thick insulating bark of longleaf pine is one of the reasons for the tree's high resistance to fire.

Crown

The **crown** is the site of the active food-making mechanism for the tree. Leaves, which are the tree's food-making factories, are the main component of the crown. The food-making process is called **photosynthesis**. Photosynthesis is a complex chemical process that converts water, minerals, and carbon dioxide into sugars, which are the tree's food. Carbon dioxide enters the leaf through small openings called **stomata** and is used by plants for photosynthesis. Oxygen is emitted into the air as a by-product. This release of oxygen is essential to all animal life.

Photosynthesis requires sunlight to power the photosynthetic process. **Chlorophyll**, the green substance in the leaves, is a complex cellular material that acts as a catalyst in photosynthesis; that is, it participates in the chemical reaction but is neither changed nor consumed.

Most of the water available to the leaf is released through the stomata to the atmosphere as water vapor. This process is called **evapotranspiration**. Evaporation of the water cools the leaf's surface and helps to transport water from the roots to the leaves.

An average size oak tree can transpire hundreds of gallons of water per day during the summer months. Imagine the volume of water released to the atmosphere in an oak forest growing 150–200 trees per acre. Evapotranspiration is one of the ways that trees cool the air around them. Trees can control the amount of transpiration by either opening or closing the stomata. Evapotranspiration is critical to the tree's survival during periods of drought.

The crown is also the site of active growth of the tree. Height growth and crown spread occur from the **terminal bud** at the tips of the branches. The terminal bud is the tree's only point of elongation above the ground. It comes as a surprise to many people that a nail driven into a tree will be at the same height many years later. In other words, trees do not grow up from the ground, they grow by adding new cells on top of old cells at the branch tips. See Figure 4.4.

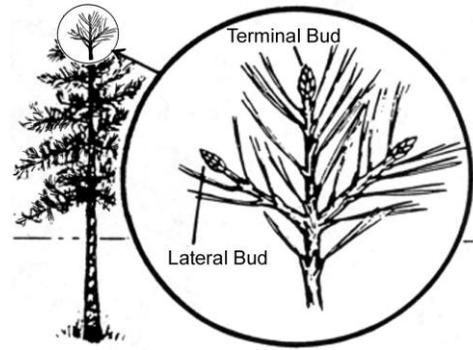


Figure 4.4. The tree grows upward at the terminal bud; if this bud is damaged, a lateral bud grows to take its place.

If the terminal bud is damaged or removed, **lateral buds** will grow to replace the terminal bud and become the dominant points of growth. Landscapers and Christmas tree growers take advantage of this characteristic and regularly shear terminal buds, producing a fuller, more pleasing tree.

Tree species, tree age, vigor, and competition are the most important factors in determining the position of tree crowns. The following classifications are commonly used:

- **Dominant** — larger trees with crowns forming the upper level of the forest canopy, receiving full sunlight from above and partly from the side
- **Co-dominant** — trees with medium-sized crowns, forming the general level of the crown cover or canopy, receiving full sunlight from above but little from the sides
- **Intermediate** — shorter, smaller crowned trees just extending into the general canopy level and receiving little direct sunlight from above
- **Overtopped** — small trees with crowns below the general canopy level and receiving no direct sunlight

Reproduction

The crown produces flowers, fruits, and seeds, the result of the tree's efforts to propagate. Some trees, such as the magnolia, have both the male and female reproductive organs in the same flower. These trees are said to have **perfect flowers**. Other trees have male and female structures in different flowers, and these are called **imperfect flowers**. Trees with imperfect flowers fall into two categories:

1. **Monoecious** — trees such as slash pine, with separate male and female flowers on the same tree
2. **Dioecious** — species that have only one type of flower on individual trees, either male or female, for example, the American holly — only the female tree bears the bright red berries.

