

# Unit A: Introduction to Forestry

## Lesson 2: Understanding Forest Ecology

# Terms

- ◆ Bole
- ◆ Ecology
- ◆ Ecosystem
- ◆ Forest ecology
- ◆ Hardening-off
- ◆ Hardiness
- ◆ Material cycle
- ◆ Mycorrhizae
- ◆ Overstory
- ◆ Photoperiod
- ◆ Stratification
- ◆ Succession
- ◆ Understory

# What is forest ecology?

- ◆ Ecology is the science that deals with the relation of plants and animals to their environment and to the site factors that operate in controlling their distribution.
- ◆ An ecosystem is the interacting of a biological community with its nonliving environment.

# What is forest ecology?

- ◆ Forest ecology is the study of the forest ecosystem.
- ◆ Forest ecology deals with the interrelationships between various trees, plants, and other living organisms that make up the community and with the interrelationships between those organisms and the physical environment in which they exist.

# What is forest ecology?

- ◆ Ecosystems can vary in size from a few hundred hectares to thousands of hectares.
- ◆ Forest ecosystems are generally classified into types based on the dominant tree species.



# What is forest ecology?

- ◆ Some ecosystems are simple, while others can be very complex.
- ◆ Apple orchards or pine plantations are simple ecosystems because they have only one species of plant.

# What is forest ecology?

- ◆ True pine-hardwood forests, an oak-hickory forest, or a beech-maple forest, are complex ecosystems because they have more than one species.
- ◆ The more complex an ecosystem, the more resistant it is to either change or damage by insects, diseases, ice storms, fire and other disasters.

# What is forest ecology?

- When an ecosystem contains many different plant species, the plants are not all affected if the ecosystem suffers from one of the damaging factors.

# What is forest ecology?

- ◆ In a mixed hardwood ecosystem, one species of tree may be killed out by a disease, yet other trees will take its place; there will not be a total loss in the timber resource and the ecosystem will continue to function.
- A simple ecosystem can be destroyed because it is susceptible to a single damaging factor.

# What are the characteristics of forest ecosystems?

- ◆ There are various characteristics and processes typical of the forest environment.



# What are the characteristics of forest ecosystems?

- ◆ Characteristics included stratification, zonation, diversity and stability.
- ◆ Stratification refers to the various layers that can be observed in the forest.
- ◆ The upper canopy of trees, tress just below the main canopy, saplings, seedlings, and small herbaceous plants near the forest floor are typical layers.

# What are the characteristics of forest ecosystems?



- ◆ Various kinds of trees in the forest have similar needs for moisture and nutrients and are often found in the same zone.
- ◆ The wet area near a stream turns to a dry area farther away.
- ◆ Several zones comprising different groups of tree species are located between them.

# What are the characteristics of forest ecosystems?

- ◆ Natural forest ecosystems are very diverse, with many kinds of trees and plants.
- ◆ The various layers in a forest provide a variety of habitats for both plants and animals, allowing many different kinds to develop.

# What are the characteristics of forest ecosystems?

- ◆ The diversity results in a stable environment that is both resistant and resilient to change.
- ◆ The location and type of habitat in which a species lives, together with its functional role in the forest ecosystem, determine the niche of a species.

