

## EASTERN FOREST

### **Intent:**

To depict the ecology of the deciduous forest, some of the diverse areas within the great eastern forest, and how its life forms adapt and interrelate.

### **Content:**

Eastward from the Mississippi River to the Atlantic Coast, the great eastern forests once canopied the land in an almost unbroken stretch. The vastness and character of the forests that were first seen by the European explorers have changed drastically in the last four centuries.

Although very few areas today can boast of a pristine forest, the flora of the Great Smokies has remained relatively unscathed. Inaccessibility has permitted these forests to remain the last area of extensive virgin timber in the east. The Smokies is considered a water forest; its western slopes have higher precipitation than any place in mainland United States except for the Pacific Northwest. The forest is of great antiquity with a lineage that goes beyond the ice ages since glaciers did not reach this far south.

The region's temperate climate and rich soil are the basis for a deciduous (broadleaf) forest; wildflowers abound throughout the area, and conifers thrive in isolated areas of poor soil. The broadleaf forest is a community composed of millions of living things in the ground, in the air, among the leaves and branches, and in ponds and streams.

The most conspicuous plants in the forest are the trees. Trees are defined as woody plants, twelve or more feet tall with a single main stem, or trunk, and a more or less distinct crown of leaves. Broadleaf trees are also known as deciduous trees, meaning that they lose their leaves in autumn. The broadleaf forest is made up of many microhabitats (small living places) within the large forest habitat. Some of these living places are found in the layers of vegetation.

The **canopy** is the leafy crown of the forest's tallest trees. Most of the photosynthesis takes place in this area. The upper side of the canopy is not a good place for animals as it is a world of extremes, intense sun, violent wind and rain. The area just below the top surface is more suitable for animal life and there is plentiful food. The thousands of leaf-eating insects and insect-eating birds live here, along with predatory insects. Squirrels and porcupines are adapted for life under the canopy.

Smaller trees make up the next layer, called the **understory**. They may be young trees of the same type as the canopy trees or they may be different species. Songbirds and flying squirrels make their nests in the understory.

The **shrub layer** is made up of woody plants with several stems. This level rarely rises above six or seven feet and provides protective cover for small animals such as shrews, deer mice and chipmunks. Some songbirds nest in the thickets and ground nesting species such as grouse and ovenbirds nest beneath the branches. The berries and seeds of shrubs are a good source of food for many animals.

The **herb layer** is next. Herbs are any green plant with a soft rather than a woody stem. Wild flowers, grasses, ferns, mosses and mushrooms are part of the herb layer. This layer is most conspicuous in the spring when the wild flowers are in bloom. Mice, insects, snakes, turtles, toads, hermit thrushes, bobcats, foxes and other creatures inhabit the herb layer.

The **forest floor** is the wastebasket. A steady rain of material accumulates during the year, including leaves, petals, seeds, twigs, limbs, tree trunks, feathers, fur, animal carcasses and feces. Most of the life is microscopic, which is involved in the process of decomposition, and therefore, recycling the wealth of energy and organic substances. Earthworms, ants, spiders and mites also live here.

The **soil** shelters more life than can be found in any other stratum of the forest. In a small section of forest soil, various creatures such as mites, springtails, millipedes and adult beetles can be found. Earthworms are particularly important because they literally eat the earth, leaving casts that help create a rich growing medium. There are also millions of bacteria, fungi, protozoa and algae. The soil consists in a number of layers called horizons. The topmost layer consists usually of dark topsoil, a mixture of plant roots and decaying matter. Beneath this is the subsoil horizon, usually containing small pebbles and stones. It is drier, lighter in color with fewer roots, and gritty to the touch. The lower most horizon is composed primarily of the chunks of rock that underlie the true soil. The moderate climate and abundant moisture of the deciduous forest aid in rapid decomposition of organic matter.

In the fall, the process of shutting down the trees' waterworks creates the magnificent colorings of fall foliage. This display is restricted largely to temperate deciduous woods. The process of dropping leaves is an adaptation for the drought of winter. By shearing off their broad leaves, trees can better preserve the supplies of moisture contained in the cells of root, trunk, and branches before the ground freezes. The brilliant colors of fall foliage are due partly to the production of certain pigments, while others are simply unmasked due to the lack of chlorophyll in the leaves.

Although seemingly bare and lifeless in winter, the forest is only dormant, and several life forms are active amid the cold and snow. The trees may be bare, but next year's leaves are already perfectly formed, tightly wrapped inside the bud scales. Several bird and mammal species are active and even snow lice appear

on warm days, when the snow is thawing, to feed upon microscopic life on its surface.