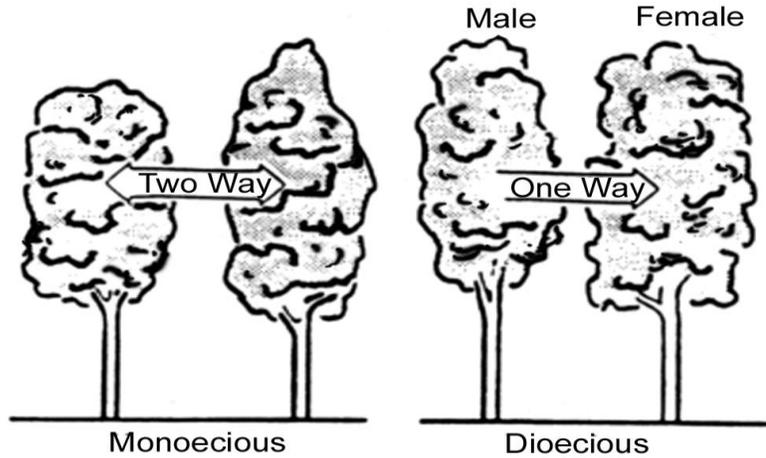


Figure 4.5. Pollination of monoecious and dioecious species

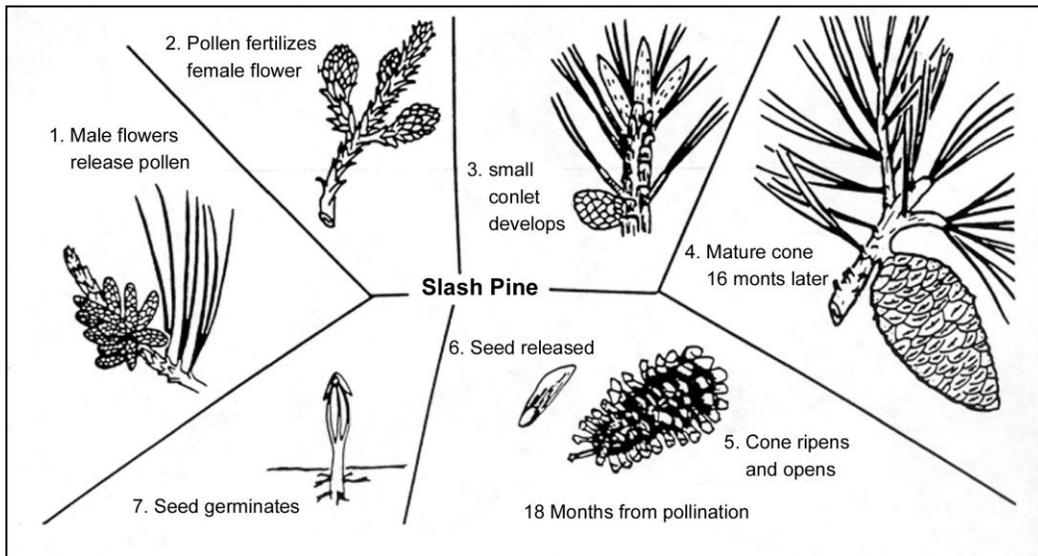


Figure 4.6. Reproductive cycle for slash pine, a monoecious conifer.