◆ Hardwoods—Red Oak

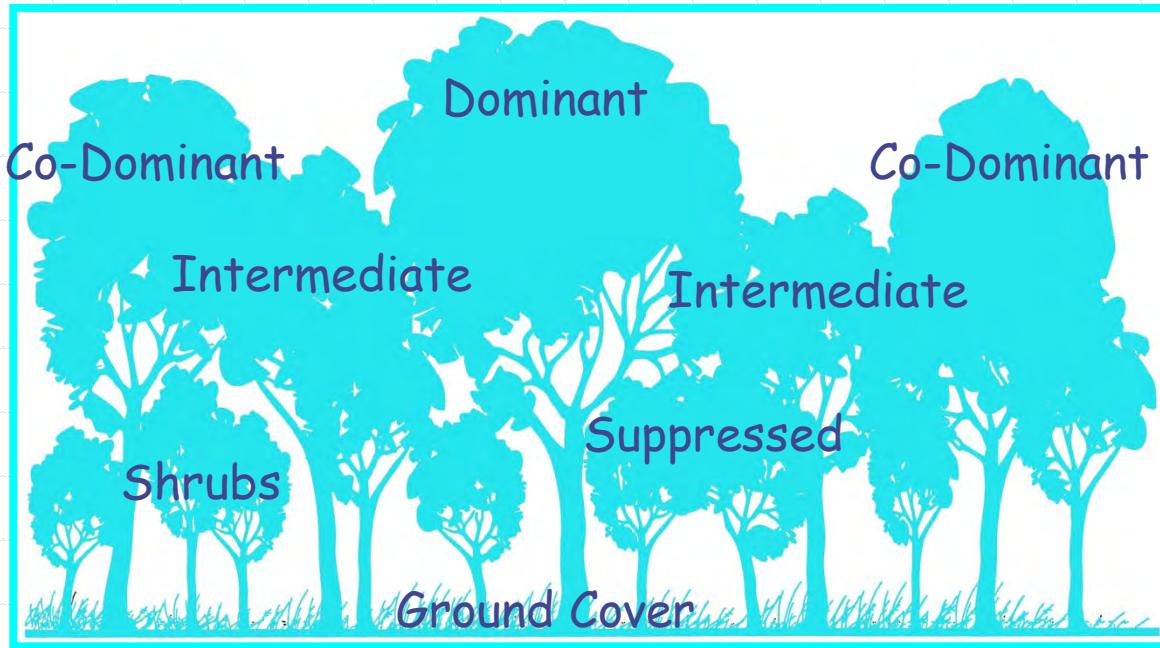


◆ Softwoods—White Pine



# Layers of the Forests

Stratification refers to the various layers that can be observed in the forest.



# What are the processes and relationships of natural ecosystems?

- ◆ There are many process and relationships of natural ecosystems.
- ◆ They include energy flow, decomposition, material cycling, competition, and succession.

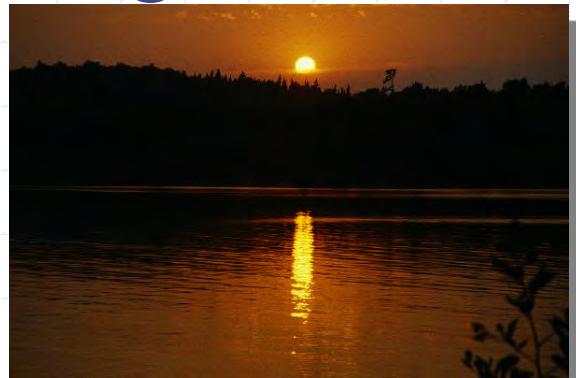


# What are the processes and relationships of natural ecosystems?

- ◆ Energy flow is an important process.
- ◆ Green plants, also known as the producers, combine the energy in the form of sunlight with water and minerals from the soil, with carbon dioxide from the air.

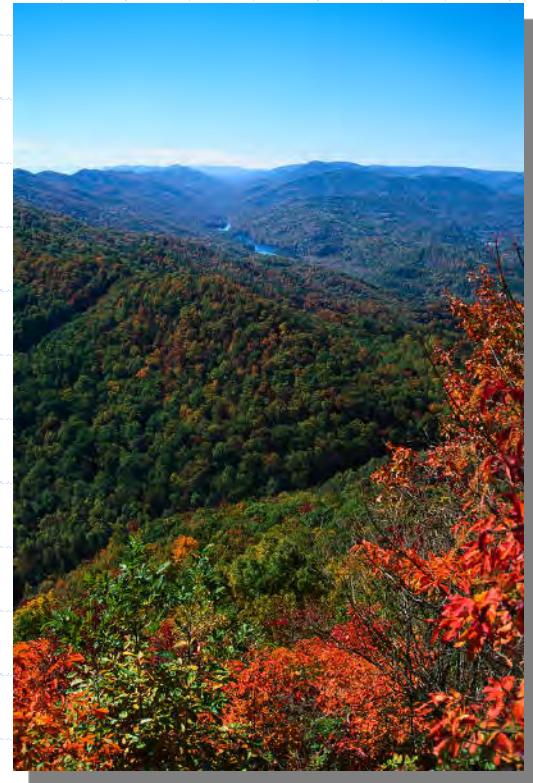
# What are the processes and relationships of natural ecosystems?

