

Ecology, Ecosystems, & You!

Forest Ecology For 4-H'ers

The term *ecology* comes from the combination of two Greek words: *oikos* meaning “home” and *logos* meaning “the study of.” So, the word *ecology* means “the study of home.” You can think of a home as the place that meets your needs.

This publication will provide you with a basic understanding of forest ecology or the study of the forest home. As you discover more about forest ecology, you will also learn that ecology is a science. You will gain an understanding of the concept and components (parts) of the ecosystem and, in the process, come to understand how complex a forest is. Finally, we will talk about how humans are part of the forest ecosystem.

At the most basic level, home is the structure (house, apartment, condo) in which we live. This home provides us with a sense of security and a place to eat, sleep, bathe, play, and relax. If a friend at school asks, “Where is your home?” this is the place you will describe.

Where Is Your Home?

At another level our home is the town or city in which we live. This home provides us with friends and neighbors, the grocery store, the school, the bank, and other essentials of life. If someone in a neighboring community asks, “Where is your



home?” you will probably give the name of your town or city.

Taking the concept of home further, when we travel to other states and someone asks where our home is we automatically say, “Alabama,” not “Opelika” or “Robin Street.” If we go out of the country and someone asks the same question we will probably say, “My home is the United States” rather than “Alabama.” When we are thinking about the entire universe, we say our home is the planet Earth.

All of these definitions of home are correct and illustrate that the answer to the question “Where is your home?” depends on where you are and what you

are doing when asked that question.

One reason for this “hierarchy of home” is that we have connections with other places. Our food comes from many locations. We have relatives and friends in other cities, states, or countries. We vacation in faraway places. We routinely watch the news about other places that we are familiar with.

What Is An Ecosystem?

We often hear the term *ecosystem*, but when asked, many people cannot say exactly what the word means. If you think about the ecosystem of a plant or animal in the same way you think about your home, it is easier to grasp this concept. An ecosystem consists of the plants, animals,

and physical environment within a particular location and the interactions these components have with each other.

What confuses some people is that, much like our home, there are no set boundaries for an ecosystem. An ecosystem can be any size depending on the questions asked and the particular situation. For example, if you are interested in a small frog found only in the ponds of one small area of Alabama, you will define the ecosystem of the frog as those ponds. If, on the other hand, you are interested in the conditions of the water within the ponds, you will define the ecosystem as the ponds and land area which feeds water into the ponds.

Often an ecosystem is defined by a physical boundary—an aquatic ecosystem may be defined by the edge of a lake, a forest ecosystem may end where the forest changes to grassland. The important point to remember about an ecosystem is that it encompasses all of the plants, animals, and physical conditions within the given area.

The study of an ecosystem involves the observation of how organisms within that ecosystem interact with each other and with their physical environment.

Forest Ecosystems

The term *forest* brings an image to most people, an image usually dominated by trees. However, it is important to realize that a forest is much more than just trees.

In fact, a forest is a complex biological and physical system—an ecosystem. A forest ecosystem includes the

- climate (temperature and rainfall) the plants and animals are living in;
- soils (including the organisms in the soils) trees are growing in ;

- plants (non-woody and woody) growing in the forest ;
- animals (including humans) living in or visiting the forest.

All of these components—climate, soils, plants, and animals—interact with each other and exert an influence on each other.

Components Of The Forest Ecosystem

Climate

The climate of a forest depends to a large degree on geographic location. Forests in the northern United States experience longer, colder winters than do those in the South. Many forests in the western United States receive less rainfall than those in the Southeast.

Climatic conditions affect the plant and animal species found within a forest, the growth rate of vegetation, and the recycling rate of organic matter.

Plants that grow in areas prone to drought are different than the plants that grow in areas which experience regular flooding. Dry regions often experience fire at frequent intervals. Many plant species growing in these environments have adaptations that allow them to survive. For example, some tree species in areas that frequently burn produce seeds that require exposure to fire before they will germinate. Some plants growing in areas which experience frequent floods produce seeds which float.

The presence of a forest affects climate at the local level. For instance, forest vegetation shades the forest floor. This reduces soil and water temperature in the summer and can reduce the amount of water lost from the soil by evaporation. Houses surrounded by trees are cooler in the summer and warmer in the winter because of the insulation provided by the trees and the protection

from wind that a stand of trees can offer.

