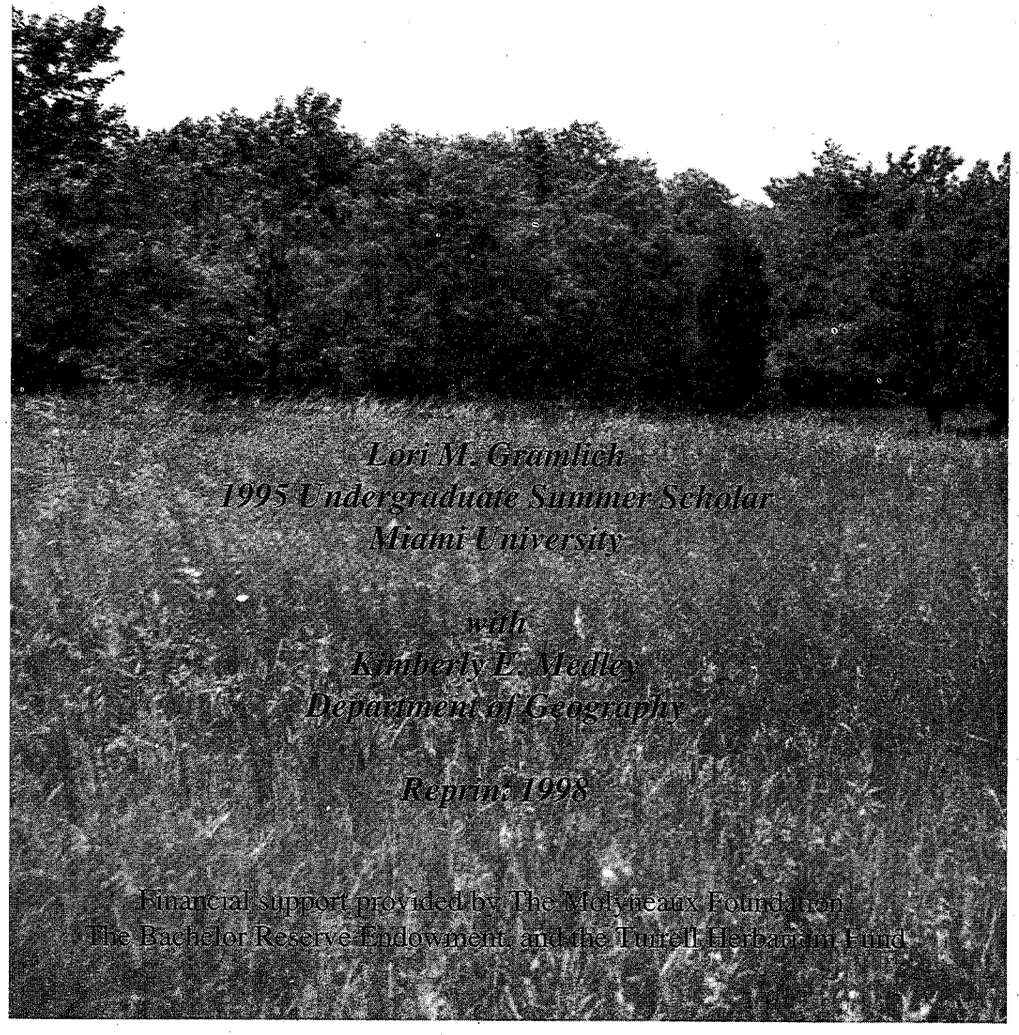
A Landscape Guide to the Bachelor Reserve



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with

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Reprint 1998

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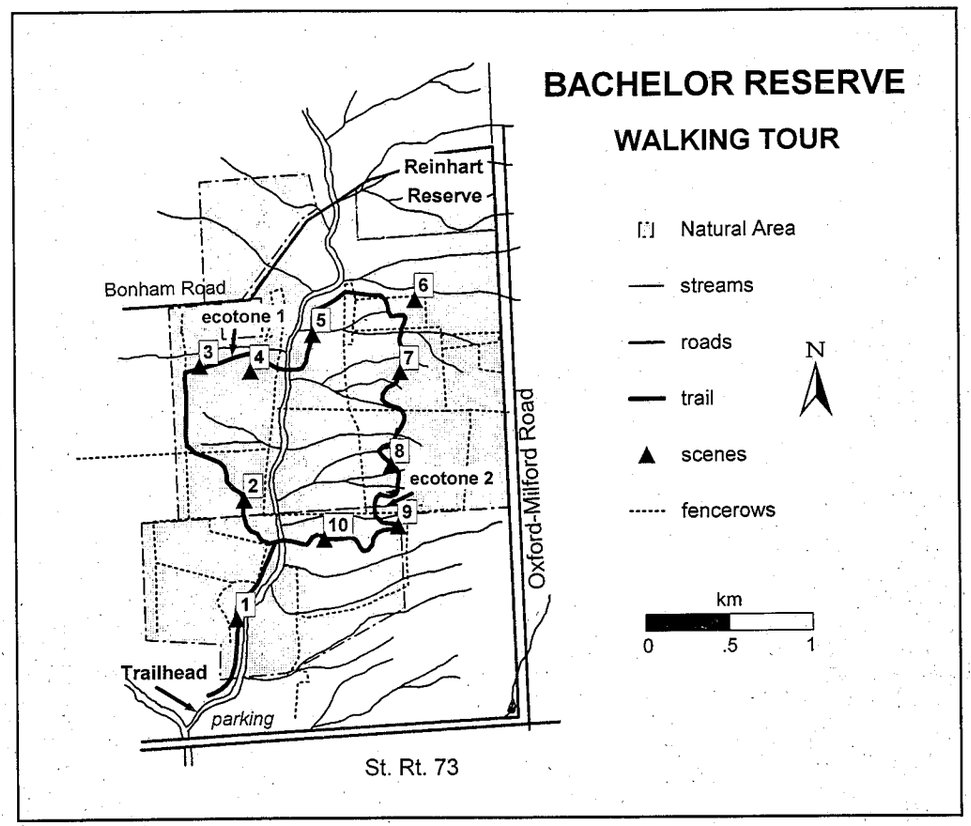
Landscape Scenes and Ecotones

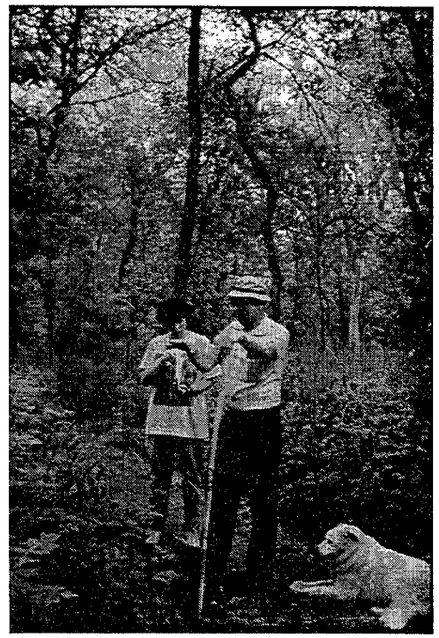


The guide follows a walking tour through the Bachelor Reserve that begins at the entrance off S.R. 73. The trail is approximately 5 km (3 mi) long that includes parts of two loop trails: the pine loop and the east loop. The pine loop is located west of Harker's Run, and the east loop is east of Harker's Run. Two suspension bridges cross Harker's Run as it flows south through the Reserve. The course of the walking tour crosses both bridges. Trail signs will identify 10 landscape scenes (S1...S10) and 2 ecotones (E1 and E2). Do not take trails to Bonham Road, Reinhart Loop, Oxford-Milford Road, or Boesal Pond.

Acknowledgements

Thank you to Miami Univeristy's Office for the Advancement of Scholarship and Teaching and the Department of Geography for granting Lori a 1995 Undergraduate Summer Scholar position. It was an honor and privilege to be a part of this program and to work together on a research project.

Heartfelt thanks are due to many people who assisted us with the creation of the guide and walking tour. Dr. Paul and Mrs. Lois Daniel and Mr. Ken Havens devoted their time to walk with us and share their knowledge on the natural and human history of the Bachelor Reserve landscape. Dr. Daniel also reviewed the guide and submitted editorial comments, as did other ecologists and environmental educators at Miami University, other universities, and in the community. Thanks also to Tony Adams, Paul Gentle, Chris Haynes, Jason Kramer, and Simone Andrus for providing computer assistance, and to Molly Eynon and Bucket for their help in the field. All graphic layouts were completed in the College of Arts and Science High End Learning Lab. John Bowser at MCIS kindly guided us through the printing process and Ken Havens directed the construction and installation of the trail signs. The Molyneaux Trust, The Bachelor Reserve Endowment, and the Turrell Herbarium Fund provided funds for the printing of the guide and development of the walking tour. Thanks Dr. Hardy Eshbaugh and Dr. Michael Vincent at the Turrell Herbarium , Department of Botany for your encouragement and advice.



We would like to emphasize our collaboration, and how a lot of skill sharing, encouragement, and rigorous reviews can lead to a product neither of us would have ever reached alone.

Preface - *Lori M. Gramlich*

The idea for a landscape guide for the Bachelor Reserve was conceived in November, 1994. The Undergraduate Summer Scholar's Research program allowed me to design and carry-out a project under the supervision of a faculty mentor during the summer of 1995.

The first two weeks of the summer were spent talking with people who know and enjoy the Bachelor Reserve like my adviser, Dr. Kim Medley, Dr. and Mrs. Paul Daniel, and Ken Havens. I also researched historical data about the Reserve to collect the background information that was necessary to understand its landscape.

I spent the next several weeks in the Bachelor Reserve with Dr. Medley trying to choose scenes that best capture the diversity in the Reserve. Once the scenes were chosen, I selected photo points. Darkroom development of black-and-white prints, and for the first draft, lots of computer enhancement of scanned photo images allowed me to show the diversity and characteristic features of each scene. The text accompanies and references the photos to better explain the clues I use to interpret what I see when looking at each scene.

The guide that I finished for the Undergraduate Summer Scholar's Research program was edited and tested during the fall semester, 1995. Participants in field tests and those who completed questionnaires provided suggestions and editorial comments about the guide. Dr. Medley and I decided to pursue a new version that incorporates the suggested changes, which is the document you are using.

Creating this landscape guide was as much a learning experience for me as I hope using the guide is for you. Nature interpretation requires a different way of thinking and seeing the environment. My goal is that the guide teaches you to interpret and understand more about nature, but at the very least, I hope that you enjoy your time in the Bachelor Reserve.

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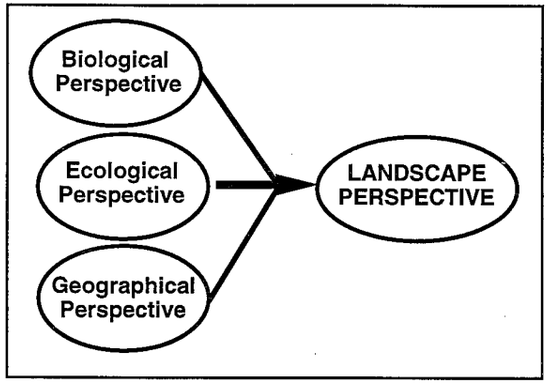
Introduction

Geography is a comprehensive discipline defined as the study of the earth from a regional or spatial perspective. Geographic studies regularly include the study and examination of how history influences the natural environment. Geographic research of nature, through time, indicates that humans play both direct and indirect roles in determining the appearance of an area. We must question present and past human influences in order to understand nature. As we learn about the relationships between nature and humans, we gain insight on how to ensure the protection of the natural environment. This landscape guide considers, in a geographic context, land-use history, vegetation composition and structure, and human influences in the interpretation of different nature scenes along a walking tour through the Bachelor Reserve.