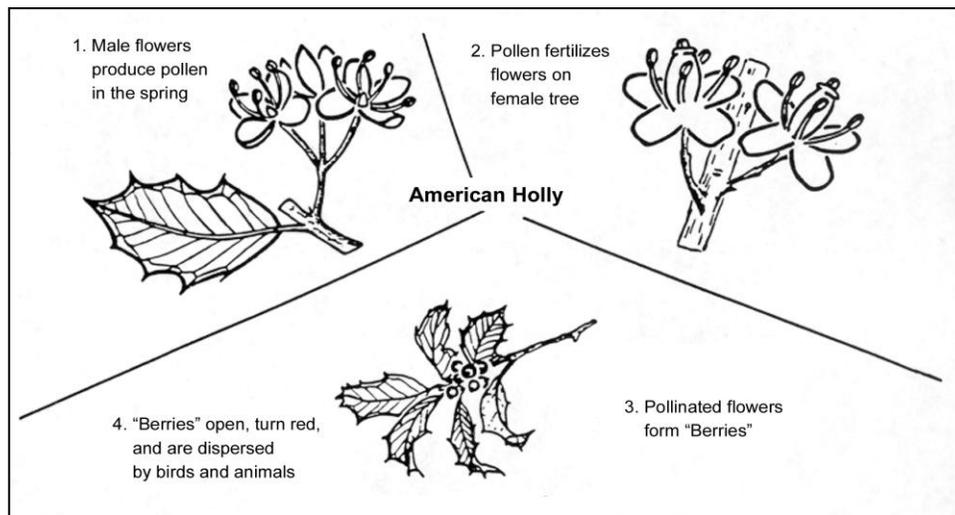


Figure 4.7. Reproductive cycle for American holly, a dioecious hardwood.

Male flowers or flower parts produce ***pollen*** — powdery reproductive particles. The pollen is carried by wind, gravity, rain, insects, or animals to female flowers or flower parts. The female flower or flower parts are fertilized by the pollen to produce a seed or seeds. This mechanism differs between conifers and broadleaf trees, but the end result is the same: the production of a fertile seed. See Figure 4.7.

Most broadleaf trees produce a seed during the same year that the flower is pollinated. Pines take 2 years to develop mature cones, following the fertilization of the female flowers. See Figure 4.6.

Tree seeds, like other seeds, use various means of dispersal. They may be scattered by wind, water, gravity, animals, or man. Sometimes a seed may lie dormant on the ground for several years, waiting for favorable growing conditions. Some seeds require a special event before germination. For example, Southern red cedar seeds require a period of low temperatures before germination is activated. This event is called ***stratification***. Some tree seeds, such as cherry, Dahoon holly and red mulberry must have the fleshy fruit removed before the seed can germinate. This task is accomplished by animals that ingest the berries. The fleshy part is digested and the seed is exposed to acids in the stomach. The seed then passes through the animal and is deposited on the ground. This is known as ***scarification***. Another form of scarification is fire.

Trees may also reproduce without seed. Broadleaf trees, in particular, have the capability to sprout from cut stumps or lateral roots. This type of regeneration is called ***coppice***. The largest organism in the world is a 106-acre aspen tree in southern Utah that reproduced 47,000 clones of itself through coppice regeneration. Pines and other evergreens do not sprout, as a rule. However, there are exceptions, such as shortleaf, Virginia, and pond pines. Willow and cottonwood trees are particularly easy to produce by sprouts or root suckers.

DENDROLOGY

The science of tree identification is called ***dendrology***. This chapter discusses the following items helpful for tree identification: tree groups, tree names, tree characteristics, and dichotomous keys.

Tree Groups

Trees are divided into two main groups, ***angiosperms*** and ***gymnosperms***. Angiosperms are also called hardwoods or broadleaf trees. They typically have broad, flat leaves (See Figure 4.8) that are either simple or compound. Their wood is dense compared to that of gymnosperms. Broadleaf trees generally lose their leaves in the winter, a condition termed ***deciduous***. Examples of angiosperms include live oak, magnolias, maples, ashes, sycamores, and mangroves. Trees may be divided into two main groups, broadleaf and conifer. Other names for broadleaf trees are deciduous, hardwood, and angiosperm. Other names for the conifer are evergreen, softwood, and gymnosperm.

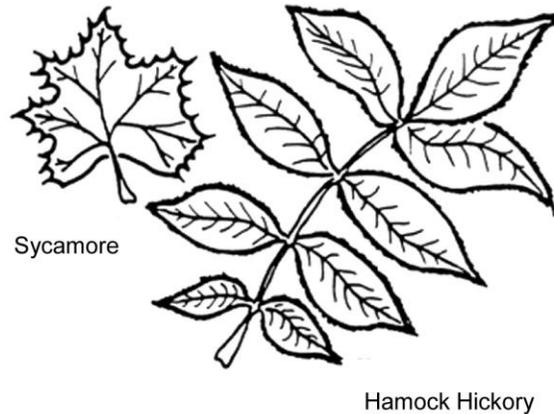


Figure 4.8. Hardwoods typically have broad, deciduous leaves, either simple or compound. They are also called deciduous or broadleaf trees.