Rain is intercepted by forest vegetation before it hits the soil surface. Rain drips off the vegetation and hits the soil surface more gently. Once the rain contacts the forest floor, the litter layer absorbs some of the moisture and slows down the rest as it moves into the soil.

Forest Soils

Forest soils provide the surface in which a forest grows. Soil is something that many people never really think much about. To many people, soil is nothing but dirt.

Soil is an important natural resource on which all living organisms depend. It is a complex mixture of inorganic materials (rocks and minerals), organic matter (materials produced by plants and animals), burrowing animals, soil microorganisms, water, oxygen, and other gases. The type and condition of soil in an area plays a major role in determining which species of plants occur in a forest.

Litter Layer

Forests usually have a litter layer on top of the soil. The litter layer consists of leaves, twigs, other plant materials, and animal wastes (organic matter) that have fallen onto the soil surface. Over time, microorganisms decompose organic matter so that it eventually becomes part of the soil.

Organic matter helps to return nutrients to the soil, keeps the soil surface cool in the summer and warm in the winter, slows down the loss of soil water due to evaporation, and helps to control erosion by slowing the movement of surface water across soils. In this way, the forest vegetation eventually alters the soil environment on which it is growing.

Texture And Pore Space

Soils have both texture and pore space. The texture of a soil and the amount of pore space directly affect the plant species growing on the soil and the animal species living in the soil. Texture, which is determined by the size of individual soil particles (sand, silt, clay), affects soil drainage.

It is difficult to imagine that soils actually have air spaces or pores within them, but they do. The size of soil particles determines how much pore space—actual space within the soil occupied by water or air—is present in the soil. Soils that have a lot of sand in them have large pores. These soils drain quickly and can become quite dry if rainfall is infrequent. Soils that contain a lot of clay have small pores and usually drain very slowly. These soils can become waterlogged if there is a lot of rain.

Structure

Soil texture and pore space influence the structure of a soil. Soil structure is determined by the clumping together of individual soil particles and is a result of physical, chemical and, often, biological processes which occur within the soil.

Roots break up the soil as they grow; organic matter helps the soil retain moisture; and soil organisms decompose organic matter and recycle nutrients resulting in a richer soil. Burrowing animals help to break up and aerate soil.

Human activities can also affect soil structure. Movement of vehicles over a wet soil will break down soil structure and create a “soup.” When dried, most of the pore spaces are filled with small soil particles. Frequent movement of vehicles over a dry soil will also eventually compact the soil and decrease the amount of pore space present. Soils without much

pore space are dense. They have very little room for soil oxygen, absorb less water, and are more difficult for burrowing animals and roots to get through. Plants do not grow as well in compacted soil.

Living Organisms

Soils contain a variety of living organisms including bacteria, fungi, roots, and soil animals such as mites, earthworms, snails, and insects. The bacteria and fungi break down organic matter and help return nutrients to the soil (nutrient recycling). As roots grow through the soil, they break up the soil mass. Roots contribute organic matter to the soil when they die. As the roots decay, the tunnels where the roots once grew allow water to move through the soil more easily.

Some soil animals feed on organic matter and others feed on living organisms in the soil. Animal burrows allow air into the soil. The feces and remains of soil organisms contribute additional organic matter to the soil.

Plants

The trees are the most obvious part of the forest. However, it is important to remember that forests consist of trees of all ages (seedlings, saplings, adults) as well as woody shrubs, herbaceous (non-woody) plants, vines, mosses, and algae.

Photosynthesis

Plants are essential to the survival of all animal species. Plants harvest the energy of the sun and convert it into sugars through the process of photosynthesis. The sugars produced by the plants are an energy source used by the plants themselves and by herbivores, animals which eat plants. Plants are called autotrophs because they produce their own food.

During photosynthesis plants take up carbon dioxide and emit oxygen. Without this fundamental reaction, life as we know it would not be possible.

Layers of Plants

Within the forest, plants exist in a hierarchy—from the tallest tree down to the smallest moss. The tallest trees make up the forest canopy and receive the most sunlight.