Land features vary considerably throughout the expanse of the eastern forests. The Great Lakes lie to the north at the junction of deciduous forest and coniferous forest. In preglacial time, the sites of the present lakes were valleys or lowlands. Several factors influenced the evolution of the Great Lakes, including the advance and retreat of glaciers. A succession of lakes formed south of the ice front of the late Wisconsin glaciation. In the last 20,000 years or so, an important factor in shaping the lakes and the courses of their outlets was the gradual rise of the crust as the load of ice was released. Many technological means have been used to determine the age and character of the Great Lakes at varying intervals. One of these, age determination of seed pollens taken from core samples, has advanced our knowledge about climate changes in response to the advancing or receding ice sheets.

### **EASTERN FOREST ANIMAL LIFE**

**Raccoon:** For its size, the raccoon possesses great strength and intelligence. Many a pack of hunting dogs has felt the intensive wrath of this tough fighter. Raccoons eat almost anything and they are inclined to gluttony at times! Their habit of washing food has been attributed to several reasons. One theory holds that the washing process increases the paws' sensitivity in determining the nature and quality of a potential food item. Raccoons remain inactive in their dens during very cold weather, but do not undergo a true period of hibernation. In the 19th century, more than one million coons were killed each year for their thick, long and durable fur.

**Great horned owl:** The tiger of the air, the great horned owl is a fantastic flying machine and deadly hunter. Owing to the muffling effect of specialized feathers, the sweep of its great wings in the silent air is as noiseless as the tread of a tiger's paw upon the soft air. It is considered the fiercest, most aggressive, and most impressive owl of North America. Second only in size to the snowy owl, it is a deadly hunter, combining keenly alert senses (and binocular vision) and an absolute silence in flight with amazing strength and audacity. Possessed of a ravenous appetite, the great horned owl has a willingness to attack nearly any kind of animal as prey as large as a fox or small dog. They can be regarded as beneficial because of the large numbers of rodents that make up much of their diet.

**Opossum:** This animal is North America's only marsupial (pouched mammals, like the kangaroo, the young are born at a very early stage and complete their development inside the pouch). Originally, a native of South America, the opossum invaded the north over a period of thousands of years, and is still successfully spreading its range. This nocturnal, prehensile-tailed animal has succeeded because it eats almost anything, is a prolific breeder, and often escapes harm by feigning death by playing 'possum.

**Striped skunk:** Primarily a creature of the night, the skunk is best known for its chemical warfare. The skunk has the ability to spray its repulsive secretion accurately at the face of an intruder or predator, thereby insuring a measure of protection rarely equaled in the animal world! The skunk is a helpful predator of various rodents. Its pelt is extremely popular in the fur trade. Tremendous numbers of pelts are taken each year.

**Bobcat:** An efficient predator of the nighttime forest setting, the bobcat's diet consists primarily of hares and rabbits. They have been known to feed upon bats in caves, among other things. Widely distributed throughout the United States, the bobcat's status has become imperiled by relentless hunting and trapping in recent years.

**American black bear:** Due to their adaptability and intelligence, black bears are still found in the majority of states. As omnivores, they eat almost anything palatable. Although they mate in June and July, delayed implantation occurs and the blastocysts remain in a dormant stage for five or six months. The cubs are born during winter months when the female is usually in a state of dormancy. The Indians had a great respect for the black bear. Sometimes it was hunted for food and warm bedding, but they were careful to apologize and to speed its spirit to the happy hunting grounds with prayerful chants and propitiatory offerings.

**Whitetail deer:** Although drastically reduced in numbers by the early colonists, the whitetail deer is probably the most abundant large mammal in the United States today. The altered landscape has proven a boon for these animals, since the clearing of forests has provided the tender buds and low growth on which they feed.

**Wild turkey:** Ben Franklin had good grounds for preferring the adoption of the turkey as our national symbol. It is a thoroughly native, useful, and handsome bird. They are woodland birds that like open mixed forests. Roosting at night in trees, they are strong fliers but never fly long distances or migrate. In the spring, each cock tries to attract as many hens as possible through his ostentatious courtship ritual. Once plentiful in New England, the disappearing forests took their toll and the last wild turkey vanished from New England more than a century ago.