- ◆ Energy captured by green plants as sunlight is considered a flow because as it is used it is constantly converted to heat energy that goes back to outer space, not to be used again in the ecosystem.



# What are the processes and relationships of natural ecosystems?

- ◆ The nonliving materials that green plants use to survive and grow are termed the abiotic part of the ecosystem.



# What are the processes and relationships of natural ecosystems?

- ◆ Animals, or consumers in the ecosystem, survive on the green plants for food.



# What are the processes and relationships of natural ecosystems?

- ◆ As waste from both plants and animals accumulate on the soil surface, decomposition becomes very important.
- ◆ Decomposers are the fungi and bacteria, primarily in the upper soil layer, that break down plant and animal matter to be repeatedly recycled by the green plants.

# What are the processes and relationships of natural ecosystems?

- ◆ The material cycle is a circular process where materials are used over and over again.
- ◆ Plants, which use materials from the environment, are eaten by animals, and as both plants and animals die, the waste is decomposed, and the decomposed materials are returned to the environment where it can be used again.

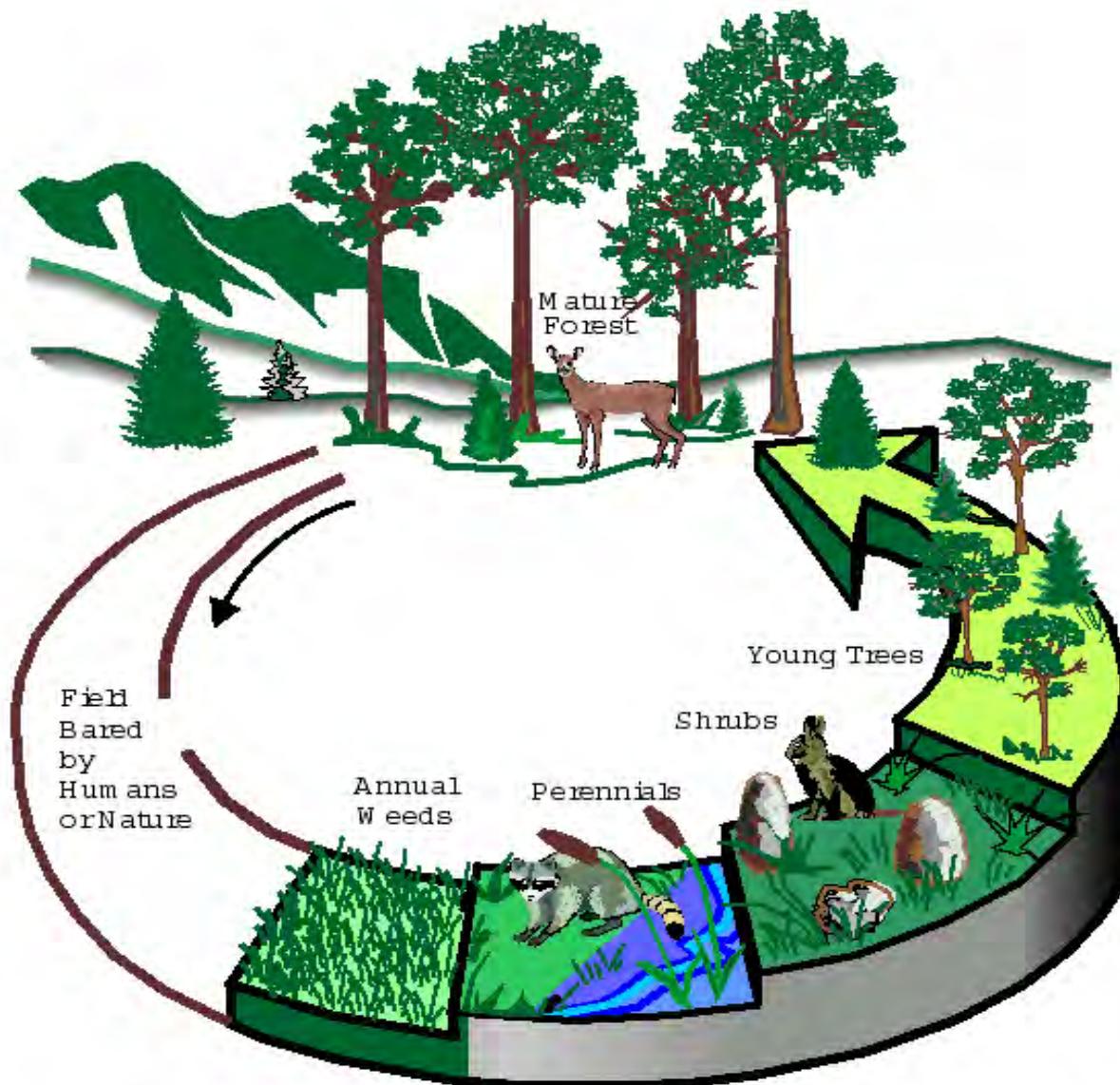
# What are the processes and relationships of natural ecosystems?