There may be a shorter subcanopy which consists of younger or more shade-tolerant trees and large shrubs. The plants in the subcanopy receive less sunlight than the canopy trees.

There may be a shrub layer below this subcanopy and an herbaceous layer below the shrub layer. Mosses may grow on the forest floor. Each of these layers has openings in them which allow light to penetrate deeper into the forest.

If a species cannot grow in the shade, its seedlings will not survive unless an opening in the forest canopy occurs. Storms often create openings big enough to allow full sunlight to reach the forest floor. Species requiring high light levels for successful growth can survive when this happens.

Competition And Change

Forest plants compete with each other for space, light, water, and soil nutrients. They may face herbivory (being eaten by animals), disease, insect infestations, storms, droughts, or floods. The species found in a forest at any one time are the species that have successfully competed for resources. They adapted to conditions that other species found unsuitable.

Forests are constantly changing. Given time, trees grow larger. Eventually they die and are replaced by younger trees. Climatic conditions, humans, and disease

can have a significant impact on the appearance and function of forest ecosystems.

Forest species composition can change dramatically with time because of changes brought about by the growth of vegetation. Light levels reaching the forest floor decrease as trees become larger. Soil nutrient levels may change as time passes. The thickness of the litter layer may affect the ability of some species to become established. Ecologists are interested in learning how to predict changes, determining the consequences of these changes, and projecting what will happen if humans interrupt some of these processes.

Animals

A large variety of animals live in or use forests. These animals range in size from microscopic mites to large mammals such as bears. Animals which inhabit forests may make their homes in burrows, caves, tree cavities, nests, or other shelters.

Types Of Animals

Some animals, such as fleas (parasites), live and feed on living animals. Others (decomposers) feed on dead plant or animal material on or in the soil. Some animals (herbivores) eat only plants, while others (carnivores) eat only animals. Another group (omnivores) will eat both plants and animals. As you can see, the animal community of a forest is diverse and complex.

Shelter

Some animals can alter the environment in order to create a "home" which meets their requirements. Some birds build nests or peck out cavities in trees. Rodents may collect straw and other insulating material to make their dens warmer. Many also store seeds and other foods for winter. Beavers harvest trees and

build dams in order to create the type of environment they need for survival.

Many activities of animals help spread the seeds of forest plant species. This eventually has an impact on the species composition of a forest.

Humans And The Ecosystem

Humans—you and I—are also members of ecosystems. We don't just live in ecosystems, we are important parts of these systems. Like other animals, humans consume ecosystem products such as oxygen, water, plants, animals, and mineral resources. Humans also contribute waste products to the system including carbon dioxide and polluted air and water.

More than any other animals, humans have the capacity to alter ecosystems. Our everyday decisions about food, transportation, what and how much we buy and use, and how we dispose of it when we're through—each of these decisions decreases the resources and increases the waste load of the ecosystem. Obviously, as the human population grows, the impacts on our planet's ecosystems grow. The magnitude of human impact, and the importance of healthy ecosystems to human life, make it essential that we understand our role as ecosystem members. Ecology—the study of our home—seeks answers to questions about how our home works, and provides important home repair information.

Ecology And You

Ecology is the science concerned with living organisms and their relationships to their physical environment and to the other organisms with which they interact. Put another way, ecology is the study of our home—the Earth. Ecologists (people who study ecology) provide information about the world in which we live.

Society uses the information provided by ecologists to establish rules concerning the use of our natural resources. The way in which ecological information is used is most often determined by non-scientists. Although the forest is a very complex ecosystem with a great many parts, this publication should give you the beginnings of a basic understanding of forest ecology. This knowledge will help you to evaluate current and future public policy decisions impacting our forest ecosystem.

If you would like to learn more about ecology in general or forest ecology in particular, look for books on these topics at your local or school library.

You can also contact Kathryn Flynn for further information by calling 334-844-1036 or writing to 108 M. White Smith Hall, School of Forestry, Auburn University, AL 36849.



This publication was prepared by Kathryn M. Flynn, *Extension Forester*, Assistant Professor, and John C. Bliss, *Extension Forester*, Associate Professor, both in Forestry at Auburn University.

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