A landscape is an area comprised of various land uses where different plant and animal communities live. The Bachelor Reserve is a natural landscape. In the past, lands in the Bachelor Reserve were farmed and grazed. Over time, the Reserve's landscape structure and composition changed in response to former human activities and natural processes. Change is a continuous process, and though the Reserve is now protected, the landscape continues to change. Three perspectives are necessary to interpret a landscape and formulate a landscape perspective. The first perspective is **biological**, or looking at the types of plants and animals present across a landscape. The guide emphasizes plants and the habitats that they provide for other organisms. The second perspective is **ecological**, or looking at the relationships and interactions between plants and their environment. Each scene in a landscape represents a plant community. The third perspective is **geographical**, or looking at the spatial relationships between various plant communities in an area and evaluating the associated influences of human activities over time. Together the three perspectives provide a basis for landscape interpretation and the development of a **landscape perspective**.



The objective of this guide is to point out, interpret, and provide explanations for variations among scenes across a landscape. The guide describes the environmental setting, plant composition and structure, and human influences for 10 landscape scenes and two scene transitions (ecotones) on a walking tour along the trail in the Bachelor Reserve. Use the descriptions and photos, as well as your own observations, to formulate a landscape perspective for the Bachelor Reserve. Since this method of nature interpretation requires the synthesis of a variety of information, the development of a landscape perspective is a holistic process.

Environmental Education

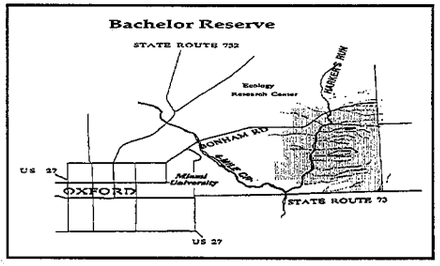
Current trends in education are toward holistic learning. Synthesizing and interpreting pieces of information to formulate an idea or view is the process of holistic learning.

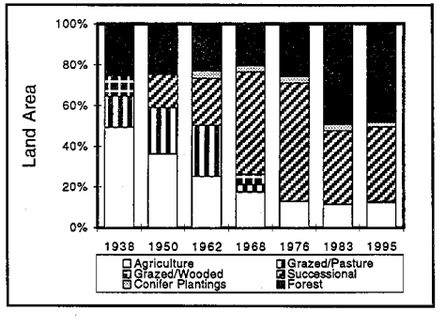
How is learning about nature through the interpretation of scenes holistic?

Learning about nature through the interpretation of landscape scenes is holistic when various perspectives are each considered individually, and then considered in relation to one another. It is not enough to simply know the plants, or biology, of a scene. Rather, a better understanding of the processes that support and enable plants to exist in a scene is gained when we look at the ecology of the plant community—the relationship of plants to one another and to the environment. Since the Bachelor Reserve was historically used in a variety of ways, and even now is bordered by agriculture fields, each scene is influenced by its geography. Different land management practices and human constructions throughout history produced strikingly different tracts of land adjacent to one another. Thus, in order to understand the scenes in the Bachelor Reserve, we must think like a biologist, an ecologist, and a geographer. We must take a holistic look at each scene and examine its environmental setting, vegetation composition and structure, and human influences.

History of the Joseph M. Bachelor Reserve

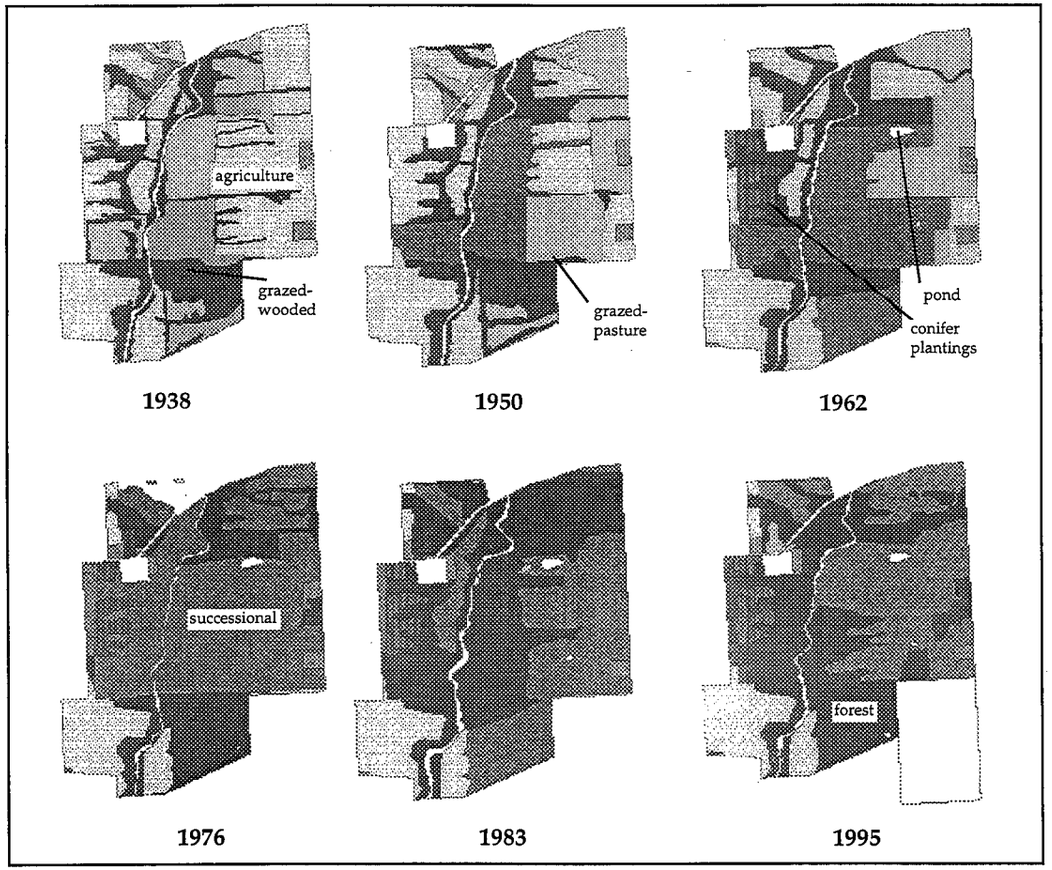
Joseph M. Bachelor, an English professor, began his career at Miami in 1927. He taught through the 1945-46 school year when he retired to the Bachelor Estate located on tracts of land he acquired north of S.R. 73 and west of Oxford-Milford Road. At Bachelor's death in 1947, almost 50% of his lands were being farmed, and more than 20% were being grazed as shown in the first column of the graph of land-use change at right. Upon his death, Dr. Bachelor left his property, totaling almost 162 ha (400 acres), to his mother and willed, upon her death, all lands and funds associated with the estate to Miami University. The property, at his request, was protected from residential development and named the Joseph M. Bachelor Wildlife and Game Reserve. Over the years, the University acquired 106 ha (261 acres) of new tracts of land to create a contiguous protected landscape that totals almost 268 ha (661 acres) and is shown in gray on the map. The Bachelor Reserve is located just east of the Oxford campus of Miami University, and the walking tour remains in the portion referred to as the main reserve.





How and to what extent has land-use changed in the Bachelor Reserve throughout history?

Bachelor's generalized management plan was to plant forests along the western portion of the estate, develop and continue agriculture on the bottomlands, separate uplands along Oxford-Milford Road for cattle grazing, and intensively crop the Hawkins farm (now the Ecology Research Center). Air photos taken between 1938 and the early 1990s document land-use activities in the Reserve. The maps below show the boundary changes for the different land uses while the graph on the previous page shows the percent of land area in each type. Between 1938 and the present, the percent of land used for agriculture (row crops) dropped from 46% to 11% while grazing dropped from 15% to 0%. Between 1962 and 1983, the proportion of land used for grazing increased with decreased agriculture. However, in general, both agriculture and grazing decreased while successional and forested land percentages increased through time. The percent of both successional and forested lands have increased more than 20% and together total more than 80% of the land area.



Through the early 1950s, the University practiced agriculture on almost half of the estate: 49 ha (120 acres) of land were cropped, 39 of which are located in the main reserve, and 87 beef cattle grazed on 42 ha (105 acres). Intense management and use of the land continued through 1958 in conjunction with the Agricultural Conservation Program Service (ACPS) who assisted the University in sustainable land use. Erosion and loss of soil fertility were problems that resulted from intense farming and grazing. Liming, seeding, and mowing the pastures by the University restored some of the structure and nutrients to the soil. Two ponds and a well were created in 1957 and 1958 to provide water for the cattle. After many protests in the late 1950s from those concerned with the way that Bachelor willed his land to be used and withdrawal of assistance from the ACPS, much of the agriculture ceased. New land management practices evolved that resulted in a decrease in agriculture and grazing between 1958 and 1962. The lands that were no longer farmed or grazed entered succession, which explains a 25% increase in successional lands by 1976.

Today, none of the land in the main reserve is used for agriculture or grazing, however, many of the Reserve boundaries are adjacent to such lands. The scenes described in this guide represent areas that were managed differently through time; each scene shows some of the diversity present across the Bachelor Reserve landscape.

Using the Guide

As a user of the guide, you play the role of a landscape ecologist; a person who considers the landscape, or geographic area, as a whole entity. The Bachelor Reserve is a diverse landscape. The guide describes and interprets 10 distinct scenes and two transitions (ecotones) along the trail, though many others occur along the walking tour.

How does one interpret a landscape? Are certain interpretive clues common to all landscapes?

Certain criteria exist that make it fairly simple for a person to learn much about the diversity of a landscape scene. The guide presents interpretive clues to the landscape under three headings: environmental setting, composition and structure, and human influences. When you first arrive at a scene, look at its location on the map and your location in the landscape. Use the map and if possible a compass to help identify directions. What is the scene's topography? Is the land sloped, flat, in a floodplain, or on an upland? Does evidence of a natural disturbance, like fallen trees, exist? Are the surrounding lands managed differently? Next, look at the dominant plants. It may be helpful to carry along an additional field guide to help you identify trees and wildflowers. The appendix provides the taxonomic names of the plants mentioned in the text. How are the plants arranged in the scene? Is the arrangement random or do you see planted rows? Do you see any vertical layers? Measurements of topographic positions, plant heights, and tree trunk diameters (dbh) are referenced in both metric and English units. Use the photos to help distinguish specific features unique to each scene, like plant structure. Third, look for legacies in the scene. Does

evidence of past or ongoing human influences exist? The graphs show you how the scene was managed throughout history. A list of additional selected readings are provided for you at the end of the guide.

Environmental Setting:

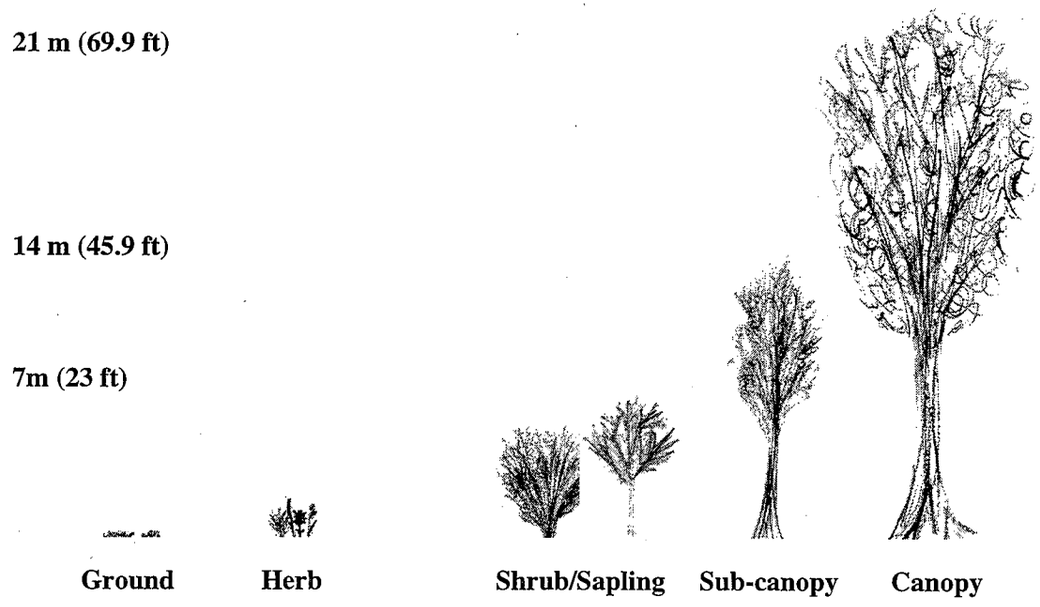
The 10 scenes differ obviously by location. The Reserve trail begins in the lowland adjacent to Harker's Run and goes through upland areas on both the west and east sides of the stream. Environmental characteristics that distinguish each scene include topography, natural disturbances, soils, and boundaries with different land-use types. For example, the topography of the Harker's Run floodplain (as shown in the photo to the right) is flat and subject to periodic flooding. Certain plants are more adapted to floodplain environments. An active floodplain also limits certain land management practices such as row-crop agriculture. Likewise, a landform like a hill or steep slope is not suitable for grazing. Boundaries between various land-use types having different management regimes help explain plant composition. For example, "exotic" species more commonly establish along open or disturbed edges.