- ◆ Competition for light, space, water, nutrients and other resources is a constant process in ecosystems.
- ◆ Throughout the processes both plants and animals are competing for the resources they need for survival.

# What are the processes and relationships of natural ecosystems?

- ◆ Many forest ecosystems are constantly changing through a very slow process called succession, where an individual tree dies and is replaced by other kinds of trees that were not previously present in the forest, resulting in a change in the ecosystem.
- ◆ A mature forest is usually considered the climax or terminal stage, which is very stable and diverse.

# Total Environment



(Courtesy, Interstate Publishers, Inc.)

# What are the interrelationships between trees and environmental factors?

- ◆ The total tree environment involves a complex interaction between a variety of physical and biological factors.



# What are the interrelationships between trees and environmental factors?

- ◆ An environmental change is rarely the result of a single factor.
- ◆ Knowledge of the nature and interrelationships of the major environmental factors is helpful in understanding how plants grow and how they respond to environmental change.

# What are the interrelationships between trees and environmental factors?

- ◆ The physical factors include:
  - Climate
  - Soil
  - Pyric activity.

# What are the interrelationships between trees and environmental factors?

- ◆ Climate directly affects both the daily growth processes and the seasonal development of plants.
- ◆ Chemical reactions tend to speed up as temperature increases and slow down when the temperature approaches the maximum at which plants can survive.

# What are the interrelationships between trees and environmental factors?

- ◆ The sun is the source of the visible light portion of solar radiation and is important as a source of energy for photosynthesis.
- ◆ The photochemical reaction is one triggered by the sun.
- ◆ Sunlight is important in regulating the processes of growth, leaf fall, fruiting, flowering, reproduction and dormancy.

# What are the interrelationships between trees and environmental factors?

- ◆ The quality, intensity, and duration of light affect the photosynthetic process.
- ◆ The light received by the understory, trees growing beneath the canopies of the tallest trees, is quite different in color and intensity from the light the overstory, upper canopy trees, is exposed.

# What are the interrelationships between trees and environmental factors?

- ◆ Photoperiod or day length influences diameter growth of trees and the time of flushing or new growth in the spring and the beginning of dormancy and defoliation in the fall.