**Gray squirrel:** Arboreal acrobats, these well-adapted rodents enjoy a tree-living existence. Their tails provide balance; they have powerful hindquarter muscles for leaping ability, and sharp claws for clinging. Their existence depends upon trees for food, shelter, and avenues of safe transport. In turn, they play an important part in the restoration of forests through their nut-burying activities. In areas where they occur simultaneously with flying squirrels, the diurnal gray squirrels may live in the same tree as their nocturnal counterparts. In response to overpopulation pressures, they have been known to migrate in large numbers

(similar to the lemmings of the north). Through the process of natural selection, they have developed differing color phases in various parts of their range. The Native Americans pursued the gray squirrel for food, roasting it whole. For pioneers, these animals were a significant source of food.

**Songbirds:** The many species of songbirds found in our eastern forest play a vital role in the broadleaf community. They consume insects, recycle organic materials and minerals, and provide a food source for bird and egg eaters. Singing behavior is mainly attributed to territorial defense and attraction of females.

**Reptiles:** The box turtle, a common wayfarer of the eastern forest, remains almost unchanged since the advent of its progenitors millions of years ago. Its hinged plastron and remarkable intelligence help insure its survival. The hognose snake plays possum when threatened. Frogs and toads enrich spring evenings with the din of their mating chorus. Hellbenders, native giants of the salamander group, dwell in cold, fast-moving streams. There is the bullfrog that is found everywhere. King snakes constrict their prey and are immune to rattlesnake venom. There are hosts of rodent-eating, poisonous and harmless snakes. All are an integral part of the forest's life and death.

## **THE MAKING OF A CAVE**

Underground chemical weathering has resulted in numerous sinkholes and caves throughout the eastern forest. In the early stages of cave formation, the water table lies close to the surface of the land. Water that is slightly acid seeps through cracks and crevices, and forms small cavities by dissolving the limestone in the zone beneath the water table. Stream erosion then deepens the valley, allowing underground water to flow faster, thereby enlarging and connecting the cavities. The cave now begins to take shape and sink holes dot the land surface where rainwater drains directly into the limestone. Finally, the water table drops below the cave, leaving it dry. Dripping water deposits new formations in the old cave. More than thousands of years, trickling water deposits minerals on the ceiling (stalactites) and on floors (stalagmites).

## **BIOLOGICAL SIGNIFICANCE OF CAVES**

The specialized fauna of caves illustrates how well species have adapted to a life in the dark. Bats are equipped with echolocation devices. Eyeless cavefish and crayfish monitor their surroundings and search for prey with sensors, stopping often to avoid reaction to their own vibrations. Colorless millipedes, crickets, large-eyed salamanders, and other invertebrates exist in the twilight zone near cave entrances. All represent unique adaptations to a unique environment. This environment is cool and damp, always dark and varies remarkably little.

## **CAVE ECOSYSTEM - PHYSICAL CHARACTERISTICS**

Several specific features characterize the physical environment of a deep cave. The most striking of these is the total absence of light, the generally high and

relatively constant humidity, and the relatively constant temperature. Photosynthesis cannot take place in absolute darkness; therefore, primary producers (green plants) are absent and almost all food energy must be imported from the outside. Terrestrial cave dwellers require moisture to some degree, so dry, dusty caves are as void of animal life as the most inhospitable desert. For these reasons, food and moisture are the factors critical to life in caves.

**Cave zones:** The cave environment is generally divided into two zones: the twilight zone and the total darkness zone.

**Twilight zone:** The twilight zone is the area in and near the entrance where there is enough light to permit vision. This is the only portion of a cave where green plants can grow and they usually consist of species that prefer cool temperatures.

**Total darkness:** Variable temperature; few caves are independent of the effects of climate taking place at the surface. Because of the density gradient between cooler and warmer air, temperate-zone caves commonly breathe with dense, cooler cave air flowing out of entrances in summer and outside air flowing into entrances in winter.

**Constant temperature:** Because of the insulating effect of surrounding rock and soil, the constant temperature zone of a deep cave is the most stable portion of the cave environment, and it is here that most true cave life is found. In most areas of the Eastern Forest, the mean temperature of deep caves is 54°.

## CAVE FORMATIONS

Formations, for the most part, are a result of water seepage into air passages. Many have rather descriptive names and all are quite beautiful.

**Soda straws** are thin-walled hollow tubes. They grow as water runs through their centers and deposits rings of calcite ( $\text{CaCO}_3$ ) around their tips.

**Stalactites** form as mineral layers are deposited by water flowing over the outside of soda straws. They usually form when the centers of the soda straw become plugged.