Composition and Structure:

Composition refers to the different plants found in a scene. Plants are often indicators of a scene's environmental setting, human influences, and change through time. For example, most scenes in the Reserve were cleared for agriculture or grazing and are currently in secondary succession. A scene's plant composition indicates its successional stage. Along streams, sycamore, willow, box elder, and cottonwood trees establish on freshly-deposited bare soils. Grasses and other herbs establish in areas cleared of vegetation, or during secondary succession. Young trees that need light like red cedar and honey locust, are next to establish. The establishment of more shade-tolerant trees like sugar maple, ash, and beech may follow over time. In southwestern Ohio, without disturbances, secondary succession proceeds toward the establishment of a mixed, broadleafed, deciduous forest of oak, ash, beech, hickory, cherry, and maple trees.

Vegetation layers are also influenced by the environmental setting and represent time in succession and past land management regimes. Within forests, the canopy layer is the tallest tree layer. When a canopy closes, little sunlight reaches the forest floor. For our purposes, the canopy is represented by trees having diameters at breast height (dbh) greater than 25 cm (10 in). Breast height is about 1.4 m (4.5 ft) from the ground. Canopy tree heights, in mature forests, are greater than 20 m (65 ft). Underneath the canopy is the sub-canopy layer of trees with diameters between 10 and 25 cm (4 and 10 in). Sub-canopy trees may be young canopy trees or smaller trees which always remain under the canopy. The shrub/sapling layer is

underneath the sub-canopy. Young trees, or saplings, have diameters less than 10 cm (4 in) and are about 1-8 m (3.2-26.2 ft) in height. Whereas trees grow from a single main stem, shrubs are also woody, but grow multiple stems from a single base. Shrub heights range from less than 1 m (3.2 ft) to about 5 m (16.4 ft). Amur honeysuckle is an exotic (not native) shrub that often dominates the shrub layer on disturbed sites throughout the Reserve. Beneath the shrub/sapling layer is the herb layer. Herbs, including narrow-leafed grasses and broad-leafed forbs (like wildflowers), grow at the herb layer in association with tree and shrub seedlings. Garlic mustard is a common exotic herb found in the Reserve. At some locations a ground layer that includes mosses, ground pine, lichens, and mushrooms will grow. In a mature forest, the ground and herb layers are often sparse and less diverse due to low amounts of sunlight reaching the forest floor. Where sunlight is abundant, the ground and herb layers often flourish and provide great diversity across a scene.



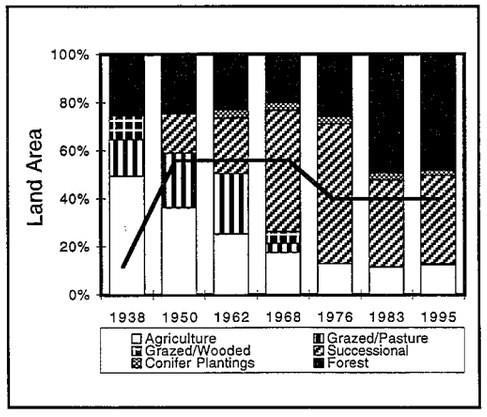
It is important to recognize that plant appearances change dramatically with the seasons. The photographs in this guide were taken in mid to late May 1995. Spring wildflowers, bare trees, fallen leaves of autumn, and many other seasonal plant characteristics and adaptations are not captured in the guide.

Human Influences:

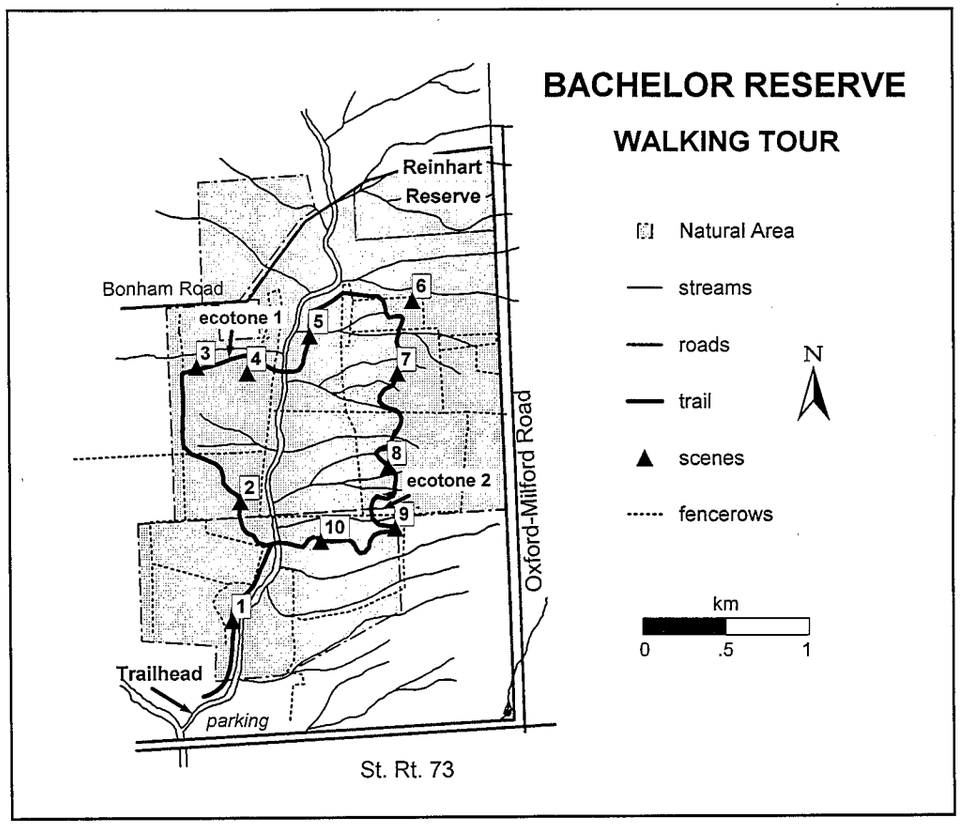
Legacies in a scene are remnants of past activities passed down through time. Past land management activities leave some obvious legacies like fences, constructions, and tools. Other legacies, shown by plants or plant structure, are not so obvious. For example, trees with low, wide-spread branches, a row of trees planted along a boundary, or a missing forest layer due to grazing are much harder to identify in a scene. Legacies provide clues to past land management practices. In the Reserve, fence lines mark the boundaries between lands used for agriculture, grazing, or forest. The photo to the right shows an obvious barbed-wire fence in the foreground, but also notice the more subtle line of trees in the background planted as a boundary between two differently managed lands. Both types of boundaries are clues to a grazing legacy. The fences kept cattle off of a steep slope and out of a gully as well as away from a pond. Legacies provide clues to the past. Once we know the history of an area, we can begin to predict where the landscape is going.

Interpreting the Graphs:

The land-use history graphs are tools that show changes in land-use for each scene within the Bachelor Reserve. You can trace each scene's land-use history by following the black line on the graph. For example, the graph at right, for scene 8, shows that in 1938 this scene was in agriculture. Then by 1950, the scene's land-use changed to grazed-pasture. By 1962, the scene went into succession where it remained through 1995. These land-use histories are based on the interpretation of air photos; an independent project completed by Tom Chatfield. Know that the ability to document past land uses depends on the quality of the air photos, which vary from year to year.



Landscape Scenes and Ecotones



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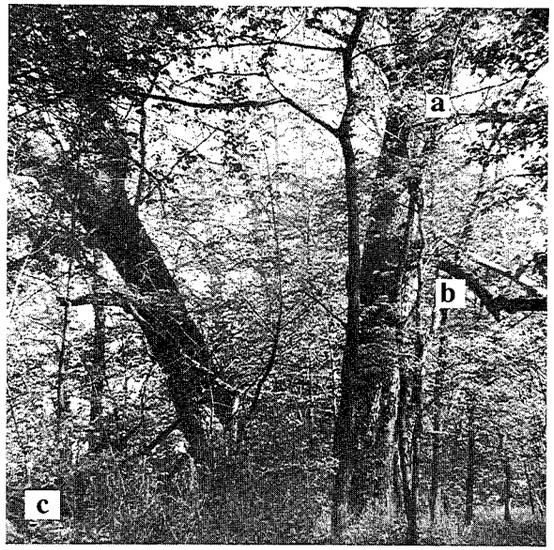
Scene 1: Floodplain Forest

The photo at right was taken looking north at a compass angle of 4° and a tripod height of 1.6 m (4.6 ft).
May, 1995



Environmental Setting:

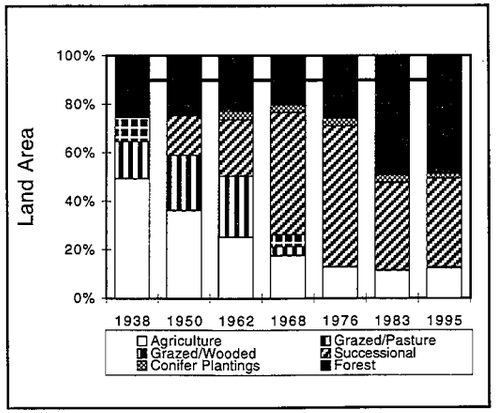
The floodplain forest forms a corridor about 50 m (150 ft) wide between Harker's Run to the east and agricultural fields to the west. The corridor is an ecotone, or transition zone, between the aquatic (stream) environment and the terrestrial (upland) environment. The floodplain topography, soils, and vegetation all respond to water-level fluctuations and changes in the stream course. The floodplain occurs at an elevation of 260 m (780 ft). The trail runs along a flat levee (a landform above the stream created by stream deposits). The stream erodes and deposits debris on the bank as it flows through the floodplain. Floodplain disturbances occur after large amounts of precipitation. The floodplain forest soils change from sands near to the stream to clays as distance from the bank increases.

Structure and Composition:

Three vegetation layers dominate the floodplain forest scene: the canopy (**a**), sub-canopy (**b**), and herb (**c**) layers. The largest trees (canopy layer) in the forest are primarily sycamore. Sycamore trees are found along Harker's Run in the Bachelor Reserve because they are specially adapted to floodplains. Sycamore bark is light grey or white and peels at the tops of the trees. The two large sycamore trunks in the scene, pictured above, have diameters of about 1.4 m (4.2 ft); they grow as one tree from a single base, a typical sycamore growth form. The smaller sub-canopy trees have diameters between 10 and 25 cm (4 and 10 in). Hackberry (thick, chunky, ridged bark), elm (furrowed, corky bark), and box elder (the only three-to five-leafed maple with green twigs) are most common.

Light is the major factor that allows for successful growth at the herb layer. Light enters the floodplain from three areas: the top through the open canopy, the stream edge, and the agriculture field. Competition is intense between native and exotic species. Native herbs include

The graph below shows the maintenance of the scene as a forest throughout history.