# What are the interrelationships between trees and environmental factors?

- ◆ Trees and other plants change physiologically in order to better tolerate and/or resist the extremes of environmental conditions.
- ◆ This change to tolerate environmental conditions is known as the hardening-off process.

# What are the interrelationships between trees and environmental factors?

- ◆ Air is the principal source of carbon dioxide required for photosynthesis and oxygen used for respiration.

# What are the interrelationships between trees and environmental factors?

- ◆ Of the environmental factors that influence the growth of trees, moisture is the most limiting element.

# What are the interrelationships between trees and environmental factors?

- ◆ There is a wide range of annual precipitation in the forested areas around the world.
- ◆ Silvicultural methods retain more of the moisture available to the tree crop and generally increase tree growth more than any other practice that can alter tree growth.

# What are the interrelationships between trees and environmental factors?

- ◆ Soil directly affects a tree by anchoring it and by serving as a growth medium.
- ◆ Besides being a reservoir for moisture, the soil provides all the essential elements for tree growth.
- ◆ Soil characteristics, organic matter, texture, structure, chemical composition, depth, and position, influence tree growth by affecting the supply of available moisture and nutrients to the tree.

# What are the interrelationships between trees and environmental factors?

- ◆ Certain biological factors affect tree growth.
- ◆ In combination with the physical factors, they make up the total forest environment.
- ◆ Biological factors may occur within trees, inherent or genetic considerations, or between trees.

# What are the interrelationships between trees and environmental factors?

- ◆ The biological factors include the interaction between plants, animals that use the forest for food and cover.
- ◆ Examples are small animal life, fungi and microorganisms in the soil.

# What are the interrelationships between trees and environmental factors?

- ◆ Reproduction is a vital process of every self-perpetuating tree species; however, the reproductive habits vary widely between trees.
- ◆ Seed formation depends on the amount of reserve carbohydrates and nitrogenous materials in the tree.
- ◆ The amount of seed formation varies by species and certain climatic factors.

# What are the interrelationships between trees and environmental factors?

- ◆ A timber tree normally directs a maximum of growth energy into the development and maintenance of one main stem or bole.
- ◆ Deviations from this typical tree form may cause a tree to take on the form of a bush or shrub.

# What are the interrelationships between trees and environmental factors?

- ◆ Many tree species assume the form of a tall, pipe-like bole in moist, fertile soils but become shrub-like on dry, windy sites.
- ◆ Variations in tree form also occur when certain trees are overtapped by others in a forest stand.

# What are the interrelationships between trees and environmental factors?

- ◆ A silvical factor related to form is a tree's tolerance or its ability to withstand unfavorable conditions.
- ◆ Light is a major factor commonly associated with the tolerance of a tree, and tree species are often grouped or classified based on their tolerance or intolerance to shade.

# What are the interrelationships between trees and environmental factors?

- ◆ Root growth is related to the inherited characteristics of a tree and root development varies considerably from species to species.
- ◆ Root systems are adaptive and tend to modify themselves to suit the environmental conditions in which they grow.