**Stalagmites** grow up from the floor where mineral laden water drips from above, generally beneath stalactites. In contrast to the pointed tips of the carrot-shaped stalactites, the tops of the stalagmites are blunt and rounded.

**Columns** are formed when stalagmites meet overhanging stalactites, or when a stalactite grows to the floor or a stalagmite to the ceiling. Water flowing down the sides of the column gradually enlarges it by adding layers of flow tone to the surface.

**Draperies** form where beads of water trickle down the undersides of inclined surfaces. As drop after drop flows along the same irregular course, a thin, often translucent sheet of calcium carbonate gradually extends downward, sometimes for several feet.

**Bacon rinds** are draperies with alternating darker and lighter bands. These bands are the result of variations in the mineral content of the trickling water.

**Rimstone dams** often create step-like terraces along streams and on cave floors. Although only inches high, they occasionally build to heights of several feet and enclose sizable pools of water. Calcite is deposited when water loses carbon dioxide as it flows over the lips of the dam.

**Flowstone** forms where films of water flow over walls, floors and formations depositing sheets of calcium carbonate like icing.

**Helictites** are small, twisted structures that grow from walls, floors, ceilings and other formations. The contorted forms result from water seepage so slowly through minute central canals that calcite crystals form in irregular positions at the tips.

**Gypsum flowers** are formed on the walls of many drier caves. They grow from their bases instead of their tips. Each petal is pushed outward sometimes a foot or more as new crystals form at the bottom.

**Dogtooth calcite** crystals form in flooded chambers. The growth rate of cave formations is variable. Many, depending upon the evaporation of a single drop of mineral laden water in 100% humidity, grow no more than 1 inch per 100 years. Others, flowstone, for example, may deposit several inches of layers in a much shorter time.

## **CAVE DWELLERS**

Representative species of cave entrance flora might be columbine, catchfly and jewelweed. Shade tolerant ferns are found within the cave entrance:

Spleenworts, filmy fern, and maidenhair fern are examples. Within the entrance, the light intensity is only sufficient for mosses, liverworts and algae. As the light levels diminish to darkness, no green plants can survive. Often tucked into the twilight zone we find phoebe nests. These nests are begun in early spring and by midsummer are abandoned.

**Indiana Bat:** Many species of bats hibernate in caves and the Indiana bat is one of these. Just prior to hibernation, these bats engage in a feeding frenzy to build up a reserve of winter fat. As they prepare for hibernation, they roost in warmer parts of the cave. They form large clusters. As fall progresses to winter, the bats move down a temperature gradient and begin to congregate at the wintering site in colder parts of the cave. When the temperatures drop below freezing, the bat increases its metabolism sufficiently to maintain its temperature a few degrees above that of the environment.

**Blind Cavefish and Spring Fish:** The blind cavefish is well adapted for a life in permanent darkness. Its sensitive lateral line organs enable it to locate prey. Its gentle swimming stroke allows it to approach prey undetected. It has an efficient stroke and does not swim randomly. The spring fish is a surface form with normal sight and locomotion, but is capable of living in caves for extended periods of time when food is abundant. The spring fish swims, rests, and swims again with short or effective fin strokes.

**Grotto Salamander:** The grotto salamander was the first cave-dwelling amphibian found in America. The larval form of the grotto salamander is aquatic

and possesses gills. As it matures, it metamorphoses into the adult stage, loses its gills, and becomes a blind adult that is terrestrial in its habit. These salamanders do quite well in bat caves, where they feed upon isopods, flatworms, and other species that feed in turn upon bat guano. When food is in plentiful supply, the grotto salamander completes its entire life cycle in the cave. When food is sparse, the larva travels to the twilight zone or even outside the cave in order to feed.

**Cave Salamander:** The cave salamander is commonly found in the twilight zone. This species is nocturnal in habit, and possesses a prehensile tail, which may be used for total body support at times. When disturbed, they leap wildly, several inches at least, and show much agility in their escape attempts. The aquatic larva move into the cave streams when rimstone pools begin to overflow during winter rains, and spend the remainder of their larval life here. They metamorphose to adults when about two inches in length, losing their gills and developing the characteristic color of this species.

**Crayfish:** Crayfish as a group are preadapted to a cave existence; they have slimmer bodies and longer legs and antennae than surface crayfish, and are mostly unpigmented and blind. They possess the sensory organs and metabolic economy necessary for survival in the cave. Cave forms rely upon chemosensors to locate food, and they often live nearly twice as long as their surface.