Garlic mustard: an exotic herb, *May, 1995*

Miami mist (which has small purple flowers), big-leaf waterleaf, and maple-leaf waterleaf. All three herbs bloom in late spring and early summer. Recent establishment of garlic mustard, an exotic herb, is evident. Garlic mustard occupies 98% of the ground cover in the floodplain.

Human Influences:

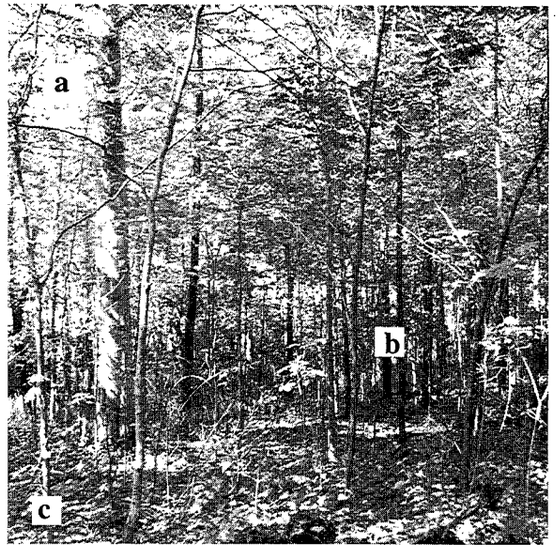
Located along Harker's Run, human influences were minimal in the floodplain forest. The forest was not grazed or farmed after 1938. Flooding and changes in the course of Harker's Run are the major disturbances to this floodplain. The large sycamores and presence of dead trees are clues that the scene was not cut or drastically disturbed by humans. The graph shows that the corridor was a mature forest since at least 1938.

However, exotic species provide evidence for indirect human influences and/ or disturbances. The establishment of garlic mustard throughout the floodplain scene may be explained by the scene's location between two disturbed areas. Garlic mustard moves in from the edge and invades the herb layer of the floodplain. The establishment of a plant across a boundary is called an edge effect. Currently, garlic mustard is so widespread in the herb layer that it appears to be out-competing the native plants. Research on plant establishment and succession correlate the establishment of new plants with the removal of existing plants. According to Dr. Paul and Mrs. Lois Daniel, the native Miami mist covered the floodplain since 1946, but now they observe that garlic mustard is replacing Miami mist. Honeysuckle is an exotic shrub also found in the floodplain.

A human disturbance, like the removal of existing plants to create a field for agriculture, fragments the landscape. Fragmentation provides exotic plants with establishment opportunities. Landscape fragmentation and the types of adjacent land uses appear to promote disturbance within this already dynamic forest scene.

Scene 2: Southwest Slope Forest

Actual scene is 11.6 m (38 ft) downslope W-SW from the trail at 250˚. The photo at right was taken facing downslope at a compass angle of 230˚ and a tripod height of 1.6 m (4.6 ft). *May, 1995*



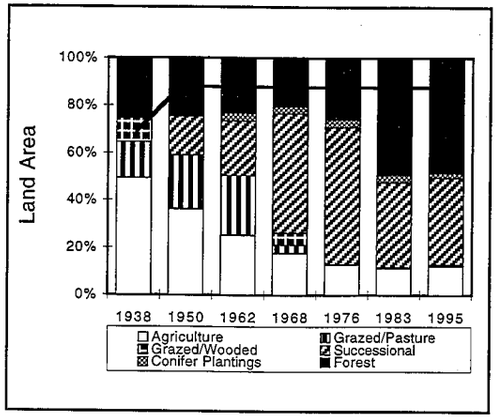
Environmental Setting:

This forest scene is located on a hill west of Harker's Run that faces southwest. The elevation at the top of the slope is 283 m (850 ft) and at the base of the slope, where you'll see an agriculture field, the elevation is 266 m (800 ft). The scene is located within a hollow on the slope which rises slightly on both sides, like a bowl. The hollow is called a concavity and the sloped sides are called convexities. Concavity and convexity are terms used to describe topography. The concavity is sunken and shaded, while the convexity is raised and typically receives more sun. Forests surround the scene except for the agriculture field at the base of the slope. The upland clay and silt soils are of glacial origin and are much finer than the sandy floodplain forest soils.

Structure and Composition:

Three vegetation layers are distinct in the southwest slope forest. As shown in the photo, they are the canopy (**a**), shrub/sapling (**b**), and herb (**c**) layers. The very large canopy tree in the photo is an American beech, however white ash is most abundant at the canopy layer in the scene. Look closely and you will see other canopy trees like oak, hickory, sugar maple, basswood, and black walnut. Enough sunlight passes through the canopy to support a thriving shrub/ sapling layer underneath. Nearly all of the saplings are sugar maples. Mature sugar maples produce many seeds that germinate, but evidently, few sugar maples actually recruit, or fill the forest canopy. The most abundant shrub is Amur honeysuckle. Notice that honeysuckle in this scene is only present on the convexities where sunlight is greatest. Amur honeysuckle is an exotic shrub that is common throughout Bachelor Reserve. The herb layer is sparse in this scene because the above layers limit the amount of sunlight reaching the forest floor. In the early spring, before the trees gain their leaves, wildflowers are common in the herb layer. Garlic mustard has established itself along the trail and up the slope from the field. Sunlight at the edges of the forest encourages growth in the herb layer.

The graph shows the change in land-use from grazed/wooded forest to forest.



The photo above was taken at a 202˚ compass angle to show the dead stump and density of saplings in the tree-fall gap. *May, 1995*

Human Influences:

The southwest forest scene was grazed from at least 1938. Large canopy trees in the scene survived and grew during grazing, but herbaceous plants and tree seedlings were eaten or trampled. No seedlings were able to establish during this time, resulting in the near absence of a sub-canopy tree layer of trees 10-20 cm dbh. When grazing stopped, the understory reestablished and succeeded into a forest, but the legacy of grazing remains.

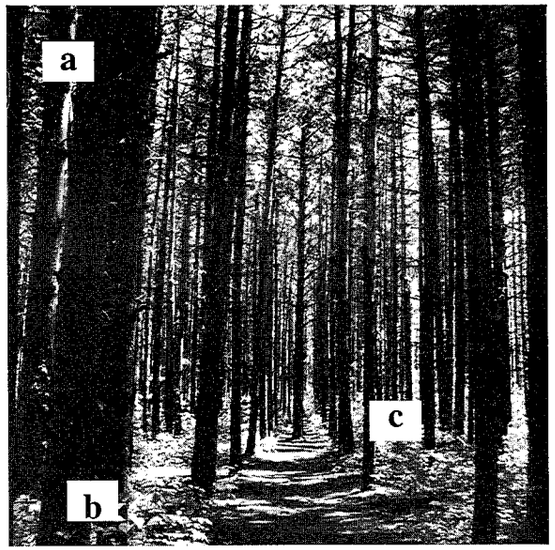
Many fallen trees are rotting on the forest floor. The presence of dead wood suggests that humans did not recently harvest timber in the scene. As you can see in the photo above, many saplings grow near the fallen canopy tree. A fallen tree opens up the canopy and allows light to reach the forest floor where seedlings can establish. The hole in the canopy is called a tree-fall gap. Sugar maple seedlings established in the tree-fall gap and are now filling the sub-canopy layer. Forest regeneration is occurring in response to both human and natural disturbances.

Increased amounts of light along forest edges and trails coincide with the distribution of exotic plants. At the herb layer, garlic mustard, shown in the foreground of the photo above, is establishing upslope from the edges bordering the agricultural field and the floodplain forest. The boundary provides for establishment of exotic species because light is able to penetrate at the edge. Establishment by exotic plants may be indirectly related with the uses or human disturbances of adjacent lands.

Forest regeneration processes in this upland scene and the floodplain forest scene differ primarily because of their different environmental settings, but humans also contribute to the observed differences in composition and structure.

Scene 3: Pine Stand

The tripod was placed at a 10˚ compass angle 2 paces from the permanent point. The photo was taken at a compass angle of 96˚ and a tripod height of 1.6 m (4.6 ft). *May, 1995*



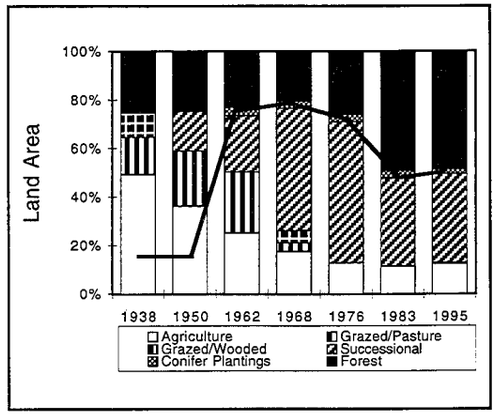
Environmental Setting:

The upland, flat pine stand is not natural, but rather was planted for use by Miami University in 1950. The pine stand is located west of Harker's Run at an elevation of about 293 m (880 ft). A fence line running from Bonham Road due south marks the western boundary of both the Reserve and the pine stand. Mixed deciduous forests surround the pine stand on steep slopes. A 2-3 year needle-leaf litter layer, pine duff, covers the pine-forest floor. The upland soils of the pine stand are glacially deposited and have slow rates of decomposition due to the thick layer of pine needles.

Structure and Composition:

Three layers of vegetation dominate the pine stand scene: the canopy (**a**), shrub/sapling (**b**), and herb (**c**) layers. White and red pine trees are almost equally abundant at the canopy layer. White pines have five needles and are larger in this stand than red pine. Red pine has two needles and flaky bark. White ash dominates the shrub/sapling layer. In a canopy opening, white ash can successfully establish and recruit to the sub-canopy. In this scene, like scene 2, the southwest slope forest, tree-fall gaps open the canopy to light. Typically, the pine canopy shades out light and inhibits undergrowth, but a tree-fall gap can provide a window of opportunity for the establishment of new species. At tree-fall gap sites, lianas (grape vines) and taller hardwood deciduous tree saplings are present. Most of the deciduous trees are seedlings and grow at the herb layer. Herbs, however, are sparse due to limited sunlight and the thick pine duff. Be aware of poison ivy, a woody vine, which grows in the pine stand. This scene is minimally influenced by exotic plants. Garlic mustard is

The graph shows the change in land-use from agriculture to conifer (pine) plantings.



The tripod sat at a 10˚ compass angle 2 paces from the permanent point. The photo looks at the vegetation along the western edge from a 292˚ angle. *May 1995*

moving upslope from the stream and in from the western boundary where it is establishing along the edges of the pine stand. The photo above shows an edge effect along the western boundary of the pine stand. Along this western boundary is a fence line, a legacy of human disturbances and an edge separating a differently managed tract of land. Along the edge, establishment of new understory species is most successful.

Human Influences:

In 1950 and 1951, 26,000 white and red pine seedlings were planted in straight rows running parallel to the trail. The pine plantation project was headed by Miami University's Botany Department whose goal was to sell the trees at Christmas time for University profit. The stand of trees that you see today is what remains of the project; the trees were not thinned or trimmed and were left to grow to their present stature. A natural thinning process, rather than that imposed by humans, produced the dead trees in the pine stand. Fallen trees create open space allowing other healthy trees to achieve maximum growth. A few pine trees, apparently not planted in the plantation rows, have seeded themselves in the deciduous forest tracts that are adjacent to the pine stand scene. More importantly, deciduous trees are also slowly beginning to establish in the pine stand scene, especially along the edges. However, many years will pass before the deciduous tree saplings recruit to the canopy layer and replace the pine stand.

Ecotone 1:
Pine and Deciduous Forest Transition

An ecotone is a transitional area that occurs at the boundary between two different ecosystems (in our case scenes). At the ecotone, scenes that differ in their setting or history meet and fuse together. Ecotone 1 is photographed facing northwest along the top of northeast slope. The pine stand is a flat upland area south and west of the slope while the deciduous forest goes down the slope to the flat floodplain adjacent to Harker's Run. Note the distinction between the two types of forests by comparing the needleleaf pines and the broadleaf-deciduous trees.

