FOREST ECOLOGY

2004 Envirothon Training

November 6, 2004

Blackbird State Forest

What is a forest?

A forest is a community of trees, shrubs, herbs, and associated plants and organisms that cover a considerable area that use oxygen, water and soil nutrients as the community attains maturity and reproduces itself.

What is ecology?

Ecology is the scientific study of the relationship of living things to one another and to their environment.

What is forest ecology?

Forest Ecology

Forest Ecology is the study of the complex interactions between the organic and inorganic elements of a forest ecosystem.

A forest ecosystem is the organisms, soil, air and water associated with the forest.

A Forest Ecosystem Is "Interdependent"

- Meaning that every organism depends on every other living and nonliving element of the system.
- Living components of the forest = producers (able to make food), consumers (eats other producers and consumers), and decomposers (break down organic material).
- Non-living components = soil, water and climate.

- There are over 346 species of wildlife living in Delaware and of those, 273 are forest dependent. Just as these species are dependent on the forest, the forest is equally dependent on its occupiers.

TREES!

- Perennial woody plants
- Grow upright with single stems and have their **roots** anchored in soil
- Must have the ability to reach at least 20ft or more in height
- The single **trunk** should be unbranched for at least several feet above the ground
- Specimen must have a sizeable **crown.**

SHRUBS!

4 MAIN PARTS OF A TREE

- CROWN- where the tree increases each year in height and spread of branches by adding on a new growth of twigs.
- LEAVES- make up the crown and produce food for the tree (photosynthesis).
- TRUNK- supports the crown and produces the majority of the tree's useful wood.
- ROOTS- anchors the tree, absorbs and stores water and nutrients.

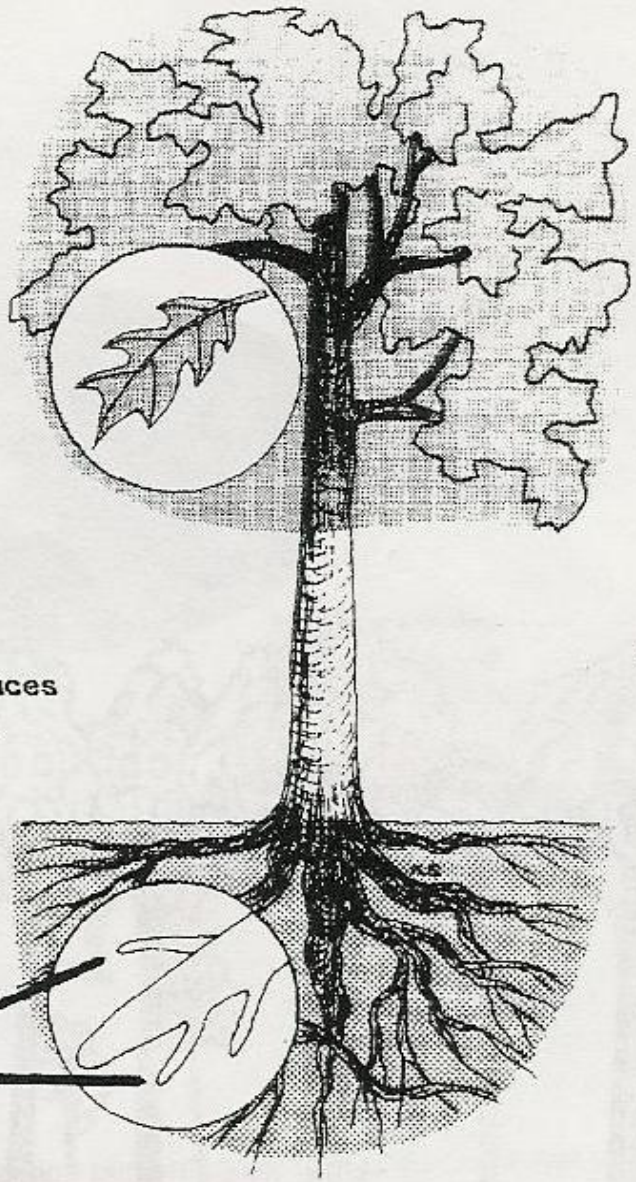
CROWN: where tree increases each year in height and spread of branches by adding on a new growth of twigs.

