



Montclair State University

New Jersey School of Conservation
One Wapalanne Road
Branchville, NJ 07826-5116
973-948-4646
<http://www.csam.montclair.edu/njsoc/>

Natural Areas Inventory: Tillman Ravine

Subject Area: Natural Science

Description:

This session deals with the recognition and assessment of important features in a natural area for the purpose of justifying continued protection of that area and areas like it. Students are bussed to a unique natural area within Stokes Forest called Tillman Ravine. By means of a trail hike through the Ravine, students will learn about unique natural features in the area, geologic formations, transitions in the forest, and the importance of preserving natural features and natural resources in any area.

Objectives:

- 1.) To understand the importance of preserving natural areas.
- 2.) To identify some of the native and invasive plants, trees, vertebrates, and invertebrates.
- 3.) To learn about the geology, climate, and hydrology of the natural area.
- 4.) To learn about succession as a natural process; to learn about vegetative transition zones.
- 5.) To understand the recreational value of visiting natural areas; to recognize human impacts on ecosystems and think about ways to better preserve our environment.

Materials Needed:

Transportation: Tillman Ravine is off campus and requires transportation. Recommended time: minimum of 2 hours (2 1/2 is better), to allow for round-trip travel to and from the Ravine.

Background Information:

Natural areas, as defined by NJSA 13:15.4, are “areas of land or water which have retained their primeval character, although not necessarily completely natural and

undisturbed, or having rare or vanishing species of plant and animal life or having similar features of interest which are worthy of preservation for the use of present and future residents of the State” (Leilich 1986). Such areas are managed to preserve their integrity through limited manipulation.

Tillman Ravine makes up 525 acres in the southwestern portion of Stokes State Forest. It is located along the western face of Kittatinny Mountain. Before the arrival of settlers, the Lenape used Tillman Ravine as a gathering area, since the sound of the many waterfalls could prevent others from listening during important gatherings. The land then belonged to Nicholas Tillman and his wife Lydia Dimon, who are buried in the historic 1800s cemetery at the end of the trail. 235 acres of the area were purchased by the State of New Jersey in 1928 as part of the Stokes State Forest expansion; the additional acreage was purchased through Green Acres Bond monies. The area was designated part of the Natural Areas System in 1978 because “it contained anticline geologic forms, the effects of water erosion on exposed rocks, a near natural habitat, and unusual and outstanding forest types composed of hemlocks, mixed hardwoods and mixed oaks” (Leilich 1986).

Geology and Physiography: The Valley and Ridge Province of New Jersey, in which Tillman Ravine lies, was formed about 550 million years ago. The bedrock of Tillman Ravine, the High Falls Formation or the Bloomsburg Red Bed, was formed about 400 to 350 million years ago, and is made up of red shale; red, green, and olive-colored sandstone; and pea conglomerate. The sediments that make up this formation were eroded from uplifted lands to the northeast, carried northwest by rivers, and deposited along meandering stream courses and alluvial fans, then reworked beneath a shallow sea. About 250 million years ago, the area was subjected to orogenies, or mountain-building events. Such forces folded and faulted the rocks in the area, creating the anticline geologic forms, or convex folds of bedrock material, that the area is known for. Also at outcrops, one can clearly see the stratification of layering of the sandstone beds.

A **ravine** is a landform created by stream erosion. Tillman Brook, which runs from the western slope of Kittatinny Ridge to the Big Flat Brook, is responsible for cutting into the High Falls Formation and eroding the rock there to form Tillman Ravine, which has the lowest elevation in the area. This erosion process began about 10,000 to 12,000 years ago, when the Wisconsin ice sheet began to recede from the area. As the ice sheet withdrew, it left behind glacial till, damming an area with a preexisting depression. Such a swamp was the origin of Tillman Brook. As snow and ice began to melt, water followed weaknesses and fractures in the rock that were caused by folding of bedrock. Tillman Ravine is the product of water eroding rock along such a fracture. Even though the ravine has been eroding for 10,000 years or more, it is still a young formation: a deep, narrow, V-shaped valley. Eventually, this formation will be eroded to a broad, gentle valley, characteristic of a mature stream. The retreating glacier also left behind the soils that make up the natural area. The soils are well-drained stony loams and rock outcrops. The soils are also very acidic, providing resources necessary for the stands of Eastern Hemlock. Because the natural area contains steep slopes and stony soils, it is susceptible to erosion from trail use.