The deciduous forest is beginning to invade the pine stand as indicated by the broadleaf trees regenerating in tree-fall gaps where the pines have naturally thinned out and along this forest boundary. Broadleaf saplings, like ash, are seeding in underneath the pines, but remain small and do not recruit to the canopy layer until the light is sufficient. The herb layer under the pine canopy is sparce because the pine needle litter layer is thick and limits herb establishment. The deciduous forest floor is covered with a leaf litter layer that is not so thick and turns over quicker than the pine needle litter. As a result, garlic mustard is more common at the herb layer in the deciduous forests, and only appears along the boundary between the pine stand and the surrounding forests.

You can see other transitions along the trail on your way to ecotone 1. The environmental setting remains a flat upland, so all changes result from different management histories. Between scenes 2 and 3, you can see the vegetation change from the deciduous forest on the southwest slope, with many maple saplings, leaf litter on the forest floor, and little ground cover, to an area in succession with many juniper trees, a shrub layer of honeysuckle, and a ground layer thick with moss and ground pine. Scene 2 was a grazed forest, while land areas between scenes 2 and 3 were cleared of trees and in cultivation. As you get closer to the pine stand, you see some isolated pine trees inter-mixed with the juniper. These pines have self-seeded outside of the planted pine stand where lighting and soil conditions were optimal for establishment and growth in open fields . Eventually you reach this ecotone between the pine stand and surrounding forest. Through time, these successional and planted scenes should merge to become an upland forest.

The photo above was taken looking northwest at the boundary between the pine stand and the deciduous forest on the slope.

Ecotone 1: Pine and Deciduous Forest Transition

Scene 4: Young Floodplain Forest

Actual scene is near the fence line, 28 m (90 ft) in a W-SW (240˚) direction from the trail. The photo at right was taken at a compass angle of 135˚ and a tripod height of 1.3 m (4.0 ft) to show the thick stand of young trees. *May, 1995*

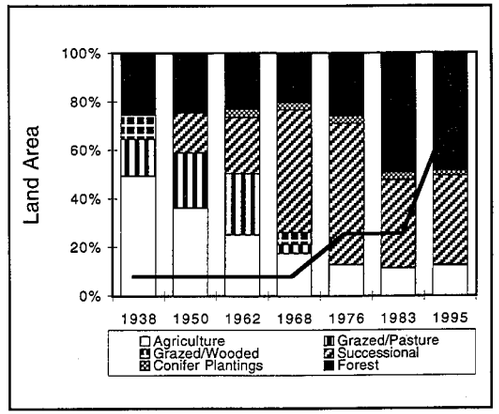
Environmental Setting:

The young forest scene occurs at the base of the deciduous forest slope, coming down from the pine stand. Older forests completely surround the young forest. The boundaries to the young forest are marked by fence lines. The young forest, located west of Harker's Run, is at an elevation of 268 m (805 ft). It is at the western extent of the floodplain, a low backwater area. The soils are typical floodplain soils, but their texture is much finer than the soils in the floodplain at Scene 1. Woody debris from the older trees upslope and a one-year leaf litter layer covers the forest floor.

Structure and Composition:

As you leave the pine stand and follow the trail downslope to the floodplain, you notice a thick stand of trees whose height is between 4- 7 m (12-21 ft). The stand is almost completely dominated by the plants of the shrub/sapling layer. Young black and sugar maple trees are most abundant and nearly fill the understory, as pictured above. Shrubs are also present in this scene and dominated by invasive Amur honeysuckle. The successful establishment of honeysuckle is relatively recent; most of the honeysuckle shrub heights are less than 2 m (6 ft). Many larger trees in this scene are the same as those found in the mature floodplain forest at Scene 1. Elm, sycamore, and box elder trees all grow in this scene, the largest of which are the sycamores. The differences between the two

The graph shows the change in land-use from agriculture to succession to forest.



floodplain scenes are due to time; this forest is less than 30 years old. Even the largest sycamores are smaller than in Scene 1; their dbn's are only about 20 cm (8 in). The diameters of the other trees are less than 20 cm (8 in). Most of the maple saplings are not likely to recruit to the canopy layer. Natural thinning of the younger trees, like the maples, produces much of the dead wood in this scene. Garlic mustard is a very successful herb in the young forest floodplain and is establishing throughout.

Human Influences:

The most unique feature of this scene is its youth relative to the surrounding forests. The boundary at the base of the slope

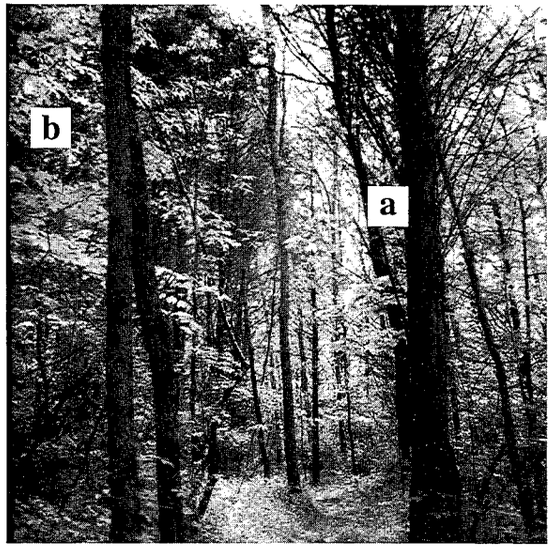
The photo above was taken at a 50˚ compass angle and a tripod height of 1.3 m (4.0 ft). *May, 1995*

between the mature forest and the young floodplain forest, shown in the photo above, is distinct. The stand of older trees with a high canopy abruptly ends. The fence line marks the boundary between the two forests. The young forest was farmed through 1968 as specified in Bachelor's plan to farm the bottomlands. By 1976, the landscape was no longer being farmed and successional processes began. Succession continued until 1983 when mixed deciduous trees became dominant. The scene was then classified as a young forest. The thick growth of saplings suggests that the soil nutrients were not exhausted from farming.

Scene 4: Young Floodplain Forest

Scene 5: Successional Forest

The photo at right was taken at a compass angle of 226° and a tripod height of 1.3 m (4.0 ft). *May, 1995*



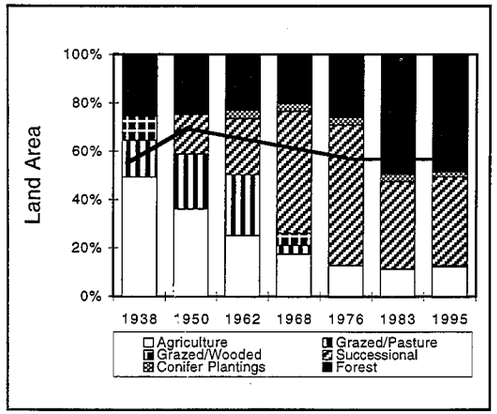
Environmental Setting:

The successional scene is located east of Harker's Run, adjacent to an intermittant stream that flows west into Harker's Run. The trail goes through the scene in a north-south direction. After crossing Harker's Run you climb 16.6 m (50 ft) to the scene's elevation of 283 m (850 ft). To the east of the trail is an uphill slope having an elevation range between 287-293 m (860-880 ft). On the west side of the trail, the land slopes and drains westward to Harker's Run. Successional lands surround the scene on all sides. The soils of the upland scene are formed from glacial deposits.

Structure and Composition:

A successional scene is constantly changing. Many diverse plants establish and are eventually replaced by different plants that are better adapted to the environmental setting. For example, as a scene changes from an open field to a forest, competition for light becomes more intense. The plants that are better adapted to less light or can reach the canopy will be better adapted to the new environmental setting. The composition of this successional scene is a mixture of conifer (**a**) and deciduous broadleaf (**b**) successional trees like juniper (the conifer shown above), and white ash and honey locust (both deciduous broadleaf). Juniper trees dominate on the slope almost exclusively east of the trail. Juniper trees need lots of light and establish early in open-field settings. White ash and other deciduous trees typically establish later. A grove of black walnut trees grows west of the trail. For some reason, juniper and black walnut trees are clustered in the scene. Elm, white ash, hackberry, and juniper occur as smaller trees with diameters between 10-20 cm (4-8 in). The juniper and broadleaf trees do not form distinct vertical layers, but they do differ in tree trunk diameters. The tree layer is less than 20 m (60 ft) in height. Exotic shrubs like Amur honeysuckle and privet make-up the shrub/sapling layer.

The graph shows the change in land use from grazed/pasture to succession to forest.



The photo above was taken on the north side of the bridge looking toward the permanent point . *May, 1995*

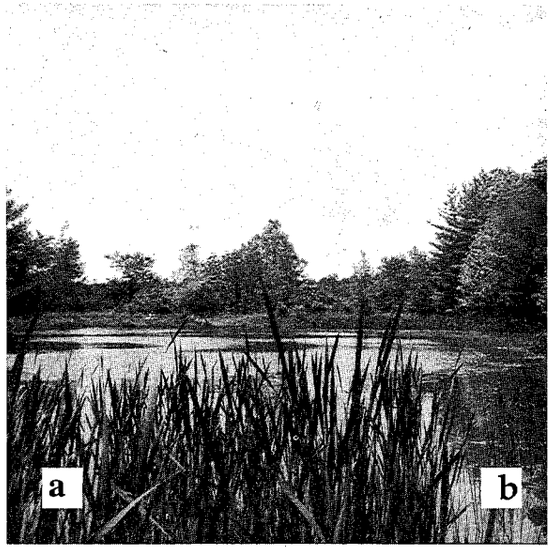
Nearly all of the honeysuckle shrubs are young, under 2 m (6 ft) in height, and are most dense along the stream. Privet grows near the forest floor at heights less than 1 m (3 ft) under the juniper trees east of the trail. At the herb layer, garlic mustard and Miami mist both grow. Evidently, as Dr. Paul and Mrs. Lois Daniel pointed out on a hike through the Reserve in May, wherever Miami mist is present, garlic mustard is not. Ferns and thick beds of moss grow near the ground, but only beneath the juniper trees.

Human Influences:

Vegetation composition and structure are key features to recognizing that this scene was once more open. Unlike a mature forest, the canopy and sub-canopy layers are merged. Only one tree layer is present in this scene, which is not very high and comprised of species that establish best in open areas. The scene was grazed pasture between 1938 and 1950. Between 1950 and 1962 the area was taken out of grazing and successional processes began in the grassland. Pioneer species like juniper and some broadleaf deciduous trees established themselves across the open scene. Succession continues as these species mature and fill in the forest canopy. The scene will change as more shade-tolerant deciduous hardwood trees establish and replace trees like juniper, ash, and honey locust that require lots of light. The scene is classified from 1983 aerial photos as a forest. The scene represents a successional forest comprised of successional tree species, not a mature deciduous forest. As forest succession continues, the pioneer trees will die out and shade-tolerant deciduous hardwoods, like sugar maples, will establish. Distinct canopy and sub-canopy layers will emerge as the trees grow in diameter and height.

Scene 6: The Pond

You can reach this scene by following the trail around the pond to the northeast corner. The photo at right was taken at a compass angle of 266° and a tripod height of 1.6 m (4.6 ft). *May, 1995*



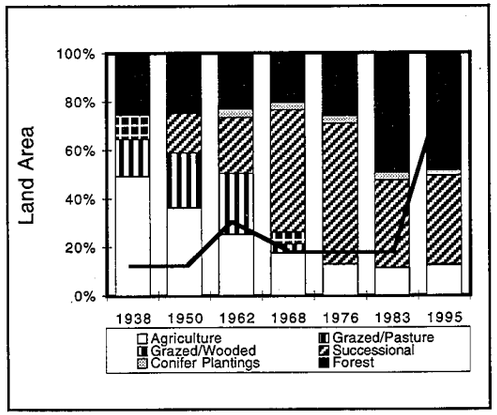
Environmental Setting:

The pond scene is located upland, east of Harker's Run and about 0.3 km (0.2 mi) west of Oxford-Milford Road at an elevation of 290 m (869.5 ft). The maximum depth of the 0.5 ha (1.25 acre), spring-fed pond is 5.3 m (16 feet). Dr. Paul Daniel says that the eastern half of the pond is less deep than the western half. The eastern half fills with sediment from the springs which flow from the surrounding catchment to the east.