**Cave crickets:** Energy sources for caves are primarily from surface organic debris, washed into the cave by flooding, and from guano that is deposited by animals seeking refuge in the cave. The cave cricket is one such animal, roosting on cave ceilings during the day but emerging at night to feed on ants, millipedes, and other forest floor arthropods.

## **VERTEBRATE FOSSILS**

Many vertebrates used caves for shelters, lived there and died there. Several excavations of the ground sloth, *Megalonyx jeffersonii*, have been made from subterranean pits in cave floors, indicating that the sloth may have wandered into the pit by accident and could not climb free.

## **CAVE ARCHAEOLOGY**

Caves have been used by many cultures dating back to the archaic people and probably the Paleo-Indians. There is evidence that caves were used for shelter, periodic community latrines and burial sites, and as sources of certain minerals. The search for minerals led to deep exploration of caves. Woodland people were the first to venture into these depths, with illumination provided by cane torches. They were probably in search of mirabolite and epsomite for medicinal purposes and tons of gypsum for unknown reasons. There is speculation that gypsum was traded extensively.

The mummy of a prehistoric miner, who lived about 400 BC, was discovered in Mammoth Cave. The miner, an adult male, approximately 45 years of age, was killed by a rock fall. At the time of his death, he had a twined bag full of gypsum. So well preserved was the mummy that its stomach and intestinal contents could be analyzed.

### **EASTERN FOREST INDIAN CULTURES - A PROFUSION OF MOUNDS**

The abundance of game food and furs, the richness of the soil, and the plentitude of waterways for transportation gave rise to a variety of successive Indian cultures in this region. Few seemed to benefit so well from this natural abundance as the mound-building cultures that developed an extensive and sophisticated society between the time of Christ and the coming of Columbus.

Mound building was a custom of tribes who planted settlements along the Mississippi and its far-flung tributaries. Some of the mounds were raised over the graves of rulers. Some covered the burials of many people, forming vast cemeteries. Strangest of the mounds were the effigy mounds, shaped like birds, beasts and man. The most famous of these is the Great Serpent Mound, 1,254 feet long, of the Adena culture in Ohio. Some mounds towered eighty feet high and must have required endless chains of workmen carrying baskets and skins filled with earth to the chosen sites, over a long period of time. Some settlements had only one high place and others might have had a number of them.

The enormous mounds tell us that there must have been some form of government powerful enough to direct the cooperative work of large numbers of people. Indeed, some kind of federated government would be necessary to maintain peace and encourage trade among the various tribes over large areas. A far-flung network of commerce spread over the country long before the white man's arrival. Indians of the Hopewell culture shared their progressive art and their desirable possessions with tribes hundreds of miles away from their own prosperous Ohio Valley settlements. Copper artifacts unearthed in Louisiana and Georgia, with the source of their metal undoubtedly the Lake Superior region indicate trade over hundreds or thousands of miles and with no beasts of burden.

The craftwork of some tribes is the most advanced of any that the eastern United States has achieved. There were copper breastplates and helmets, copper anklet bands with an astonishing degree of skilled craftsmanship, gaily colored woven cloth, shining with spangles of mica and freshwater pearls. Thread was obtained from the forest in the form of nettles, rushes, swamp milkweed and other suitable plants. Artists turned out pipes in the Hopewell region in the form of practically every bird and beast of the American forest. Stone frogs, squirrels, crows, raccoons and rabbits perched on the top of platform pipes were sculpted with an artistry that has probably never been surpassed by any people of the Stone Age. Since they weighed up to 18 pounds, they must have been smoked with the bowl resting on the ground. Pottery was made in the form of animal effigy jars. The

principal crops of these wigwam dwellers were corn, beans and squash. Nuts, berries and game, as well as mussels and fish supplemented this diet.

The culture of the mound builders developed out of an archaic period around 1500 BC and received some new stimulus, expressed in fine arts and extensive temple building, around 900 AD. There is some evidence that this stimulus came from the Mexican-Mayan culture of Central America, although it is not clear as yet how this contact came about. City/states flourished in the middle Mississippi area, then came to some unknown end. The progression, then, was from Woodland culture to Mississippian culture to the chiefdoms. The abrupt demise of these cultures is left, for the time being, to historical conjecture. There is still much to be learned from the thousands of mounds scattered over two-thirds of the states, and the unexplained intermingling of artifacts from different areas in individual sites.