Microclimate and Hydrology: Due to the steep walls of the ravine and the forest canopy cover, sunlight in the natural area is reduced to 20% of total available light. Reduction of sunlight and the cooling effect of the brook result in cooler temperatures in the ravine. Tillman Brook is a tributary of the Big Flat Brook and flows southwest for about 12,000 feet through the natural area. It joins the Big Flat Brook just east of Walpack Center. After summers with little rain, the brook can be very dry from August through November. Throughout its course in the natural area, the brook drops from 1,050 feet above sea level to about 440 feet above sea level.

Procedures:

- 1.) Remind students of rules when entering a natural area: they may not pick, cut, remove, or in any other manner disturb the vegetative and animal life or geological deposits and structures; they may not leave the trail; no picnicking, fires, or camping are permitted in natural areas.
- 2.) Begin the guided hike. Educators can choose to do any variation of the information listed below depending on knowledge and preference of material. The stand of trees when you first enter the trail is a mixture of red and white pine, planted by the Civilian Conservation Corps in 1932. The CCC was a public work relief program that operated as a part of Franklin D. Roosevelt's New Deal program. The red pines are the only unnatural tree species in the area.
- 3.) Leaving the stand of pines, a stand of Eastern Hemlock comes into view. The dense tree crown of this hemlock stand allows little sunlight to enter. Ask students: Can you feel a temperature change? Is it cooler or warmer than in the pine stand? Why? Hemlocks prefer acidic soil and a cool, humid **microclimate**, an area where the climate is different than in surrounding areas. Hemlocks are considered to be at the endpoint of ecological succession. **Succession** is the process by which an ecosystem progresses from one state to another over time. The hemlocks here are up to 46 inches diameter at breast height, over 120 feet high, and over 160 years old. Eastern Hemlocks live in cool, moist areas along streams and the edges of swamps and bogs. They prefer slightly acidic soil, and they make the soil even more acidic when they shed their leaves. The ground beneath the hemlock stand is covered with hemlock needles, and few plants grow there. Tea can be made from Hemlock needles, and this tea contains seven times the amount of Vitamin C as an equal amount of orange juice. Eastern Hemlocks provide shelter for deer, owls, and many other animals. Their cones provide food for many songbirds and red squirrels, and deer eat the leaves. The wood of Hemlocks is soft and hard to use, but it is sometimes used for construction lumber or paper pulp. Today they are often planted as ornamental hedges. During the colonial period, settlers would make brooms out of the branches. The bark of Hemlocks is rich in tannin and was often used for tanning leather hides. Native Americans used the twigs to make tea and for steam baths. Tea from the inner bark was prescribed for colds, fevers, diarrhea, stomach troubles, and scurvy. The bark was also used in poultices to slow bleeding. The Eastern Hemlock is the

state tree of Pennsylvania.