Structure and Composition:

Three main groups of plants grow in and around the pond: underwater plants, emergent aquatic plants, and upland plants. The pond's plant structure is distinguished horizontally by the three groups. Underwater and emergent aquatic plants grow in the littoral zone, a transition zone from the pond to the land. The upland plants differ in vertical structure and grow at the ground, herb, shrub/ sapling, sub-canopy, and canopy layers. In the photo, you can see two emergent aquatic plants: cat tails (**a**) in the left foreground and bulrush (**b**) in the right foreground. Horsetails grow along the bank. Planted grass, found along the dam, is part of a managed, mowed, herb layer. Wildflowers like daisies grow in the scene too. Some of the largest honeysuckles in the Reserve grow east of the pond scene at the shrub layer. The upland tree composition is diverse; both native and planted trees grow on all sides of the pond. Willow and sycamore trees occur naturally on the pond shore on soils that were freshly deposited when the pond was built. White pines and Norway spruce were planted to the north and south, and a planted line of sweet- gum trees grows northwest of the pond.

The graph shows the change in land-use from agriculture to grazed-pasture to succession to forest.



The photo above was taken below the dam. *May, 1995*

Human Influences:

In 1957, the pond was constructed on the Bachelor Reserve. Dr. Paul Daniel says the pond is known by several different names: Hefner pond, the big pond (as compared to the smaller Boesel Pond), and the "Seeke" pond (which refers to the policing of the pond by security personnel in the 1960s when it was a skinny-dipping hot-spot).

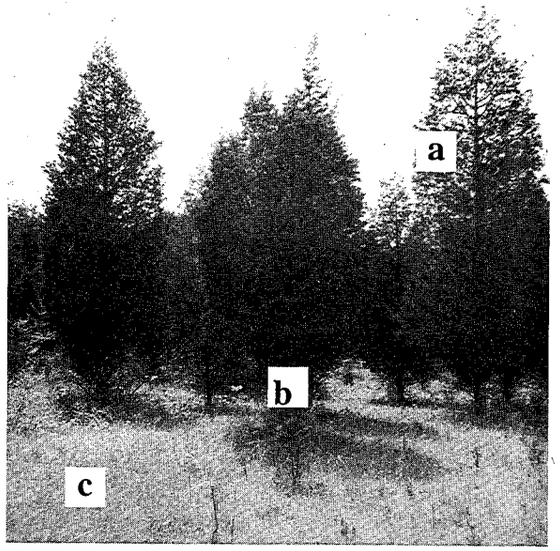
The graph above shows land-use changes associated with the lands immediately adjacent to the pond. The pastures west and south of the pond that were grazed from 1938-1950 and 1962-1968, respectively, are not represented by the graph.

The Soil Conservation Service designed the pond to supply water to the grazing cattle. The western bank of the pond is a human-made dam; the trail follows along the top of the dam. The well, pictured above, is a legacy from the former grazed-pasture. The well was built to the west of the pond in 1957. Underground pipes filled the well with pond water. The cattle that grazed in the surrounding pastures drank from the trough in the photo.

When the pond was built, pines were planted along its shore and it was protected by barbed-wire fences. Fences and tree lines still stand at the margins of the pasture and form a cattle corridor. The corridor begins near the well and runs along the northern edge of the pond as a boundary between Bachelor's lands and the Reinhart property to the north. The corridor guided cattle to pastures located west and south of the pond.

Scene 7: Open Juniper

The photo at right was taken at a compass angle of 270° and a tripod height of 1.6 m (4.6 ft). *May, 1995*



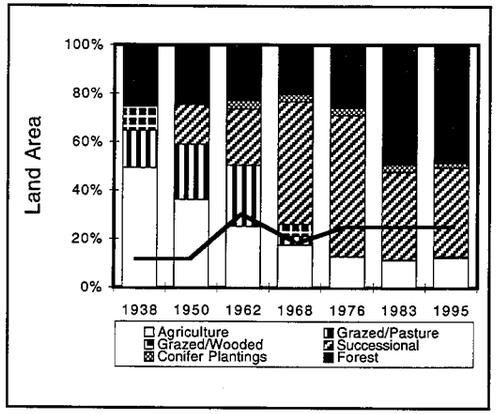
Environmental Setting:

The open juniper site is a rolling upland scene east of Harker's Run and west of Oxford-Milford Road. It's elevation ranges between 290-297 m (870 ft-890 ft). Several stream gullies, flowing west into Harker's Run, traverse the scene. Precipitation runs off of the slopes to fill these streams. South of the juniper scene is an adjacent successional closed forest of dense juniper, and the pond is to the north. The soil is very light-colored and was exhausted by farming and intense grazing.

Structure and Composition:

Four plant layers can be seen in the open juniper scene: tree (**a**), shrub/ sapling (**b**), herb (**c**), and ground (**d**) layers. Juniper is the only species that occurs as a large tree and is the most abundant small tree species with heights greater than 1 m (3 ft) in the open juniper scene. Osage orange, flowering dogwood, white ash, and other early successional small trees also appear in the scene. Amur honeysuckle shrubs less than 1.5 m (4.5 ft) grow in clusters at the base of juniper trees at the shrub layer along with other exotic shrubs like privet, Russian olive, and multiflora rose. Poison ivy is very dense in the open juniper scene too. Herbs include both narrow-leaved grasses and broad-leaved forbs. Grasses have greater cover in the open juniper scene, but the forbs contribute more to the plant diversity. Dr. Paul and Mrs. Lois Daniel pointed out open-field herbs like field daisies, goldenrod, and Queen Ann's Lace at the herb layer. Mosses, lichen, and ground pine make up the ground layer. Ground pine, pictured in the photo on the next page, grows in a circle at the base of many juniper trees. Why does ground pine grow exclusively at the base of juniper trees in the open juniper scene? Soils that provide essential nutrients for ground pine growth and the shade may be possible explanations. Many of the shrubs and herbs in the scene grow on the shaded north side of the juniper trees. The photo shows the asymmetrical shadow of the juniper trees. The shrubs and herbs

The graph shows the change in land-use from agriculture to grazed-pasture to succession.



The photo of ground pine above was taken with camera facing 45° down from a tripod height of 1.3 m (4.0 ft). May, 1995

are more abundant within the shadow than in the direct sunlight.

Human Influences:

The open juniper scene is the same age as the young floodplain forest (Scene 4). Both scenes entered succession after 1968. The differences between the two scenes are due to different environmental settings as well as different management. Prior to 1950, the juniper scene was farmed. After Bachelor's death, a new management plan designated the land east of Harker's Run for grazing. Heavy grazing by cattle occurred through the late 1950s, as directed by the Agricultural Conservation Program Service (ACPS). Farming, followed by intense grazing, exhausted the soils of nutrients and limited productivity. The topsoil was lost and the less fertile, light-colored soil is all that remains. Between 1958 and 1962, grazing declined and land restoration began with seeding and mowing of the pastures. The Daniels claim that the open juniper scene was a blackberry haven in the 1960s. The scene was grazed through 1968 and went into succession by 1976. Ken Havens, former Assistant Director of Facilities at Miami University, recalls that multiflora rose, another exotic shrub, grew along the fence rows at heights between 3 and 5 m (9-15 ft) from the 1950s through the 1970s. Multiflora rose still grows at the base of juniper trees, but it seems unable to compete with honeysuckle. Juniper and open-field herbs have successfully established. At present, the scene is still open. Deciduous trees like white ash, are only beginning to grow at the shrub/sapling layer. A unique feature of this scene is the greater plant density along the intermittent streams. Intermittent streams are typically dry and fill at times of large amounts of heavy precipitation. Woody plants, especially honeysuckle shrubs, tend to establish along the streams where soil moisture and soil disturbances are greater.

Scene 7: Open Juniper

Scene 8: Closed Juniper

The photo at right was taken at a compass angle of 240° and a tripod height of 1 m (3.3 ft). *May, 1995*

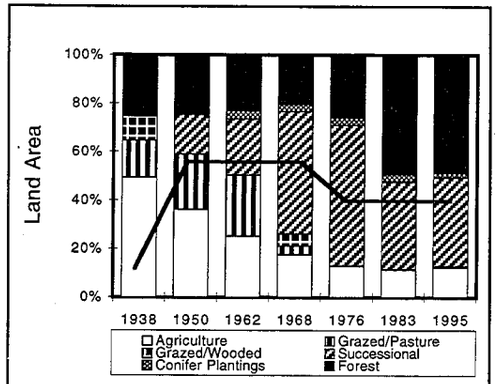
Environmental Setting:

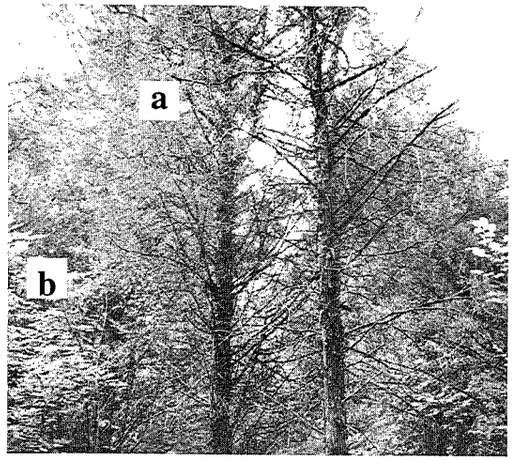
The closed juniper is a successional upland scene, east of Harker's Run, at an elevation of about 293 m (880 ft). As you follow the trail south, a convex (up) and concave (down) topography characterizes the closed juniper scene. Intermittent streams flowing west into Harker's Run in the concave gullies traverse the scene. The dense juniper scene is a continuation of the open juniper scene to the north. Mostly deciduous forests are south and west of the scene, while the Boesel property, now part of the Reserve, is to the east. Miami University graduate students live in the Boesel house, and in return they maintain the Reserve nature trails.

Scene Structure and Composition:

Four plant layers exist in the dense juniper scene: a merged canopy/sub-canopy, shrub/sapling, herb, and ground layers. Juniper trees comprise almost 85% of the canopy, the layer with trees that have diameters greater than 10 cm (4 in). The trees in the canopy/sub-canopy are about 15 m (45 ft) tall. The canopy and sub-canopy layers are not distinct by height, but rather by tree trunk diameter. Some of the juniper trees have diameters greater than 25 cm (10 in). Deciduous hardwoods like osage orange, cherry, and redbud have diameters of less than 10 cm (4 in). They merge with juniper at the canopy. Hardwood saplings like ash, cherry, sugar maple, buckeye, and black walnut comprise the sapling layer and suggest a transition toward a young forest. Juniper is no longer establishing and osage orange is dying-out under the shaded

The graph shows the change in land-use from agriculture to grazed-pasture to succession.





The photo above was taken at a compass angle of 172°, the camera pointed 40° up, from a tripod height of 1 m (3.3 ft). *May, 1995*

tree canopy. Shade-tolerant trees are now beginning to establish. The shrub layer is very diverse in the closed juniper scene. Young honeysuckle shrubs less than 1 m (3 ft) in height are very abundant. Other exotic shrubs like multiflora rose and privet are established on the upland convexity. Grasses, wildflowers, and ferns, like spleenwort, grow at the herb layer. Ground pine and mosses grow near the bases of juniper trees creating a nearly continuous ground cover. The Daniels believe that ground pine established in this scene within the last 20 years once the juniper became large canopy trees.

