Teacher's Guide to Geography and Ecology of Cross Creek

A Component of First Peoples: Archaeology at Meadowcroft Rockshelter

This program is made possible through the generous support of the C

Claude Worthington Benedum Foundation.

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Teaching Geography and Ecology at Meadowcroft Rockshelter

In debating the themes to *First Peoples: Archaeology at Meadowcroft Rockshelter,* the Educators Advisory Team repeatedly emphasized the need to cover the **geography** and the **ecology** of the Meadowcroft Rockshelter. At first, these themes were treated separately, but as work continued and ideas were tested on pilot audiences, it became clear that the **geography** and **ecology** themes should be combined to enhance student understanding. Meadowcroft Rockshelter is unique in that during the Pleistocene, despite the geographic proximity to glacial advances (within 80 miles), the Cross Creek valley maintained a **temperate ecology** displaying characteristics of **Carolinian biomes**. After the glacial period, the **ecology** of the **watershed** remained relatively stable throughout the next 12,000 years, with minor climactic episodes. In the case of Meadowcroft, the **ecology** cannot be separated from the **geography** of the place.

Students visiting Meadowcroft during pilots for *First Peoples* were especially captivated by explorations of the **geography** and **ecology** of the region. All grade levels enjoyed handling and interpreting various mapped representations of the Cross Creek **watershed**. To the Meadowcroft staff's surprise, even high school students became engrossed in observing the natural landscape surrounding the site and handling **evidence** about the numerous **species** that inhabit the forest and stream.

During a *First Peoples* field trip, all groups will experience the **Geography** and **Ecology** station at the Rockshelter. The staff interpreter will walk them through an exploration of the physical and human **features** of the landscape, **watershed** flow, and **habitats** of diverse aquatic and forest **species**. Hands-on touchable and guided observation of the natural **environment** helps to emphasize the diversity of the site, while leading students to draw the conclusion that with so many natural resources existing here over such a long period of time, the site would logically be attractive to humans.

Students exploring *First Peoples* virtually using the GigaPan images will be able to get close with many of the **features** of the landscape. The zoom capabilities on the images, particularly the exterior shot, enable the tiniest **feature** to be analyzed (this exercise would be especially interesting if students were to examine the trees in the exterior image to notice the bark and crowns, all **features** that professional arborists and foresters use to help classify **species**). Interest points for **geography** and **ecology** will lead students to draw the conclusion that diverse natural resources, a stable **environment** over a long period of time, and easy-to-navigate valleys resulted in continuous human occupation of the site over 16,000 years.

Intersection of Geography and Ecology Theme and Disciplines

The table below summarizes how the Geography and Ecology theme of the *First Peoples: Archaeology at Meadowcroft Rockshelter* curriculum can be used to explore various academic disciplines.

First Peoples Themes	Major Disciplines addressed in First Peoples				
	Science	History	Environment and Ecology	Geography	Technology and Engineering
Geography and Ecology	The topography of the region dictated the movements of early peoples. All aspects of prehistoric life were dominated by climatic conditions and the availability of natural resources. The processes that created and changed the physical landscape are still at play today.	All prehistoric human activity at Meadowcroft Rockshelter was dictated by the topography of the region and availability of natural resources.	The Cross Creek drainage displayed a stable, **temperate ecology** during the Pleistocene, despite being only 80 miles south of the glacial advances. The diverse **ecology** remained stable until the Historic Period.	The physical characteristics and natural characteristics of a landscape contribute to discussions of how people used and modified the land to meet their needs. The decreasing availability of natural resources and population explosions resulted in shifts from foraging to horticultural, then agricultural and industrial **cultures**.	Abundant natural resources provided materials for prehistoric tools. Adaptations to tools and techniques were influenced by the movement of peoples and the response to **environmental** conditions.

Geography and Ecology GigaPan Inquiry

The First Peoples Archaeology GigaPan addresses the following points of inquiry with students.