- 4.) Once you pass through this stand of trees, you will reach Tillman Brook. This stream arises from a natural spring 1.5 miles east of the area along the side of the Kittatinny Mountain ridge. The stream erodes the rock here in a down-cutting action along the joints and beds of the red shale.
- 5.) Next along the trail, adjacent to the upper waterfalls, you will see a fold in the rock. This anticline was caused by slippage or pressure. This fold in the rock bed allowed older rock layers to rise to the surface.
- 6.) After crossing the second bridge, you will come upon an abundance of rhododendron plants. There are over 1,000 species of rhododendrons—shrub-like or tree-like woody plants. These are *Rhododendron maximum*, or Great Rhododendron. These rhododendrons are evergreens; like conifers in the area, these plants retain their leaves throughout the winter. To avoid being weighed down by snow, they allow their leaves to curl up so that they are narrow and droop from the stems. They shed their leaves about once every eight years; once they are shed, they take a long time to decompose. The leaves can also be poisonous. These plants, like the hemlocks, prefer acidic soil, and they produce thick, peat-like humus. The sub-canopy that the rhododendrons form is known as a “laurel slick.” The plant produces a showy, white, pink, or light purple flower, primarily in June.
- 7.) After crossing the fourth bridge, you will see evidence of wind-throw damage. There will be fallen trees and an opening in the canopy. This opening allows sunlight to reach the forest floor, aiding seed germination and **secondary succession**. Secondary succession occurs in an area where an event, such as a forest fire, wind damage, or harvesting, has disturbed the ecosystem. After such an event has reduced the number of species in an ecosystem, seeds will begin to germinate again and plants will begin to grow. Secondary succession is faster than primary succession because the soil is already in place and the roots and seeds of many plants already exist in the soil and are quick to regenerate.
- 8.) On the hillside opposite the trail, you will see that the forest floor is covered in ferns. These ferns are in the wood fern family, in which there are over 250 species. Worldwide, there are about 12,000 species of ferns. Ferns reproduce with spores; they do not have seeds or flowers. They mark a significant milestone in plant evolution; ferns first evolved about 360 million years ago, before seed-bearing plants. Ferns can be found in moist, shady forests, like in Stokes; in crevices in rock faces, especially when sheltered from the sun; in acidic wetlands, bogs, and swamps; and as epiphytes on tropical trees. Ferns provide food for both humans and animals. Some species can also remove pollutants from the air and soil.

- 9.) After you cross the fifth bridge, you will see a tall tulip tree, or yellow poplar, recognized by its cat-like leaves, duck-bill shaped buds, and tulip-like flowers. The tulip tree is the tallest of the Eastern hardwood trees. Because they are so tall and straight, they are useful timber products, used for furniture, fruit and vegetable baskets, siding, cabinets, and musical instruments. Early colonists in Virginia introduced the Tulip Tree to Europe because the wood is so valuable. Native Americans often used them to make dugout canoes because the wood is soft and light. To do this, they would cut down the tree, hollow it out using fire and scraping tools, and then shape it using carving tools. Deer eat the sprouts of the tree, and squirrels use the seeds in early fall and mid-winter. Bees make honey from the blossoms of this tree. The Tulip Tree is the state tree of Indiana, Kentucky, and Tennessee.
- 10.) On top of the ridge, you will reach another Eastern Hemlock stand. At this point, you can talk about the Hemlock Woolly Adelgid (HWA), *Adelges tsugae*, an **invasive**, aphid-like insect which feeds off the sap of the tree. The insect was first described in western North America in 1924 and first reported in the eastern United States in 1951 near Richmond, Virginia. Now, the insect can be found from Georgia to Maine. The insect originated in Japan, where trees have built up a resistance to it. The HWA is less than 1/16-inch long and is dark reddish-brown or purplish-black. As it matures, it produces a covering of wool-like wax filaments to protect itself and its eggs from natural enemies and to prevent them from drying out. This “wool” is most conspicuous when the adelgid is mature and laying eggs, and they can be seen from late fall to early summer on the underside of hemlock leaves. The pest affects both the Eastern Hemlock and the Carolina Hemlock. Evidence of the insects’ effects on this forest ecosystem can be seen in the many fallen hemlock trees. Infected hemlocks will die within 4 to 10 years of becoming infected. With the loss of the hemlocks, other tree species such as maple and oak will begin to appear in the ravine. This is a good time to talk about **nonnative** species (such as the honey bee), **invasive** species (such as the HWA), **biological controls** (such as a natural predator of the HWA), and the history of the **American Chestnut** as a point of comparison.
- 11.) Near the bottom of the ravine is a structure commonly known as the Teacup. This structure is a pothole, formed by the swirling motion of sand and rock carried by rapidly moving water. This motion deepens and enlarges the pothole, giving it a circular shape and smooth walls. Eventually, the motion will erode the front wall of the pothole, as in the semi-circle formation just below the Teacup. This is a convenient place to rest, take pictures along the water, and sit on the rocks.

- 12.) The area where the hemlocks and deciduous trees are seen together is called the **transition zone**. This zone is an area of change between one ecosystem and another. Because different trees have different requirements for growth (i.e. the hemlocks grow in acidic soil, while the maple and oak trees do not), they grow in different places. The boundary between the hemlock forest and the deciduous forest marks a difference in physiographic and biological factors that make up the ecosystem.