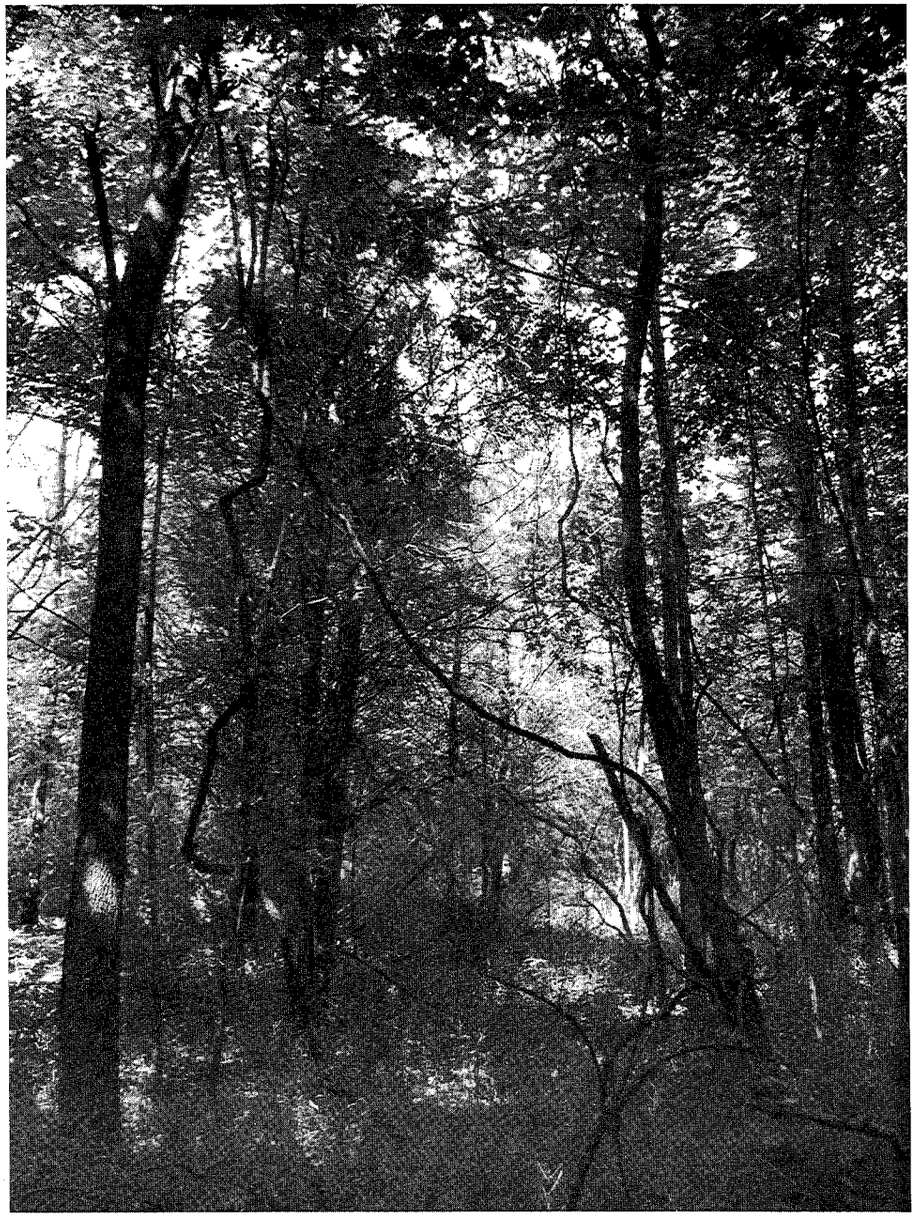
Human Influences:

The dense juniper scene was farmed prior to 1950; between 1950 and 1962 the scene was grazed. Agriculture and intense grazing exhausted the soil of its nutrients. In 1962, the closed juniper scene entered succession and is currently growing into a mixed-deciduous forest. Juniper (**a**) are beginning to naturally thin themselves out and broadleaf trees (**b**) are recruiting to the sub-canopy and canopy layers. The open juniper scene (7) and this closed juniper scene have the same environmental settings and similar plant compositions, but they differ in tree density and height. Time is probably the main factor explaining differences between the two scenes. Grazing ceased in this closed juniper scene almost eight years before it did in the open juniper scene. The tree canopy is closed and only shade-tolerant deciduous trees are able to establish and recruit successfully.

Ecotone 2:
Forest-Successional Transition

Another marked area of transition is between scenes 8 and 9. Ecotone 2 is photographed facing east along the fence line between successional forests to the north and an intermittent stream and grazed-deciduous forest to the south. Pioneer trees, like the osage orange and honey locust growing along the stream, establish in open sunlight, grow very fast, and die young. Shade tolerant trees, like maples and beech, can establish in more shaded areas, do not grow very quickly, but live long. Trees representative of successional and mature deciduous forests mix across this ecotone.

Scenes 8 and 9 are both flat, upland environmental settings. The differences between the two forests are a result of their former management. The grazed forest at scene 9 was released from grazing sometime between 1938 and 1956, while the closed juniper forest at scene 8 was cultivated and in pasture prior to 1962. A continuum of successional changes occurs along the trail between scenes 7 and 9, which result from former management. These transitions follow a time sequence according to when each area was removed from pasture. As you move from scene 7 to scene 9, the settings become increasingly shaded. Scene 7 is the most open because it was left as pasture through 1968. The herb layer is thick with wildflowers and grasses because it is open and receives lots of sunlight. The canopy may eventually close with juniper trees as shown in scene 8, fill with pioneer broadleaf trees (black and honey locust, osage orange), or form a mixture as seen across this ecotone. Since all communities between scenes 7 and 9 were in cultivation and grazed pastures, the principle differences in their composition and structure are attributable to time. To the south, at scene 9, is a grazed forest. This scene was not open pasture like the other grazed scenes, but rather the cattle grazed in mature forest. They would feed on young trees, shrubs, and herbs. Old beech, ash, and maples fill the canopy and allow little sunlight to support the sparse remaining herb and ground layers.

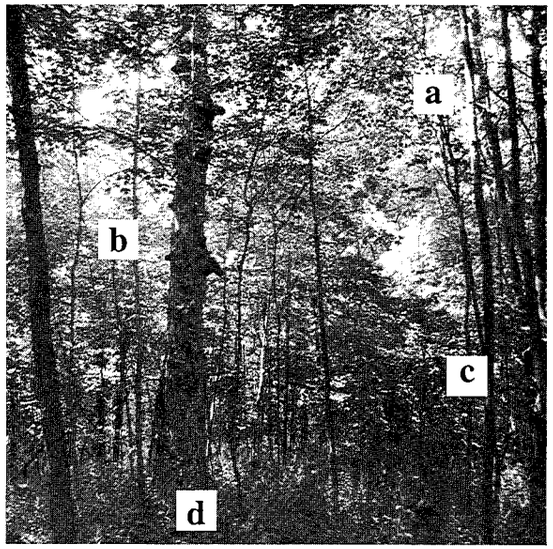


The photo above was taken looking east along a fenceline between scenes 8 and 9, and adjacent to an intermittent stream.

Ecotone 2: Forest-Successional Transition

Scene 9: Grazed Forest

The photo at right was taken at a compass angle of 312° and a tripod height of 1.6 m (4.6 ft). *May, 1995*



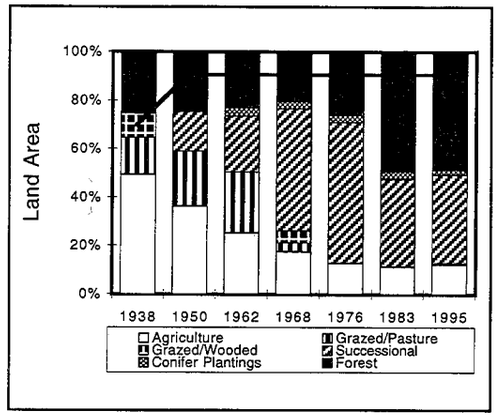
Environmental Setting:

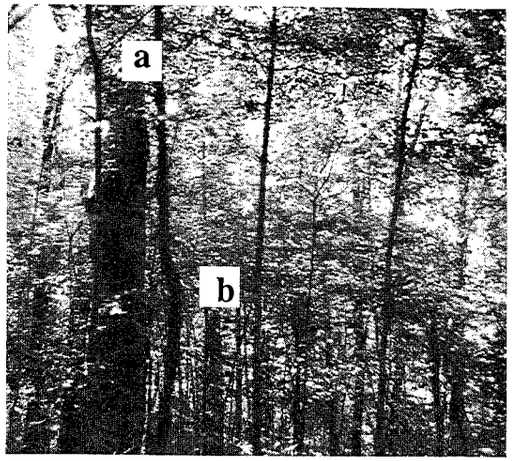
The grazed forest scene is located east of Harker's Run and west of Oxford-Milford Road. North of the grazed forest is a mixed successional and deciduous forest, slightly older than the closed juniper (Scene 8). A legacy fence line marks the transition zone between the two different scenes. A fence line between a pasture and the forest marks the eastern boundary. Older forests surround the grazed forest to the south and west. As you follow the trail into the mature forest, evidence of grazing disappears. The elevation of the grazed forest is about 287 m (860 ft), and the soils are glacially deposited. A single year layer of leaf litter covers the forest floor.

Structure and Composition:

Four structural layers dominate the grazed forest: the canopy (**a**), sub-canopy (**b**), shrub/sapling (**c**), and herb (**d**) layers. The largest canopy trees in the area are two standing dead beech, each with a diameter greater than 90 cm (30 in). White ash, live beech, and sugar maple also occur at the canopy layer. The smaller, sub-canopy trees with diameters between 10-20 cm (4-8 in) include sugar maples, white ash, and hickories. Notice the distinct differences in diameters and heights between the canopy and sub-canopy trees. A dense stand of sugar maple saplings thrives beneath the sub-canopy along with Ohio buckeyes, the state tree. Small honeysuckle shrubs less than 0.5 m (1.5 ft) dominate the shrub layer. The herb layer is a mix of both garlic mustard and mayapple. The percent cover of garlic mustard at the herb layer is close to 60% and about 10% for mayapple. Mayapple characteristically grows in clusters throughout the scene.

The graph shows land-use change from grazed-wooded to forest.





The photo above was taken to show the distinct canopy (a) and sub-canopy (b) layers. *May, 1995*

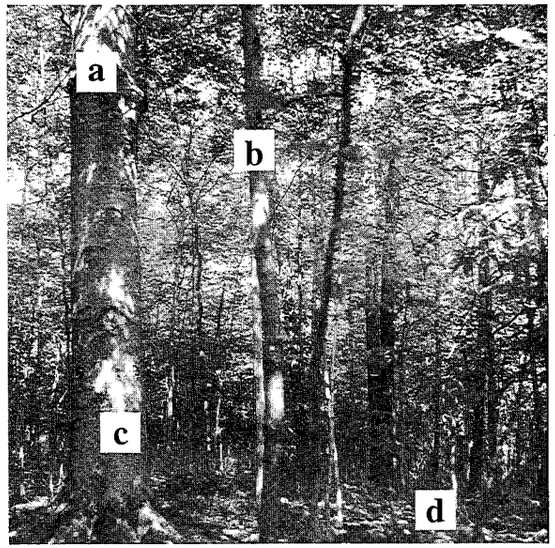
Human Influences:

The grazed forest scene borders several different scenes. At the eastern edge, sunlight enters the forest from the open pasture. This edge effect helps to explain the abundance of garlic mustard along that edge. The pasture provides a window for establishment of exotic herbs like garlic mustard, and shrubs like honeysuckle and privet.