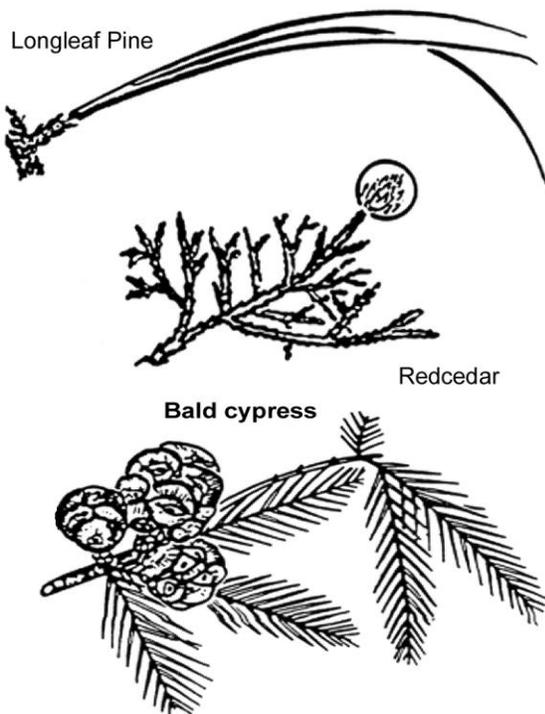


Figure 4.9. Conifers have persistent needles or scale-like leaves and are sometimes called evergreens or softwoods.

Gymnosperms are also called softwoods or conifers. Their leaves are needle-like, scale-like, or feather-like (See Figure 4.9). Unlike angiosperms, they bear cones and have relatively soft wood. Conifers retain their leaves during the winter and are often called ***evergreens***. Examples of evergreens in our area include pines, cypress, and red cedar.

Several trees listed in the two groups do not totally conform to these descriptions. For instance, southern magnolia and live oak, considered broadleaf trees, do not lose their leaves in the fall. Baldcypress, considered a conifer, does. Red cedar, a conifer, does not bear cones at all; it bears a fleshy fruit instead. Hardwoods such as cottonwood and willow have wood that is much softer

than that of longleaf pine, a softwood tree with rather dense, hard wood.

Palms are not included in these groups of trees. Palms - including our state "tree" the sabal palm - do not have a vascular cambium. They have vascular bundles, tubes that are grouped together and run up the length of the "tree". It is because of this difference that palms are not considered a true "tree".

TREE NAMES

Trees, much like humans, have common names and scientific names. For example, Debbie, Eric, and Becky are common names, but their scientific name is *Homo sapiens*. South Florida slash pine, southern pine, yellow pine, slash pine, and Dade County pine are all common names of one tree whose scientific name is *Pinus elliottii* variety *densa*. Each tree has only one scientific name. Scientific names are frequently used by foresters and biologists to eliminate confusion when speaking about specific trees.

A scientific name consists of two parts, ***genus*** and ***species***. Sand pine's scientific name is *Pinus clausa*. *Pinus* is the genus, *clausa* is the species. Some trees share the same genus such as longleaf pine, *Pinus palustris*, and slash pine, *Pinus elliottii*. Examples of scientific names are given in the dichotomous key at the end of the Forestry Section.

TREE CHARACTERISTICS

When identifying trees, foresters use the tree's characteristics to aid them. Characteristics include: leaves, bark, twigs, flowers, fruits, and tree shape. Leaves are the easiest characteristic to use in tree identification. They can have varying sizes, shapes, margins or leaf edges, orientations on the branch, and simple or compound leaves. Please refer to the Appendix for examples of leaf characteristics.

