



Preserving the Battlefield: Forest Ecology Lesson

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Overview

The theme for this week is preserving the battlefield. This goal requires a combination of environmental protection, historical preservation, and community relations. By considering how the landscape of the park and surrounding area has changed over the decades, we can better understand what stressors challenge preserving the battlefield's artifacts and landscape.

Learning Objectives

- YCC precipitants will have a good understanding of the importance of forests
- YCC precipitants will have a general understanding of forest ecosystem disturbances
- YCC precipitants will have a general understanding of forest management practices

Materials Needed

- Two copies of the Map of Forest Conditions at the Monocacy National Battlefield
- Two copies of the Historian Preservationist Factsheet
- Two copies of the Ecosystem Biologist Factsheet
- Two copies of the Environmental Activist Factsheet
- Two copies of the Local Farmer Factsheet
- Two copies of the Logger Association President Factsheet
- Paper and writing utensils

General Outline

- 1. Forest Ecology**
 - a. Importance of Forests*
 - b. Protected vs. Unprotected Forests*
 - c. MONO*
- 2. Disturbances and Management**
 - a. General Disturbances*
 - b. MONO-Specific Disturbances*
 - c. Management Practices*
- 3. Forest Sustainability**
 - a. Activity*

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Background (for park employee benefit)

Certain activities conducted at MONO, like cutting down trees and having on-site farms, may seem counterproductive to outsiders in relation to NPS' mission. However, as a National Historical Park, some environmental sacrifices are necessary for the sake of historic preservation. The balance is complex, and encouraging YCC precipitants to understand its value is key.

Procedure

4. Forest Ecology

a. Importance of Forests¹

- i. Forests provide essential ecosystem services: water purification, groundwater recharge, regional economic benefits, and provide food and habitat for countless organisms
- ii. Healthy forests ensure long-term ecosystem health, maintain biodiversity, and provide a continual supply of environmental services for humans
 1. Services: provide oxygen, store carbon, shade watersheds, purify air and water, improve ground water recharge, protect structures, reduce ambient heat in hot weather, provide wood for goods
- iii. Forests are dynamic ecosystems, they are always changing. They are also highly productive systems, as they can amass large amounts of biomass in animals and plants.
 1. Species make up complex webs of relationships, be it between animals, between plants, or between animals, plants, fungi, and protists. These relationships are ever-changing as species face death, disease, and resource competition, and some become dominant for certain periods of time. Natural and human-driven factors impact these relationships, as floods, droughts, fires, diseases, and deforestation help determine the performance of species.
 2. Dependent relationships exist between biotic and abiotic factors. Living beings (biotic) cannot survive without non-living (abiotic) factors, which in turn benefit from living beings. For example, trees purify water and decomposers return nutrients to the soil. In turn, the presence and health of freshwater and soil are crucial for the survival of all living things.

¹ Miller, K.M., et al. (2016) "National parks in the eastern U.S. harbor important older forest structure compared with matrix forests."

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- iv. On the east coast, forests are largely second-growth forests: they were impacted by logging (or another disturbance) and have since re-grown. This is a stark contrast to forests in the west, which are old-growth and have largely been undisturbed.² East coast forests share similar land-use histories (e.g., logging, clearing for agriculture) prior to the establishment of government protection due to the early history of settlement.
- v. Maryland has over 2.5 million acres of forest, amounting to 41% of Maryland's landmass.
- vi. Video: [Healthy Forests](#)³
- b. *Protected vs. Unprotected Forests*
 - i. In the eyes of the government, forests can have two designations:
 - 1. Protected forests have effective laws that prevent (to varying degrees) resource exploitation. They are often managed by government agencies.
 - 2. Unprotected forests have no regulations that prevent resource exploitation.
 - ii. Maryland has a suite of regulations and incentives to protect forests, such as the Sustainable Forestry Act of 2009, which balances the environmental and economic importance of Maryland's forests. The Maryland Forest Service manages over 214,000 acres of high-quality forestland for conservation, and there are a few federally-managed National Parks.
 - iii. 76% of Maryland's forests are privately owned, and are sometimes subject to the sale of small acreage forest lands for timber harvest.
 - iv. A recent study by the NPS Inventory and Monitoring (I&M) Northeast Temperate Network found that NPS forests support greater diversity of breeding birds and protect rare plant species than the unprotected areas around it, regardless of size.⁴
 - v. This is largely because NPS does not allow commercial timber harvesting, which creates a unique space for natural disturbance regimes. NPS is a leader in conservation by protecting core sites of biodiversity and ecological processes.
 - vi. Protected forests tend to have a greater proportion of:

² Miller, K.M., et al. (2016) "National parks in the eastern U.S. harbor important older forest structure compared with matrix forests."