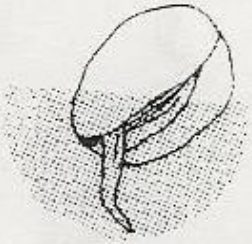
LEAVES: make food for the tree by combining carbon dioxide from the air and water from the soil, in the presence of sunlight, to form sugar. Moisture is given off through transpiration on the underside of the leaves.

TRUNK: supports the crown and produces the majority of the tree's useful wood.

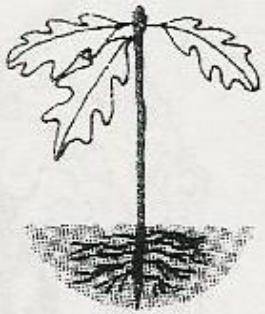
ROOTS: anchor the tree, absorb and transport water and nutrients.

ROOT HAIRS: absorb water and nutrients from the soil.





SEED



SEEDLING

HOW A TREE GROWS

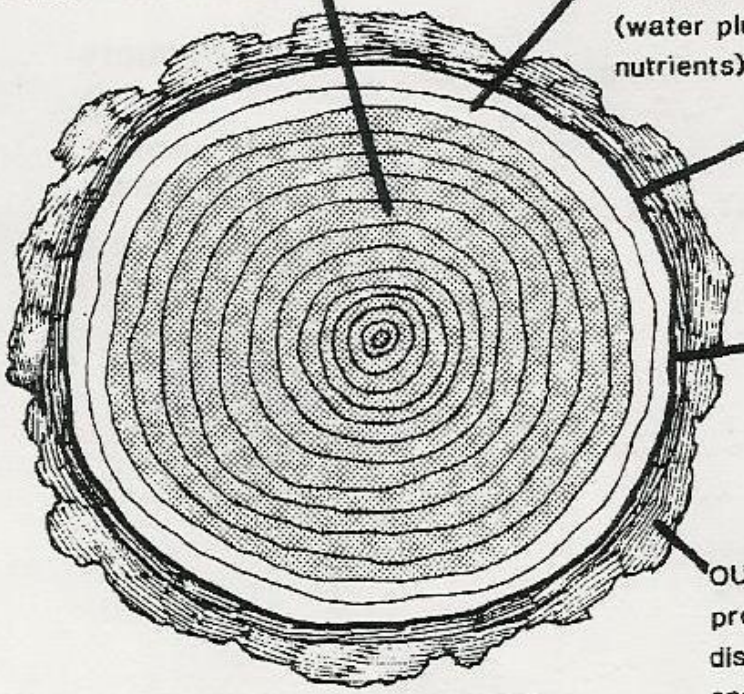
HEARTWOOD: the supporting column of inactive (dead) sapwood which gives the trunk strength and stiffness.

SAPWOOD: (xylem) the new layers of wood which allow passage of sap (water plus nitrogen and mineral nutrients) from roots to leaves.

CAMBIUM: the microscopic layer of cells where growth takes place, annually producing new wood and bark.

INNER BARK: (phloem) carries sugar made in the leaves down to the branches, trunk and roots, where it is converted to substances vital to growth. It eventually dies and becomes outer bark.

OUTER BARK: holds moisture in and protects the tree from insects and disease, excessive heat and cold, and mechanical injuries.



TRUNK CROSS-SECTION

HOW A TREE GROWS

- Heartwood- the supporting column of inactive (dead) gap-wood which gives the trunk strength and stiffness.
- Sapwood **(xylem)-** new layers of wood that transports water and nutrients from roots to the leaves.
- Cambium- microscopic layer of cells where growth takes place.
- Inner bark **(phloem)-** carries food made in leaves down to the branches, trunk and roots.
- Outer bark- hold in moisture and protects the tree from insects and disease, excessive heat and cold, and mechanical injury.

COMPETITION

- All trees compete for the same basic requirement of life – light, water, essential elements, oxygen, and other necessities.
- The species that are better able to gather those requirements will out-compete others.