Conifer leaves vary in shape, but Florida's most important conifers (longleaf, loblolly, slash, and sand pines) all have needles of similar form. Florida's other important conifers, bald cypress and red cedar, are easily distinguished by their leaf shape. Pine needles arise from the branch in little bundles or bunches called ***fascicles***. Needle length and the number of needles per fascicle will distinguish the various pine species.

When identifying hardwoods by their leaves, one must first determine whether the leaf is **simple** or **compound**. Simple leaves are defined as having one leaf per **petiole**. Whereas a compound leaf will have many **leaflets** per petiole. It is important to distinguish leaflets from simple leaves. Beginners make the error of examining leaflets on a compound leaf, mistaking them for a simple leaf. This can be avoided by following the petiole back to the leaf bud. The leaf bud is positioned between the petiole and the twig. Drawings of leaf parts can be found in the appendix.

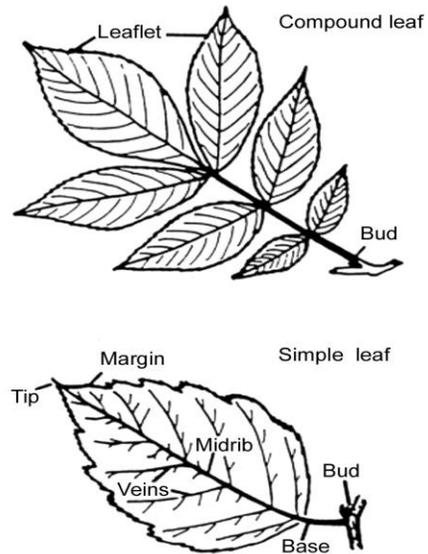
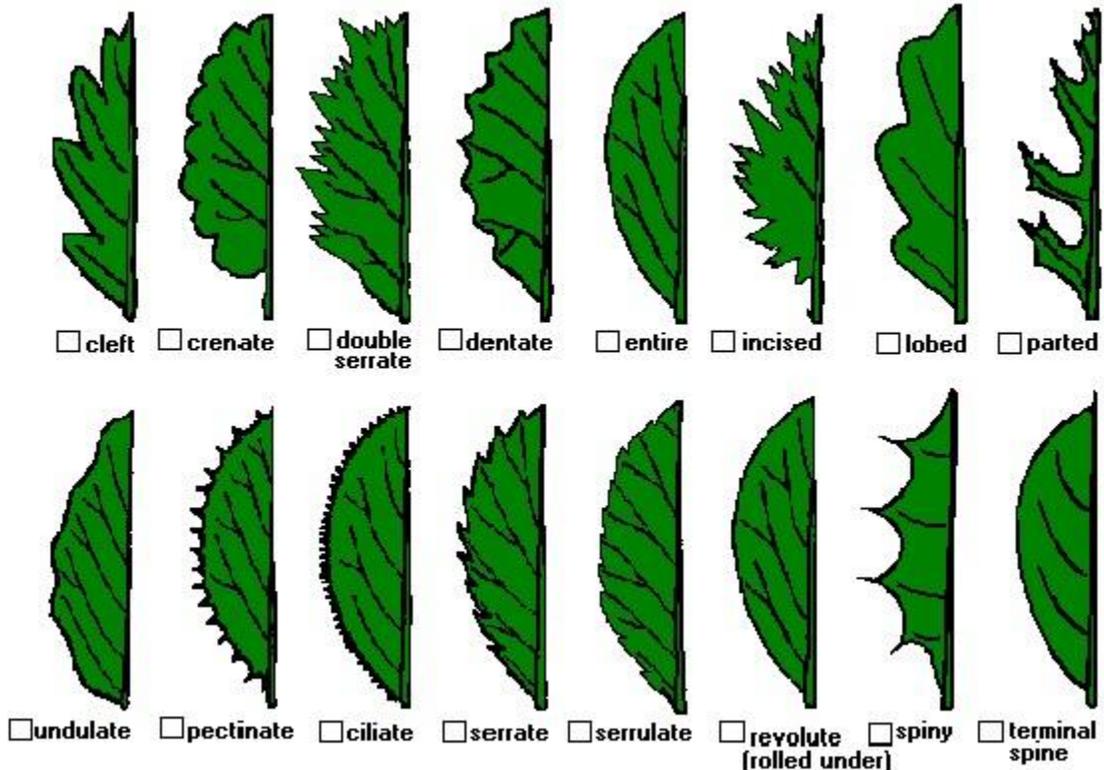