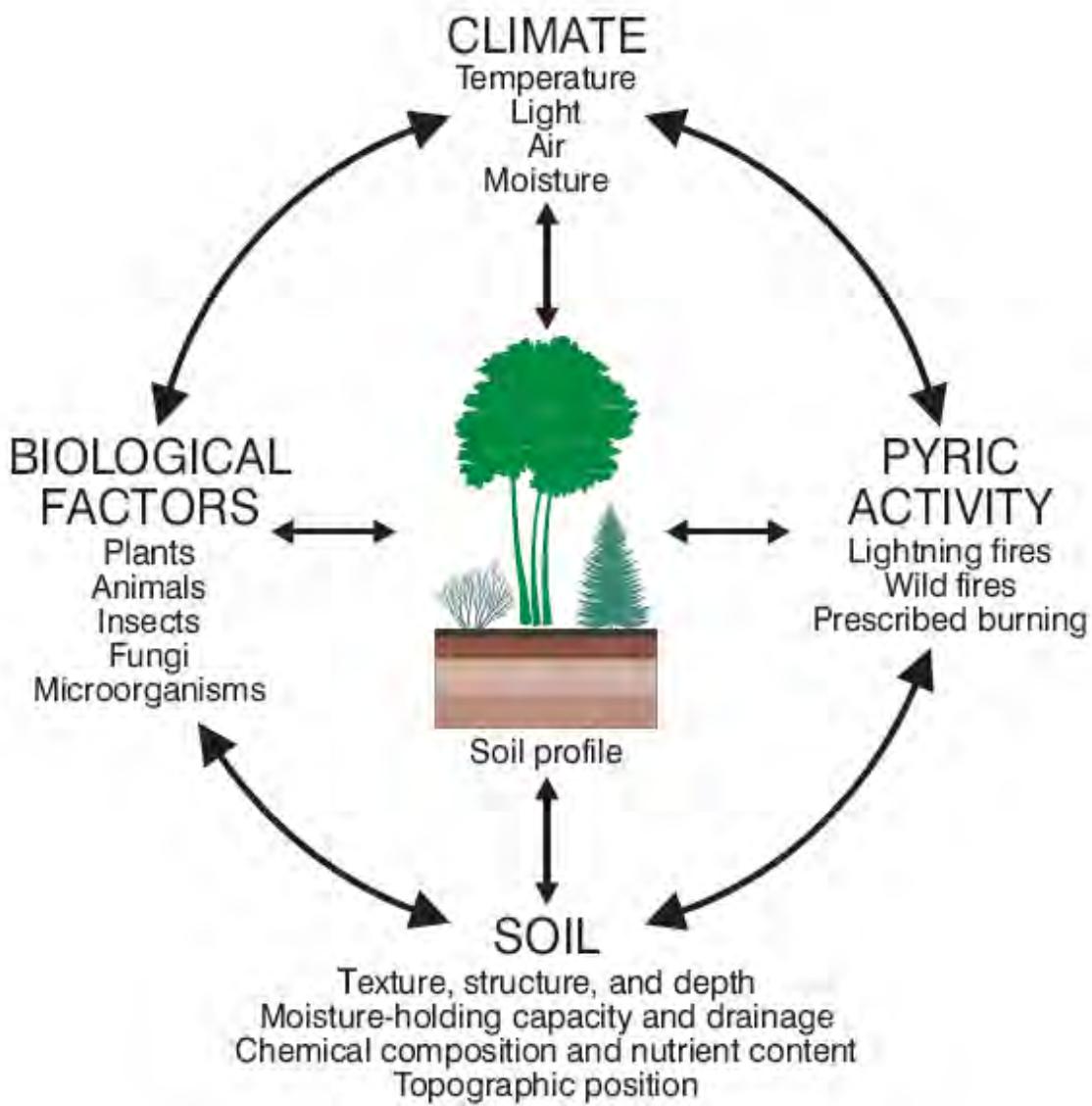
# What are the interrelationships between trees and environmental factors?

- ◆ The presence of certain soil fungi is essential for the successful growth of many tree species.
- ◆ Mycorrhizae are certain soil fungi that enable trees to more fully utilize water, minerals, and nitrogen in the soil.

# What are the interrelationships between trees and environmental factors?

- ◆ The hardiness of a tree is its ability to resist heat, cold, droughts, insect infestations, disease attacks, and other elements limiting survival and growth.
- ◆ Hardiness differs between species and between individual trees within a species.
- ◆ Hardiness is important when considering the planting of a species in an area where it normally does not grow or where it is not native.

# ECOSYSTEMS



# Review / Summary

- ◆ 1. Define forest ecology.
- ◆ 2. Identify the components of forest ecosystems.
- ◆ 3. Explain the processes and relationships of natural ecosystems.
- ◆ 4. Describe the interrelationships between trees and environmental factors.