COMPETITION

- Broadleaved or **hardwood** trees are better able to compete and grow on deeper, heavier, more productive soils.

- The needle-leaved trees or **conifers** do better on poorer, lighter textured soils.

The only thing constant about a forest ecosystems is that they never stop changing!

- Natural changes:

fire, storms, drought, flood, death and disease

- Man-made changes:

harvesting, farming, trails, recreation and development

Succession

- These changes are known as disturbances and spark the process called succession.
- **Succession** is the gradual change in plants and animal communities over time.

  - **Primary succession** occurs in an area that has no true soil. Pioneer species are the first plants to grow at these barren sites.
  - **Secondary succession** occurs on landscapes where the natural vegetation has been removed or destroyed but the soil remains intact.

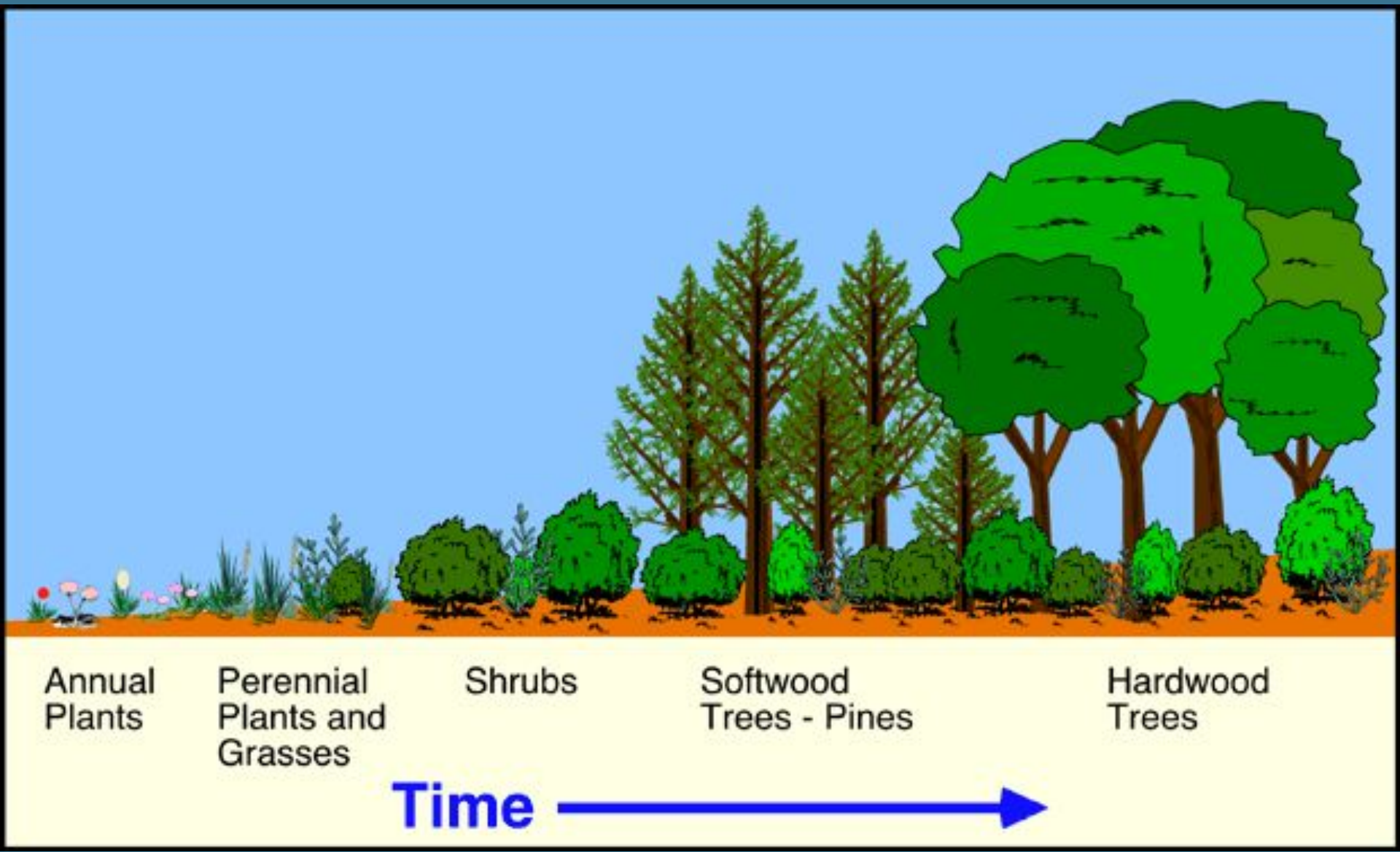
What's your tolerance?