Figure 4.10. Hardwood leaves are either simple or compound.

The **leaf margin**, or edge of the leaf, is useful in identifying hardwood trees. Examples are shown below:



There are 3 common types of leaf **orientations**: **opposite**, **alternate**, and **whorled**. Most trees have an alternate leaf orientation. Opposite leaf orientations can be found on maples, ashes, dogwoods (M.A.D.), and mangroves. Catalpa trees have a whorled leaf orientation, but do not occur naturally in our area.

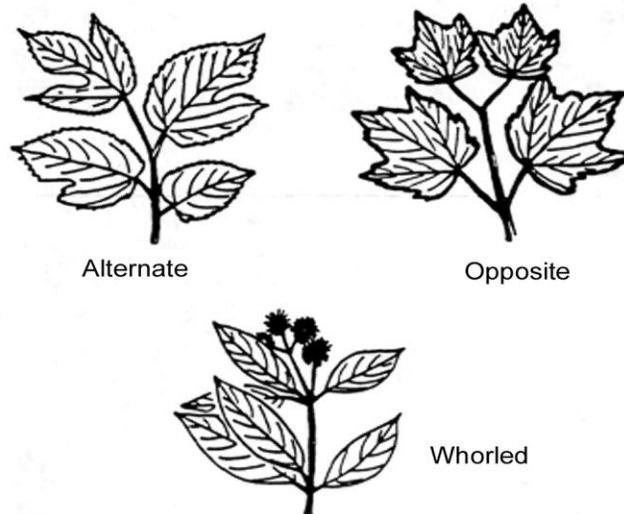


Figure 3.11. Leaf orientations.

Trees may also be identified by observing the site in which they grow. For example, dry, sandy soils are often colonized by longleaf and sand pines. Tidal areas along estuarine waters will contain mangroves. Moist, rich soils may support red bay, live oak, and red mulberry. Be aware that trees planted in landscaped areas may be growing outside of their preferred conditions.

DICHOTOMOUS KEY

A dichotomous key is a chart that botanists and foresters use to identify trees according to a tree's group and characteristics. Here's how the dichotomous key works:

Pretend you are looking at a broadleaf tree whose leaves have U-shaped lobes, toothed leaf margins, and are arranged in an alternate fashion on the twig. What tree is it?

First decide which dichotomous key is the appropriate one to use...conifer or hardwood? Hardwood!!

Next, go to the #1 on the hardwood key...are the leaves and twigs alternate or opposite? Alternate!! Good! Proceed to #3 on the hardwood key.

Are the leaves lobed or unlobed? According to our observation, the leaves are unlobed. The number in the right-hand margin indicates that we must proceed to #4.

The #4 description that matches our described tree is that of the red mulberry, *Morus rubra*.

Below is the dichotomous key that will be handed out at the Envirothon competition. You will be allowed to use this key to identify trees at the Forestry site. This key will not identify all trees in Indian River, Martin, Okeechobee, and St. Lucie counties. This key is intended for use in the Indian River Lagoon Envirothon.