Wildlife you may see at Tillman Ravine:

Mosses: There are over 12,000 species of moss in the world. They grow close together in clumps or mats in damp or shady locations. They must live in damp places because they have no vascular system to carry water through the plant. They will grow on soil, rocks, trees, and logs. Mosses are usually bright green, although some are very light green, and others are red or brown in color. All mosses have definite stems and simple leaves. Like all green plants, mosses harvest sunlight to produce food through photosynthesis. Mosses have little pods called capsules which produce seed-like bodies called spores. The spores are so tiny that they usually look like fine dust. The spore capsules are often so distinctive that they help to identify the moss. The spores require water to germinate and reproduce.

Lichen: Lichens are symbiotic organisms composed of fungi and algae. The fungi provide a home for the algae, while the algae provide food for the fungi through photosynthesis. The fungi protect the algae by retaining water and capturing mineral nutrients. Both the fungi and algae gain water and mineral nutrients from the atmosphere, through rain and dust. For fungi, this is a very efficient lifestyle, and about 20% of all fungal species have developed this symbiotic relationship. There aren't specific fungi and algae that are exclusively associated with each other; one fungus can be associated with several different algae, and one alga can be associated with several different fungi. Lichens are widespread, and they are indicators of good air quality. They grow in some very extreme environments—arctic tundra, hot deserts, rocky coasts, and toxic slag heaps. However, they are also abundant as epiphytes on leaves and branches in temperate woodland, such as in Stokes; on bare rock, including walls and gravestones; and on exposed soil surfaces. Some lichen look like leaves, others form a crust on a surface, some are gelatinous, and some are shrub-like. Lichen can survive periods of dryness, unlike many other plants. In an experiment, lichen even survived 15 days in space! Lichen provides food for some animals such as reindeer and red squirrels, and they provide nesting material for birds such as hummingbirds. Some human cultures even eat lichen.

Fungi: A fungus is a spore-bearing organism without chlorophyll; they cannot produce their own food. Many fungi get their nourishment from dead, organic material. They are decomposers. Fungi are actually more closely related to animals than to plants! There are an estimated 1.5 million species of fungi. Fungi reproduce via spores, which are abundant in soil, water, and air, and germinate and grow where it is damp enough.

Mushrooms are the fruiting bodies of some fungi, and they hold thousands of tiny spores that will grow into new fungi.

Redback Salamanders: If you flip over some wet logs or stones at Tillman Ravine, you'll be likely to find a Redback Salamander. Redback Salamanders are found from the spring through the fall. They are 2 to 5 inches long. They have both a red phase (with a red stripe down the back) and a lead phase (with a dark gray or black back). They eat invertebrates that dwell in leaf detritus. They breed in June and July, with females laying 4 to 17 eggs in a year.

Timber Rattlesnakes: Northern Timber Rattlesnakes have been spotted at Tillman Ravine, though they are very rarely seen. This venomous snake is endangered in New Jersey due to habitat loss, illegal collecting, and being hit by cars. Timber Rattlesnakes are the only rattlesnakes in New Jersey; they have a strong, triangular head, a characteristic rattle at the end of their tail, and range from yellowish-brown to dark brown to black in color, with V-shaped crossbands. They are found on rocky, wooded ledges, and they are active from May through October.

Wrap-up:

At the conclusion of the trail hike, ask students:

- What natural features did you perceive to be most unique?
- What did you learn during the hike?
- Why is it important to preserve and visit natural areas?
- Why is it important to have unique natural areas like Tillman Ravine in a state like New Jersey?
- What are some of the types of natural features that make your community special or unique?
- Why are open spaces important for communities in New Jersey?

Additional Activities:

This session can be combined with a trip to Sunrise Mountain and/or a cemetery investigation at the historic Tillman Cemetery at the base of the ravine (see Interdisciplinary Population Studies description under the Social Sciences).

Sources:

Leilich, B. L. (1986). *Tillman Ravine Natural Area Management Plan*. Trenton, NJ: New Jersey Department of Environmental Protection: Division of Parks and Forestry.