- Tree species that first colonize an area are usually **shade-intolerant** species and must have full sunlight to do well.

(pines, black locust, black cherry, yellow-poplar, sweetgum, blackgum, sassafrass, and sumac)

- Once they have developed some sun coverage the **shade-tolerant** species will begin to grow and eventually take over the canopy.

(oaks, hickories, and American beech)


Annual Plants
Perennial Plants and Grasses
Shrubs
Softwood Trees - Pines
Hardwood Trees
Time

Succession is always occurring

- Succession ensures the continuation of the forest by allowing other species the chance to grow and helps to increase the forest's biodiversity.
- Biodiversity is the species richness or variability among species in a given ecosystem.
  When an area is rich in native species is encourages other native animals and insects to inhabit that area, this in turn makes the ecosystem stronger.
- When forests are strong they are better able to withstand and recover from stress the outside environment imposes.

Trees occupy all layers of the forest!

Forest Canopy: formed by the branches and leaves from the tallest trees.

Understory: the middle layer where shorter trees and shrubs grow.

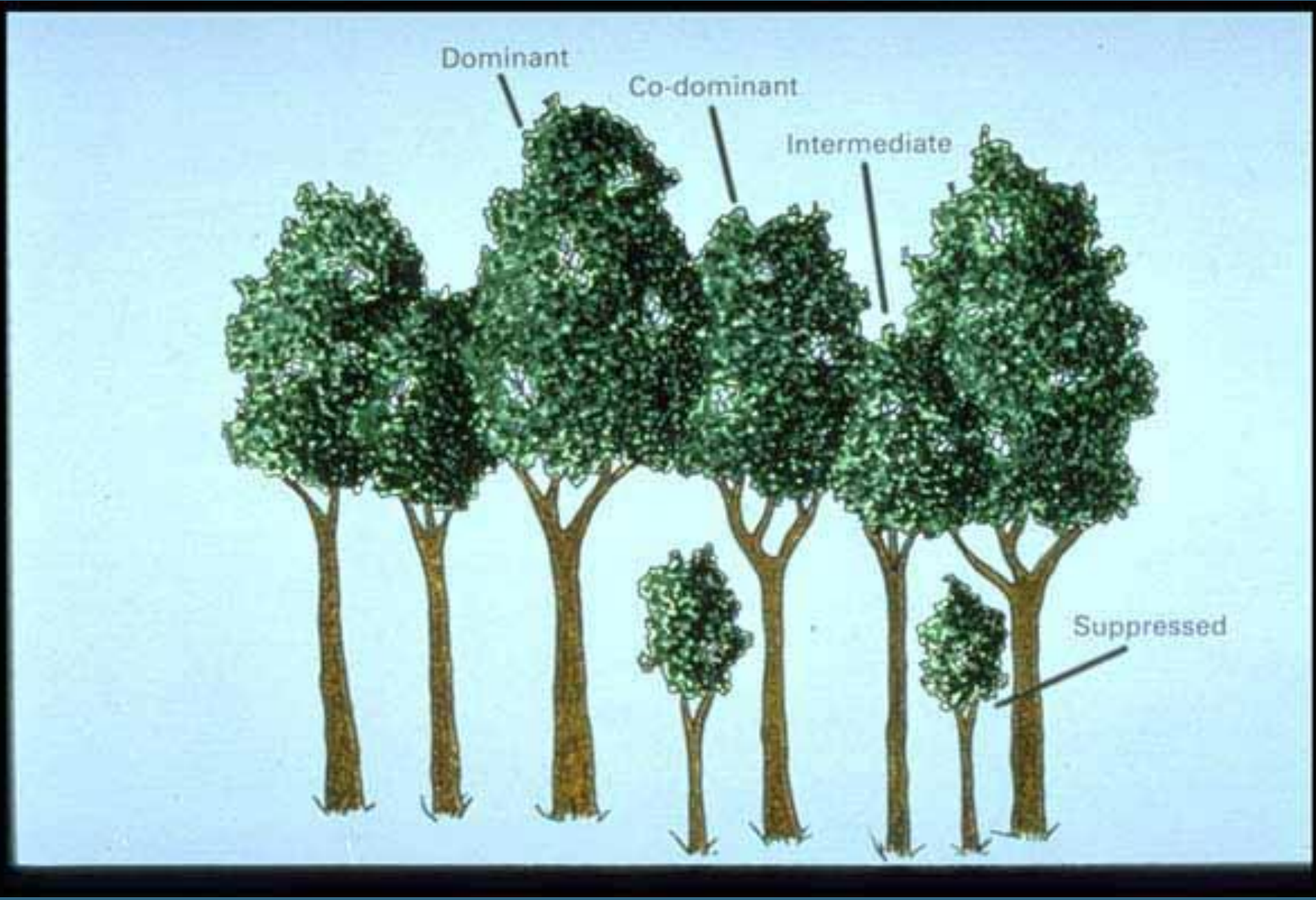
Forest floor: is the third layer where trees begin as seedlings. Tree roots also make up this layer that hold onto to soil and organic matter so that grasses, ferns, fungi, decaying plants and logs, microorganisms and animals may flourish.