Objectives Students will . . .	Grade Bands	Indicators of Mastery Students will be able to . . .
• Describe the geographic location of Meadowcroft Rockshelter • Identify **watersheds** and describe how they relate to archaeology • Identify major **floral** and faunal **species** and their **habitats** • Describe a **temperate environment** and give examples of the **species** and conditions one might expect to encounter there • Describe **ecological** continuity over time in the Cross Creek **watershed**, using evidence from the site	11th - 12th Grade	• Analyze how geographic location impacted the **ecology** of the Cross Creek **watershed** during the Pleistocene and today • Analyze how **watersheds** impacted prehistoric land use • Evaluate the diversity of **floral** and faunal **species** and explain how diversity reflect the health of an ecosystem • Evaluate the implications of the paleoecology at Meadowcroft on previous paleo-ecological theories • Evaluate how **ecological** continuity impacts cultural patterns in the Cross Creek **watershed** throughout time
	8th- 10th Grade	• Explain how geographic location impacted the **ecology** of the Cross Creek **watershed** during the Pleistocene and today • Describe how **watersheds** impacted prehistoric land use • Describe the diversity of **floral** and faunal **species** and explain how diversity reflects the health of an ecosystem • Describe the paleo-ecology at Meadowcroft vs. accepted theories of paleo-ecology • Demonstrate the impact of a stable **ecology** on cultural patterns at Meadowcroft
	5th-7th Grade	• Identify three examples of how **geography** impacts **ecology** • Explain the drainage patterns for Cross Creek and the Ohio River; identify how these patterns impacted prehistoric human activity • Describe the diversity of **floral** and faunal **species** and explain how diversity reflects the health of an ecosystem • Describe the prehistoric **climate** and explain why this is surprising given Meadowcroft's proximity to glaciers • Explain the continuity of the **ecology** by citing evidence from the **excavation** and evidence from the landscape today
	K- 4th	• Recognize that geographic location can help you understand what the **ecology** of an area is • Identify the Cross Creek and Ohio River **watersheds** • Recognize the two primary **habitats** at Meadowcroft and identify three **species** that inhabit each • Recognize that Meadowcroft has a **temperate climate** • Recognize that the same plants and animals that lived at Meadowcroft during prehistoric times can be found there today

Major Terms and Concepts

Scattered throughout the curriculum guide and GigaPan exploration are terms highlighted in bold. These include key vocabulary terms, concepts, and items of significance. Teachers can incorporate the terms in vocabulary and spelling lists

Terms	Concepts	Identification Significance
Climate	Constant Volume Samples	Meadowcroft Rockshelter
Deciduous	Dendritic drainage	Ohio River
Ecology	Glacial Periods	Monongahela River
Geography		Carolinian Biome
Floodplain		
Flora		
Fauna		
Uplands		
Lowlands		
Precipitation		
Species		
Springs		
Slope		
Springs		
Temperate		
Topography		

Use the Geography and Ecology GigaPan Exploration guide to learn about how ecology impacts cultural patterns.

The Geography of the Cross Creek Watershed

Meadowcroft Rockshelter is located in northern Washington County, PA, roughly 35 miles southwest of Pittsburgh and just over 2 miles from Avella, PA. The site is situated on the north bank of Cross Creek, a small **tributary** of the Ohio River, which lies roughly 7 miles to the west. The site is in the Pittsburgh Plateaus Section of the Appalachian Plateaus Physiographic Province.

Meadowcroft Rockshelter is oriented roughly east-west with a southern exposure, and stands approximately 50 feet above Cross Creek and 803.5 feet above sea level. The area protected by the extant **sandstone** overhang is ca. 213 square feet while the overhang itself is about 42.6 feet above the modern surface of the site. In addition to the potential availability of water from Cross Creek, springs are abundant in the immediate vicinity of the shelter. The prevailing wind is west to east across the mouth of the shelter providing almost continuous ventilation and ready egress for smoke and insects. The Cross Creek **floodplain** below, and bluff face and bluff top immediately around Meadowcroft Rockshelter, are currently covered with a mixed **deciduous** forest.

On the bluff top behind Meadowcroft Rockshelter, several reconstructed villages are erected. The villages and Rockshelter are currently open to the public as Meadowcroft Rockshelter and Historic Village. The museum is owned and run by the Historical Society of Western Pennsylvania.

The Cross Creek Watershed

Meadowcroft Rockshelter owes its rich **history** and very existence to the Cross Creek **watershed**. Cross Creek is one of fifteen main **watersheds** in Washington County, Pennsylvania. The Cross Creek **drainage system** encompasses 14,164.4 ha (35,000.7 acres) of land in Washington County and Brooke County, West Virginia. The creek flows northwestward to westward, crossing into Brooke County, West Virginia and emptying into the Ohio River.

The boundaries of the Cross Creek **watershed** was formed by the hilly **topography** of the area; 50% of the **watershed** is in valley **slopes** with limited **upland** and valley bottoms. The drainage system is **dendritic**, with multiple small streams leading into three forks that flow northwestward to westward. The south fork roughly parallels modern Rea Road (Pennsylvania Route 50), while the North fork roughly parallels Cross Creek Road. The Middle fork roughly follows Patterson Road and converges with the North Fork near Patterson Mills. The two forks converge at the town of Avella. Meadowcroft Rockshelter is located just downstream from this convergence and approximately 7 miles upstream from the **confluence** with the Ohio River.