³ EPA Chesapeake Bay Program. "Bay 101: Healthy Forests"

⁴ Miller, K.M., et al. (2016)

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1. late-successional forest: they have multi-layered tree canopy (the layer where tree crowns are, referring to the height of trees), shade-tolerant tree species, and a high volume of dead wood.
2. coarse woody debris: referring to the accumulation of dead wood, like snags and logs. Many animal species depend on this for habitat and food.
3. live tree basal area: referring to the diameter of a tree trunk at around 4.5 ft above ground. Many species depend on larger-diameter down-logs, which require big live wood in the first place!⁵ This crucial structural component is slow to develop in eastern forests.

c. *MONO*

- i. 4 forest communities have over 500 species of plants over 132 acres.
 1. Mixed oak forests
 2. Beech-maple forests
 3. Edge-type forests
 4. Riparian zone forests
- ii. MONO does not have older forest structure compared with surrounding forests. The park does not have greater live tree basal area or a greater density of large-diameter trees.
- iii. NCR I&M monitors forest vegetation at 15 plots throughout MONO. Trees, shrubs, vines, and specific non-woody plants are identified, and trees are measured and labeled.

5. Disturbances and Management

a. *General Disturbances*

- i. Disturbances are not inherently villainous. Ecosystems rely on the mortality of organisms and changes to their spatial patterns to shape the structure of individual populations and the character of the ecosystem.⁶ Wildland fires, for example, are necessary in Maryland to return nutrients to the soil, maintain open space, and redistribute plant life! Problems arise when humans exceed the disturbance threshold of intensity and frequency that the ecosystem can take, rendering it useless and causing massive die-off events. Some disturbances include:
 1. Logging: cutting down trees to produce lumber and charcoal. Logging decreases the size of the ecosystem, the amount of

⁵ Miller, K.M., et al. (2016)

⁶ Paine, R.T. (2019) "Ecological Disturbance."

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- nutrients available to cycle through. Logging does not always lead to deforestation; sustainable logging is possible.⁷
2. Fires: caused by lightning strikes or human activity. Uncontrolled fires can be heightened during drought events, killing wildlife and destroying the habitat.⁸
 3. Natural disasters: extreme heat, hurricanes, tornadoes, droughts, floods, ice storms, and other events can harm or kill trees, weakening their roots through soil erosion, knocking them down, or breaking too many branches.⁹
 4. Pests: destructive animals that attack plants. For example, the Emerald ash borer is a beetle that has killed over 50 million ash trees in 25 states in the U.S. since being detected in 2002, including Maryland.¹⁰
 5. Invasive species: animals, plants, and pathogen species that, when introduced into an ecosystem by human activity, establish and spread, and cause economic or environmental harm to native organisms or ecosystems. For example, the Garlic mustard spread quickly through upland forest habitats, outcompeted native plants, and confused native butterflies, like the Virginia white butterfly, that lay their eggs in flowers with similar smells, like the native toothworts.¹¹
 6. Land use conversion: completely clearing forested areas for human activities, like livestock grazing, agriculture, mining, urban development, or roads. At the time of European colonization, it is estimated that Maryland was 95% forests. By 1995, this was cut by half. In Maryland, over 40 million acres have been developed.¹²
 7. Habitat fragmentation: disconnected patches of forest land occur when land is cleared, be it by human activity or natural events. Many species require large contiguous forests, and when they are forced to leave their habitats in search of resources, they become increasingly vulnerable to death.¹³

⁷ Maryland Department of Natural Resources. (2015) "State Wildlife Action Plan: Chapter 5."

⁸ *ibid.*

⁹ Maryland Department of Natural Resources. (2015)

¹⁰ *ibid.*

¹¹ *ibid.*

¹² *ibid.*

¹³ *ibid.*

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b. *MONO-Specific Challenges*

- i. Invasive species:¹⁴ Tree of Heaven (*Ailanthus altissima*) grows very quickly and it can out-compete almost all the surrounding native vegetation (high ecological tolerance). This tree releases a chemical into the soil that suppresses growth (allelopathy) preventing germination, reducing general growth, or killing plants within range.
- ii. Historical park:¹⁵ the Monocacy Historic Tree Survey located, marked, and recorded the trees present at the time of the battle, called “Witness Trees”. Some trees outside of this category are cut to maintain the historic accuracy of the landscape at the time of the battle, perpetually reducing the number of trees in specific areas.
- iii. Deer:¹⁶ white-tailed deer populations have increased to the point where they are changing the composition and structure of forests by preferentially feeding on select plant species. Their rise is tied to drastic decrease in recreational hunting. Bobcats, wolves, and coyotes used to be major predators for the species, but their populations have fallen significantly over previous decades, so humans are deer’s only major predator in the area.¹⁷ MONO has more than 60 deer/km²

c. *Management Practices*

- i. Invasive species removal: targeted removal of these species to allow native species to thrive. This can be done mechanically or chemically.
- ii. White-tailed deer population management: keeping deer populations at sustainable levels to prevent them from eating too much of some plants and destroying the habitat.¹⁸ NPS employs professional sharp shooters for this task.
- iii. Prescribed and managed fires: burning specific trees and shrubs to bring back natural ground fire regimes to return nutrients to the soil, maintain open space, and redistribute plant life. Dense forests put too much pressure on the limited resources (soil nutrients, water, sunlight). Previous efforts of fire suppression only intensified the damages caused by fires when they occurred, as the amount of woody materials present increased.