Tree Classification

- Trees can be classified according to the position they occupy in the forest canopy or understory. Such as system measures how well a tree has grown relative to its closet competitors. (Trees that get the most sunlight generally grow fastest).
- There are five **crown classes.**

Crown Classes:

- Dominant – have tops that rise above the general canopy level. They receive full sunlight from above and all sides.
- Co-dominant – These trees make up the canopy level. Their crowns get full sunlight from above, but dominant and other co-dominate trees restrict some side sunlight.
- Intermediate – These trees also occupy the average canopy level, but receive sunlight only from above.
- Suppressed – These are trees that receive no direct overhead or side sunlight. They are usually are slow growing and are weak.
- Dead trees (snags) – These can be found in the canopy, understory or forest floor.


Dominant
Co-dominant
Intermediate
Suppressed

If uninterrupted, succession will lead to the “climax" community.

- Climax Community- a point in succession where the overstory trees are replaced by younger trees of the same species and have reached equilibrium.

Climax forests

- Typically, climax forests are dominated by shade-tolerant species.
- In the Northern Hardwood Forest, the climax community is made up of sugar maple, American beech, and hemlock.
- In this example American Linden or Basswood precedes the climax stage and is said to be the “sub-climax” tree.

- What would be the climax forest in Delaware?
    - American Beech

- What would be the sub-climax species?
    - Oak & Hickory

Major Forest Types

- There are six major forest types in the conterminous United States
  - The Northern Forest
  - The Central Forest
  - The Southern Forest
  - The Bottomland Forest
  - The West Coast Forest
  - The Western Interior Forest