Grazing is the primary management regime that played a role in determining the present forest structure. The significant number of large, old beech trees, both dead and alive, indicate that a forest was present prior to 1938. Air photos document that the scene was a wooded-grazed tract of land between 1938-1950. Grazing prior to 1950 explains the distinct height differences, as shown in the photo above, between the canopy (**a**) and sub-canopy (**b**) trees. The large trees were not influenced by grazing and continued growing. Saplings could not establish while the scene was grazed so the sub-canopy trees established after 1950. They are now about 40 years old. The greater gap between the forest layers suggests that grazing was more intense or longer here than at the southwest slope forest (Scene 2). No management occurred in the scene following grazing, which ceased around 1950. The scene then made a transition toward a mature forest. Dead wood indicates that humans did not chop and remove timber. The scene was classified as a successional forest in 1968, though no obvious evidence of past management supports this transition. According to ecologist Jim Runkle, osage orange, which is often found on formerly grazed sites and establishes in lighted settings, is present in the scene and supports that this area was grazed. Very few beech trees are present beneath the canopy. Rather, ash and maples seem to be flourishing. The forest may be changing from a grazed beech forest to a mixed deciduous forest.

Scene 10: Upland Forest

The photo at right was taken at a compass angle of 88° and a tripod height of 1.6 m (4.6 ft). *May, 1995*



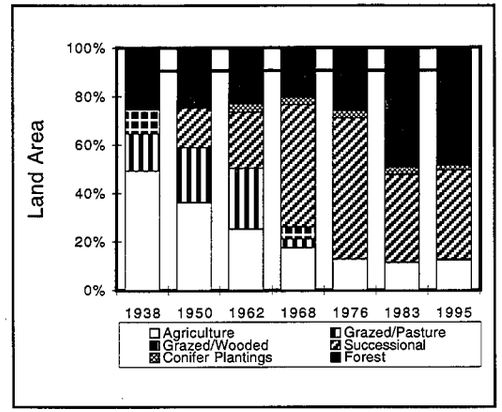
Environmental Setting:

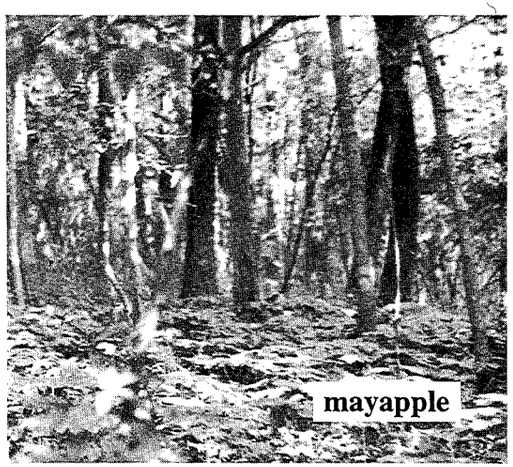
The upland forest scene is located at an elevation of 283 m (850 ft), east of Harker's Run in an area of the Reserve formerly called the Brown-Glover Tract. The scene is immediately surrounded by forested slopes to the south and west, and a forested flat upland to the north and east. Beyond the forests, scenes to the east were farmed and those to the south and west were grazed or have deep gullies. The upland soils are glacially deposited and covered by a single year layer of leaf-litter.

Structure and Composition:

The upland forest scene has four vegetation layers: the canopy (**a**), sub-canopy (**b**), shrub/sapling (**c**), and herb (**d**) layers. The canopy layer is tall and closed. The most common trees of the forest canopy are bitternut hickory, oak, white ash, sugar maple, and beech (the tree on the left margin of the photo above). The canopy beech trees are dying, but several sub-canopy beech, pictured above to the left of **b**, with diameters between 10-20 cm (4-8 in) occur in the stand. Flowering dogwood, buckeye, and other smaller canopy trees dominate the sub-canopy. Sugar maple saplings are abundant below the sub-canopy. Black haw, privet, and honeysuckle are common shrubs. The honeysuckle shrubs are less than 1 m (3 ft) in height. Both mayapple and garlic mustard are present at the herb layer. Mayapple grows in clusters on the flat upland, while garlic mustard is establishing up the slopes. The two herbs do not seem to intersperse. Wildflowers like bloodroot, toothwart, and sessile trillium bloom in the forest at different times during the spring, before the sun is shaded out by the leaves of the canopy and sub-canopy trees.

The graph shows that the upland forest has been a forest since at least 1938.





The photo above was taken at an 8° compass angle and a tripod height of 1.6 m (4.6 ft). May, 1995

Human Influences:

The upland forest scene is located within the Brown-Glover Tract, which was not a part of Bachelor's estate nor an original part of the Reserve. According to Dr. Paul Daniel, the Brown-Glover Tract was a beech/maple climax forest through 1962. Classification of aerial photos document the scene as a successional orchard between 1962 and 1968. Do you see any evidence of a former orchard like fruit trees or trees that establish in open areas like juniper, osage orange, and honey locust? Would a canopy layer of large, old trees be present if an orchard existed here in the past?

Over the years, the Miami University Natural Areas Committee acquired various tracts of land to add to the Bachelor Reserve. In 1984, 40 ha (100 acres) of the Brown-Glover Tract, where you stand, was traded for 40 ha (100 acres) of the Hawkins Tract, known today as the Ecological Research Center. The trade was arranged to preserve the Reserve as an unmanaged landscape and to designate lands for the University to use for experimental ecological research.

Tree-fall gaps are common in the upland forest. The sugar maple saplings, pictured in the background above, are establishing in the gap opening. Tree-fall gaps promote diversity and the establishment of new individuals. Presently, the growth of many small trees toward the canopy continues to support the regeneration of a mixed deciduous forest.

Selected Readings

Boden, Thomas. A., et al. 1984. "Management Plan for the Joseph M. Bachelor Wildlife and Game Reserve." Institute of Environmental Sciences, Miami University, Oxford, Ohio.

Chatfield, Thomas. 1991. "Creation of a Computer-Based Geographic Information System Database of the Joseph M. Bachelor Wildlife and Game Reserve, 1938 to 1988." Miami University, Oxford, Ohio.

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Kaufman, D. and C. Franz. 1996. *Biosphere 2000.* Kendall/Hunt Publishing Co., Dubuque, Iowa.

Luken, James O. 1990. *Directing Ecological Succession*. Chapman and Hall, New York.

Norton, William. 1984. *Historical Analysis in Geography*. Longman Group Limited, Essex, England.

Appendix

Trees:

American beech- *Fagus grandifolia*
ash- Fraxinus spp. (mostly *F. americana*)
basswood- *Tilia americana*
black walnut- *Juglans nigra*
buckeye- *Aesculus glabra*
cherry- *Prunus serotina*
cottonwood- *Populus deltoides*
black locust- *Robinia pseudoacacia*
black maple- *Acer nigrum*
box elder- *Acer negundo*
flowering dogwood- *Cornus florida*
elm- Ulmus spp.
(*U. rubra* and *U. americana*)
hickory- *Carya* spp.
(*Carya cordiformis* is bitternut hickory)
honey locust- *Gleditsia triacanthos*
juniper- *Juniperus virginiana*
**Norway spruce- *Picea* sp.
oak - *Quercus* spp.
(*Q. borealis, Q. muhlenbergii, Q. alba*)
*osage orange- *Maclura pomifera*
**red pine- *Pinus rubra*
redbud- *Cercis canadensis*
sugar maple- *Acer saccharum*
sweetgum- *Liquidambar styraciflua*
**white pine- *Pinus strobus*
willow- *Salix* spp.
sycamore- *Platanus occidentalis*

Shrubs:

*Amur honeysuckle - *Lonicera Maackii*
blackberry- *Rubus allegheniensis*
*multiflora rosa- *Rosa multiflora*
*privet- *Ligustrum vulgare*
*Russian olive- *Elaeagnus angustifolia*
Black haw- *Viburnum prunifolium*

Lianas (Woody vines):

grape- *Vitis* spp.
poison ivy- *Toxicodendron radicans*

Herbs:

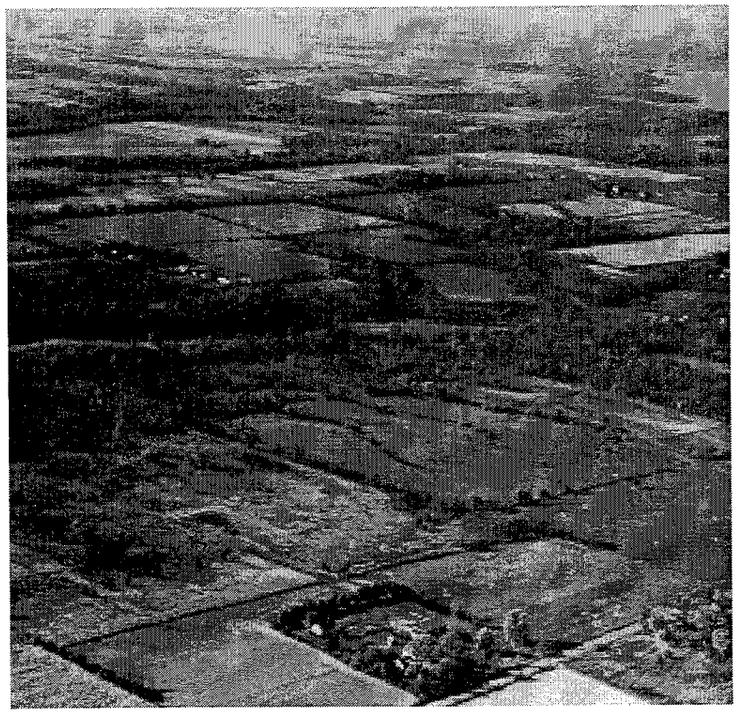
cat tails- *Typha* spp.
bloodroot- *Sanquinaria canadensis*
bigleaf waterleaf- *Hydrophyllum macrophyllum*
bulrush- *Scirpus pendulus*
Daisies- *Chrysanthemum* sp. or *Erigeron* sp.
goldenrod- *Solidago* spp.
horsetails- *Equisetum* sp.
*garlic mustard- *Alliaria petiolata*
maple-leaf hydrophyllum- *Hydrophyllum canadense*
mayapple- *Podophyllum peltatum*
Queen Anne's lace- *Daucus carota*
sessile trillium- *Trillium sessile*
Ebony spleenwort fern- *Asplenium platyneuron*
toothwart- *Dentaria laciniata*

Ground flora:

ground pine- *Lycopodium digitatum*
lichens- many species
mosses- many species
mushrooms- many species

* not indigenous, exotic
** mostly planted

Afterword



Aerial photograph of the Bachelor Reserve circa 1957. The perspective view is from Oxford-Milford Road, looking toward the pond at Scene 6, and then north to Acton Lake in Hueston Woods State Park. Photo (scanned) courtesy of the Bachelor Reserve and Other Natural Areas Committee.

Just as the Bachelor Reserve landscape has changed so very much from the open fields and fencerows of the mid 1950s, shown on the photo image above, we were amazed at the changes that occurred just while we were putting this guide together. The large beech tree in the center of Scene 9 dropped about two months after the photo shot in May 1995. The heavy rains of spring 1996 kept the level of Bachelor Pond up through the summer and limited the growth of cattails on the far end. Tall flowering garlic mustard plants dominated the old floodplain of Scene 1 in 1995, but in spring 1996 only the low young first-year shoots were apparent. Stability as a protected reserve is often overshadowed by the notable changes of a dynamic landscape: from morning-to-evening, day-to-day, month-to-month, year-to-year, and through time. How many new observations and interesting changes did you see during your walk through the Bachelor Reserve?

For More Information

If you have any questions, comments, or suggestions on the landscape guide and walking tour please contact:

Dr. Kimberly E. Medley
Department of Geography
Miami University
Oxford, Ohio 45056

If you would like to learn more about any of Miami's Natural Areas or to investigate educational or research possibilities available through the Natural Areas, contact:

Dr. Douglas H. Taylor
Chair, Bachelor Reserve and Other Natural Areas Committee
Department of Zoology
Miami University
Oxford, Ohio 45056

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Miami University
Oxford, OH 45056

You may designate your contribution specifically for the *Bachelor Reserve Landscape Guide and Walking Tour* or for the Bachelor Reserve and Other Natural Areas. If you have any questions, please contact Dr. Kimberly E. Medley at (513)529-1558.

Notes and Comments