¹⁴ NPS. (2015) “Monocacy: Trees.”

¹⁵ *ibid.*

¹⁶ Pursell, A., et al. (2013) “Too Many Deer: A Bigger Threat to Eastern Forests than Climate Change?”

¹⁷ Chesapeake Bay Program. “White-tailed Deer.”

¹⁸ Anzelmo-Sarles, J. (2014) “Antietam-Manassas-Monocacy Deer Management Plan and EIS”

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- iv. Mechanical thinning: cutting down specific trees for management purposes, including historical preservation. The trees are not always removed from the space; as mentioned, dead wood is a crucial part of the ecosystem.
- v. Protect more areas: increasing the amount of protected forestland is crucial to reducing habitat fragmentation and land use conversion.

6. Forest Sustainability

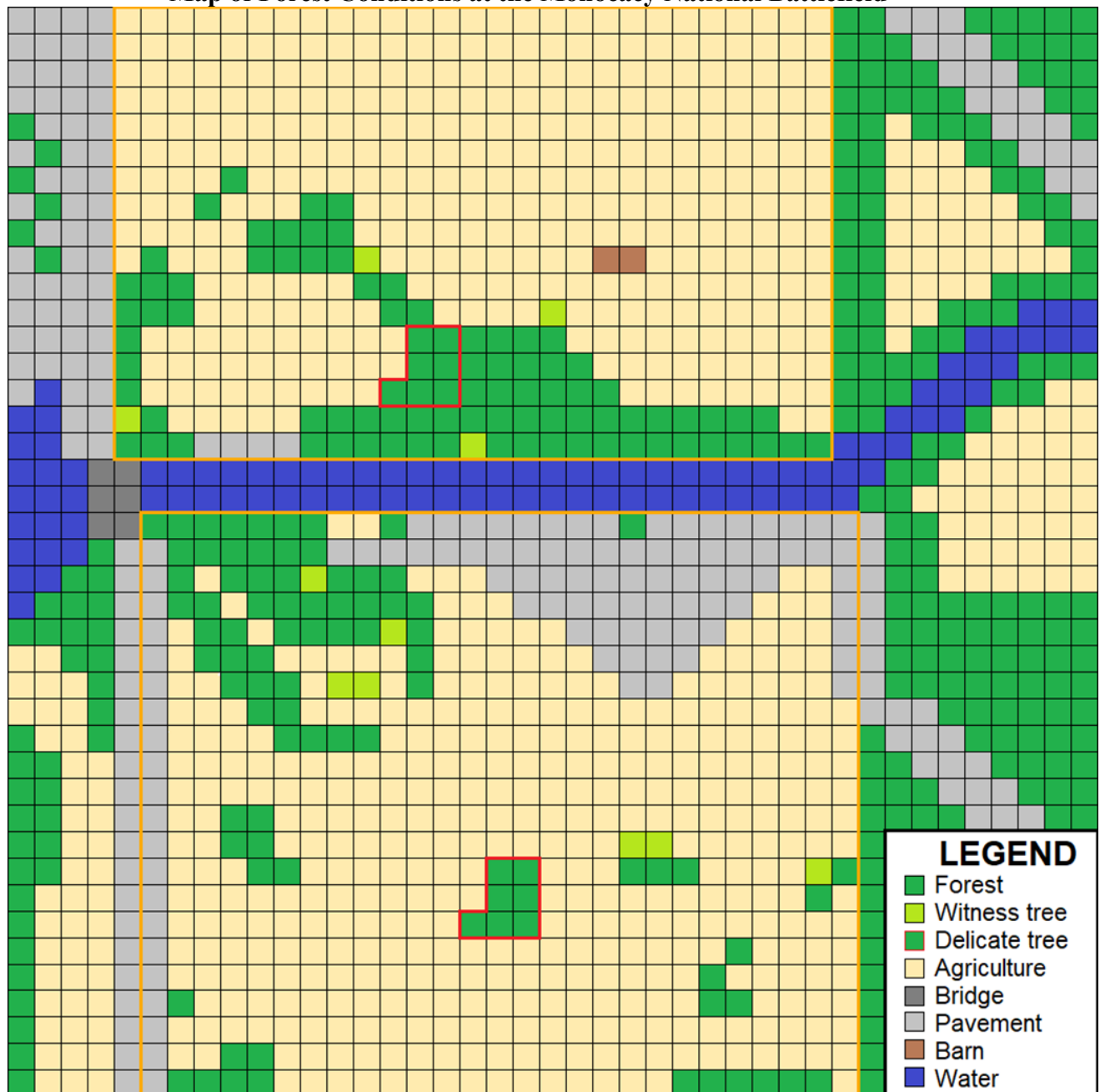
a. Activity

- i. Divide the YCC precipitants into two groups of 3-4. Randomly give each student a copy of a factsheet.
- ii. Tell YCC precipitants: “Your job is to become your character! Choose a name, give yourself some back story, and try to really understand why your character thinks and acts the way they do. To start, individually look at the budget provided and your goals. Try to achieve your goals within the budget, and write down what trees you would remove, cut, or plant.”
- iii. Give the YCC precipitants 5 minutes, or until they are all done, to do this. Bring back their attention and say: “Now, rejoin your group. Regardless of how you personally feel about your character’s priorities, your task is to represent their interests. As a group, reach consensus on which trees to remove, which to cut, and where to plant within the budget given. The goal of this activity is to understand some of the actors that matter in forest conservation, and how achieving a balance is complicated, but necessary.”



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Map of Forest Conditions at the Monocacy National Battlefield



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Historian Preservationist Factsheet

Background: You have spent your entire career researching the American Civil War, and your specialty is the Valley Campaigns of 1864.

MONO Position: As the head of the Cultural and Natural Resource division at Monocacy National Battlefield, you oversee the management, protection, and maintenance of the park's resources to ensure that future generations can continue to enjoy and learn from them.

Priorities:

- You want to keep as many witness trees as possible. These are the trees that were present at the time of the Monocacy Battle.
- At the time of the battle, the barn north of the Monocacy River was a base for Confederate artillery and the sharpshooter that fired at the Union soldiers at the bridge.¹⁹ You would like to cut down some trees to bring back a clear view of the bridge from the barn. Cutting the trees but keeping the wood at the site is not historically accurate.

Budget to consider:

Activity	Cost
Fully remove a plot of trees	\$200
Cut down a plot of trees (keep fallen trees in the forest)	\$100