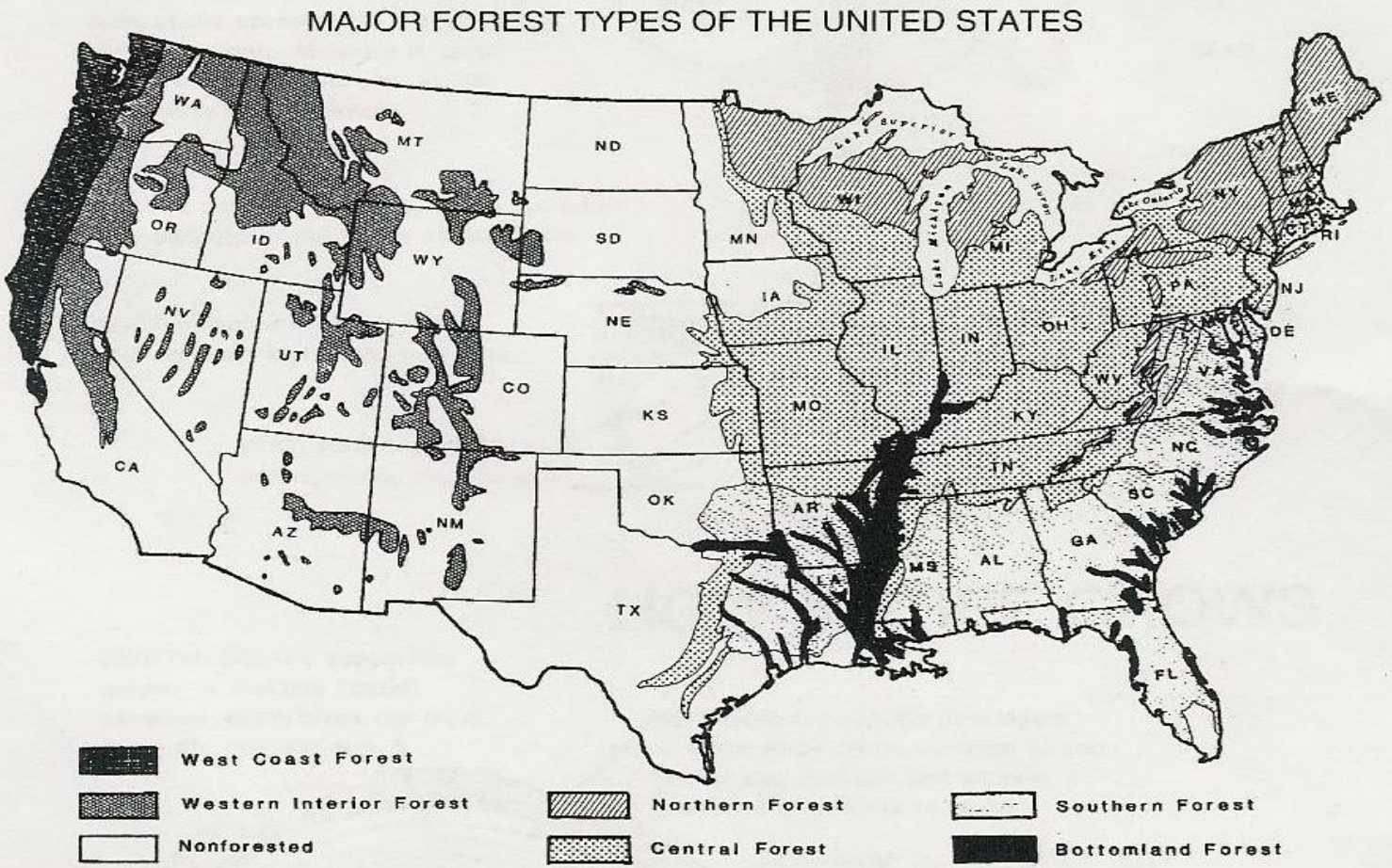


FIGURE 3-1
The major forest types of the contiguous 48 United States. (Adopted from A. W. Kûchler's *Potential Natural Vegetation of the Conterminous United States)*

Delaware is a unique state !

- Delaware is a unique state because the upper portion of the state lays in the Central Forest type and lower Delaware is made up of the Southern Forest type.
- This means we have an interesting blend of species that have reached their most northern region and others that have reached their most southern region.

Southern Magnolia

Magnolia grandifolia

Major Forest Types in the U.S

- The Northern Forest- found in New England, New York, & the northern most portion of the Lake States. It also extends southward along the Appalachian Mtns, at the higher elevations.
  - Northeastern Spruce-fir- 7 million acres; Red, White, and Black Spruce; Balsam Fir; N. White Cedar; Hemlock; Tamarack; Birch; and Beech
  - Northern Harwood Type- 30 million acres; Sugar maple; Beech; Yellow Birch; Basswood; White Ash and Hemlock

- The Central Forest- The largest of our forest types at 111 million acres. This is probably the most familiar type.
- Thirty states have this forest type & at least 75 commercially important trees are found in this type.
- Included are 30 oak species, several Hickories; five Ashes; Black Walnut; Cherry; Beech; Maple; & along waterways: Sycamore; Cottonwood; Sassafras; Sweetgum; Magnolia & others.