CONIFER KEY

1. Leaves needle-like, in fascicles _____ 2

1. Leaves feather-like or scale-like _____ 4

2. Needles in fascicles of three only. **LONGLEAF PINE (*Pinus palustris*)**

2. Needles in fascicles of 2, or 2 and 3 _____ 3

3. Needles in fascicles of 2; needles 2-3 inches long;
cones 2-3 inches long _____ **SAND PINE (*Pinus clausa*)**

3. Needles in fascicles of 2 and 3; needles 8-12 inches long;
cones 3-6 inches long _____ **SLASH PINE (*Pinus elliottii*)**

4. Needles are feather-like; deciduous; cones are ball-like,
3/4-1 inch long _____ **BALD CYPRESS (*Taxodium distichum*)**

4. Needles are scale-like _____ 5

5. Needles are scale-like in two fashions; the most common is dark green clasping tightly to the stem. The other kind appearing on young stems or vigorous growth is awl-shaped and sharp-pointed; fruit is a small gray-blue berry _____
 _____ **SOUTHERN RED CEDAR (*Juniperous silicicola*)**

HARDWOOD KEY

1. Leaves and twigs are opposite _____ 2
 1. Leaves and twigs are alternate _____ 3
2. Leaves are compound and 7-12 inches long; 5-7 leaflets per leaf _____ **CAROLINA ASH (*Fraxinus caroliniana*)**
 2. Leaves are simple _____ 11
3. Leaves are lobed _____ 4
 3. Leaves are unlobed _____ 6
4. Lobes on leaves are V-shaped _____ 5
 4. Lobes on leaves are U-shaped, toothed leaf margins _____ **RED MULBERRY (*Morus rubra*)**
5. Leaves 3-5 lobes, 4-9 inches long and broad, light green and smooth above and paler below _____ **SYCAMORE (*Platanus occidentalis*)**
 5. Leaves star-shaped, 5-7 lobes _____ **SWEET GUM (*Liquidambar stryaciflua*)**
6. Tree is evergreen _____ 7
 6. Tree is deciduous _____ 10
7. Leaf margins are entire _____ 8
 7. Leaf margins are pointed or toothed _____ 9
8. Leaves are 3-4 inches long, oblong-lanceolate, apex is acuminate; leaves are edible used in cooking, fruit is a dark blue berry (drupe) _____ **RED BAY (*Persea borbonia*)**
 8. Leaves are 2-3 inches long, leathery, oblong-obovate, apex is obtuse (immature leaves may have a toothed margin); fruit is an acorn _____ **LIVE OAK (*Quercus virginiana*)**

9. Leaves are 4-6 inches long, finely toothed; fruit is a woody capsule that splits and releases seed _____ **LOBLOLLY BAY (*Gordonia lasianthes*)**
9. Leaves are 1½ - 3 inches long, toothed above the middle toward the apex; fruit is a red berry _____ **DAHOON HOLLY (*Ilex cassine*)**
9. Leaves 2-4 in. long, ½ in. wide, coarsely serrate-toothed; fruit is a 1/8 inch berry covered with a bluish wax
_____ **WAX MYRTLE (*Myrica cerifera*)**
10. Lvs. are 2-3 in. long; entire leaf margin (immature leaves may have toothed margins); fruit is an acorn **_LAUREL OAK (*Quercus laurifolia*)**
10. Leaves are 2½-5 in. long; entire leaf margin or just a few teeth towards the apex; fruit is a berry____ **SUGARBERRY (*Celtis laevigata*)**
11. Leaves have 3 lobes _____ **RED MAPLE (*Acer rubrum*)**
11. Leaves are unlobed _____ 12
12. Leaves dark green on both sides, thick & leathery; proproots extend downward from the trunk; seeds pencil-shaped;
_____ **RED MANGROVE (*Rhizophora mangle*)**
12. Lvs. dark green on top, but distinctively pale and silver-green underneath; leaf surface often coated with salt; lvs. Narrow and oblong _____ **BLACK MANGROVE (*Avicennia germinans*)**
12. Leaves are oval & have a small notch at the leaf tip; two small salt glands are visible on either side of the stem below the leaf blade____ **WHITE MANGROVE (*Laguncularia racemosa*)**