Plant a plot of trees	\$250
Park's forestry budget	\$3,000

¹⁹ NPS. "Best Farm." (2015)

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Ecosystem Biologist Factsheet

Background: You have a PhD in Forest Ecology, focusing on Maryland forests.

MONO Position: As head of the Resource Protection Division, you oversee the management, protection, and maintenance of all species and ecosystems at MONO for the well-being of the regional environment and visitor experience.

Priorities:

- You want as few trees cut as possible, given the fragility of forests at MONO
- You seek a good balance between live and dead trees, and know that cutting trees but keeping the fallen wood in the forest is helpful for this balance. You are aware of some fragile ecosystems in the park (red outline) that require some dead wood and as many live trees as possible. Planting trees around these ecosystems may also strengthen them.

Budget to consider:

Activity	Cost
Fully remove a plot of trees	\$200
Cut down a plot of trees (keep fallen trees in the forest)	\$100
Plant a plot of trees	\$250
Park's forestry budget	\$3,000

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Environmental Activist Factsheet

Background: You are a sophomore studying Environmental Studies at a local university. You grew up in Frederick, and have volunteered at MONO multiple times.

MONO Position: You do not have an official position within MONO. However, as a recurrent volunteer and active community member, the park's leadership is interested in your input.

Priorities:

- You want as few trees cut as possible! You are highly concerned about the increased rate of urbanization near Frederick
- You want as many trees planted as possible
- You are also concerned about habitat fragmentation, and want to unite forest patches
- You have learned about how trees improve the quality of bodies of water if they are planted by the shoreline

Budget to consider:

Activity	Cost
Fully remove a plot of trees	\$200
Cut down a plot of trees (keep fallen trees in the forest)	\$100
Plant a plot of trees	\$250
Park's forestry budget	\$3,000

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Local Farmer Factsheet

Background: Your family has worked on the Thomas Farm for over a century, and the Thomas family entrusted you to make decisions about the farm. Your farm is south of the Monocacy river.

MONO Position: As the representative of the privately-owned farm within MONO's borders, you have a good relationship with the park's leadership about working towards shared conservation goals.

Priorities:

- You want to clear some trees to extend your farmland to increase yield
- You don't want fallen trees on your farmland, as you can't grow crops there
- The EPA's Chesapeake Bay Program has encouraged you to increase tree cover along the river to improve the water's quality

Budget to consider:

Activity	Cost
Fully remove a plot of trees	\$200
Cut down a plot of trees (keep fallen trees in the forest)	\$100
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