- Southern Forest- This forest extends along the Atlantic coastal plain south nearly to the lower end of FL & west to east Texas and eastern OK.

- This 29 million acres of forests is an important producer of wildlife and features four important pines: Loblolly; Slash; Shortleaf; Longleaf.

- Other species in association are Oaks; Willows; Gums; Tulip Poplar; Magnolias; Pecan; Hickories; and others. This forest is the #1 producer of pulpwood

- Bottomland Hardwoods- These forest are located along the Mississippi River & its tributaries south of Illinois & Indiana, and encompass an area of about 33 million acres.

- These forests are a final filter of all the rainfall draining through these states before it finally flows in to the Mississippi. They are also a tremendous producer of wildlife, especially waterfowl & many endangered species.

- Unfortunately, they are being cleared at a rapid rate for a variety of commercial purposes. Baldcypress is the major species in the swamps, with Water & Swamp Tupelo.

- Upland species include several Oaks; Elms; Red Maple; Green Ash; River Birch; Cottonwood & Sycamore. These forests can be difficult to regenerate.

- Western Interior Forest- These scattered, dry forests occur from Canada on the North all the way to Mexico on the South; And from the western edge of the prairies up the eastern slopes of the Cascade & Sierra Nevada Mountains.

- Two main species are present: Lodgepole pine, covering 13 million acres in the U.S., (& another 50 million in Canada); and the Ponderosa Pine type, 24 million acres from the Black Hills of South Dakota & Wyoming, through Colorado, Utah, New Mexico & Arizona.

- Western Interior Forest con't- Other associated species are found with these two pines depending on altitude include: Pinyon Pines; various shrubby oaks; Quaking Aspen; Douglas-Fir; White Fir; Englemann Spruce; Subalpine Fir & Limber Pine.

- Many of these forests are "fire" types, termed a "disclimax" in ecological terms for they are perpetuated by natural fires. Further on the West, in eastern California, one can find Jeffery Pine, Sugar Pine, & Western White Pine mixed with Ponderosa Pine, & White & Red Firs.

- West Coast Forests- This entire forest lies west of the crests of the Cascade & Sierra Nevada Ranges from Alaska southwards to near San Francisco Bay. Two major subtypes are present.

- The first is the Coastal Douglas Fir Type- 17 million acres of highly productive forests most of which lies within a 50+ miles distance from the Pacific Coast in a fog-belt area. The principal species are: Sitka Spruce; Western Hemlock; Western Redcedar; and Pacific Silver & Grand Firs. Western White Pine and Nobel Fir are found with Douglas-Fir. Important hardwoods are Red Alder; Bigleaf Maple; Oregon Ash; Madrone & Black Cottonwood. At the southern end of this fog-belt, the Redwood forest is found. Although it is one of the smallest forest types in the country, some years it produces more than one-third of this countries forest products. These forests are world famous for the size of trees here.

- West Coast Forest con't-
- Sitka Spruce/ Western Hemlock/ Western Redcedar- This small, narrowly situated forest types is found immediately alongside of the Pacific Ocean stretching from southern Alaska down through Oregon to Northern California . It encompasses less than 8 million acres in the U.S. and only about 7 million acres along the Alaskan Coast, but is key habitat for many endangered birds & wildlife. Port Orford Cedar; Red Alder; Madrone; Tanoak; California –laurel; & Bigleaf Maple are also found here.

West Coast Forests con't-

- Alaska's Interior Forests are composed primarily of Spruce; Quaking Aspen; & Paper Birch encompassing about 4.1 million acres.
- They are largely inaccessible, slower- growing, and , not suprisingly, this forest type occurs in a circumpolar range, being found also in Siberia and westward across Northern Russia, Finalnd, Sweden, Norway, & Canada.
- It is, perhaps, the most widely distributed forest type in the world