The Ecology of the Cross Creek Watershed

The Cross Creek drainage is located on the northern edge of a great **deciduous** forest that occupies most of the eastern United States. The forest starts in southern Michigan towards western New York, south to Tennessee, east to Georgia and the Atlantic Coastal Plain and north to Connecticut. This region is sometimes referred to as the **Carolinian Biotic Province**, which is bordered on the north by the

Canadian Biotic Province. The **climate** of the area is characterized by a wide seasonal temperature range with a moderate amount of **precipitation** falling primarily during the warm parts of the year.

In Washington County, PA, the yearly temperatures range from -20°F during the winter months to 90°+F in July and August. The temperatures tend to be lower in hilly areas than in more level parts of the county, with nighttime temperatures dropping colder than daytime. Meanwhile, daytime temperatures are generally higher in valley bottoms than on hilltops. Approximately 22 inches of rain fall during the 150 frost-free growing season days, with an average total of 40 inches of rain falling annually.

The vegetative cover in the Cross Creek **watershed** is a mosaic of second-growth forest, abandoned fields and pastures, agricultural tracts and residential areas. The degree of vegetation is principally determined today by the amount of disturbance, with the degree and exposure of **slope** also impacting vegetation. At one time, forest covered the entire **watershed**. **Mixed oak forests** dominated hill-tops and south-facing **slopes**, mixed Appalachian **mesophytic forests** on north-facing **slopes** and in headwater coves, and **riverine** forests on alluvial **floodplains**. Today, around 40% of the area is wooded, though little of it is old growth. Most of the area was cut in the early nineteenth-century when the land was first cleared and prepared for agriculture. Areas which are reforested have been repeatedly logged and represent secondary forests. Woodlands that could mature are beginning to resemble original stands.

The Cross Creek drainage supports a remarkably varied range of **terrestrial** and **avian fauna** of typical Carolinian type. However, this modern **faunal assemblage** at Meadowcroft is a pale reflection of that which was once established in the **deciduous** oak/hickory forests of the area following the end of the Wisconsinan glaciation. As late as the beginning of the Historic Period of the eighteenth-century, elk, black bear, mountain lion, wild cat, timber wolf, fisher, otter, beaver, wild turkey and passenger pigeon could be found in the hills of western Pennsylvania. Hunting and the rapid replacement of forest by cleared land devoted to cultivated crops and dairy farming in the nineteenth century soon altered the **faunal** population of the area. Today, thanks chiefly to game **conservation** laws and the onset of secondary forest growth, the **faunal assemblage** has regained some of its former character. Today, the white-tailed deer, cottontail rabbit, gray and fox squirrel, ringneck pheasant, bobwhite quail, ruffed grouse, muskrat and mink constitute the principle game **species** of the area.

While many of the larger **mammals** died out or moved on, smaller mammals often survived the end of Wisconsinan glaciation and the deforestation of the Historic Period. During the 1973-78 archaeological **excavations**, field crews observed numerous representatives of this group, including gray squirrel, fox squirrel, gray fox, raccoon, and a large and abundant variety of rodents. Smaller mammals abound, including chipmunk, southern flying squirrel, meadow vole, woodland vole, southern bog lemming, white-footed mouse, meadow jumping mouse, short-tailed shrew, least shrew, smoky shrew, hairy-tailed mole, least weasel, long-tailed weasel and several **species** of bats. In some cases, deforestation benefitted smaller mammals: cottontail rabbit, groundhog, opossum, skunk and red fox are more prevalent today than in pre-historic times. Several domesticated animals are found in the region, including horses, cows, sheep, pigs, dogs, cats, rats and house mice.

Avian **fauna** of the area reflects the continuing adjustment to changes in how the land is used and vegetative cover. Generally, forest-dwelling **species** have diminished in preference to open-country forms since the advent of historic settlement of the region. The ruffed grouse, wild turkey, and the introduced ringneck pheasant comprise the game birds of the area. Man has introduced the rock dove, English sparrow and the starling to the inventory of birds. Thirty other **species** of resident and migratory birds reside in the immediate vicinity of the Rockshelter today. Missing are the abundant numbers of waterfowl, including swans, ducks, and geese that prevailed in the region prehistorically.

Terrestrial and riverine **reptiles** are represented by black snake, garter snake, box turtle and snapping turtle. **Amphibians** include various salamanders, toads, tree frogs and bull frogs. Due to pollution from sewage and mine effluvia in the twentieth-century, numbers and variety of fish are depleted from those seen in Cross Creek prehistorically. However, due to conservation efforts, the numbers and variety of fish are increasing, with 26 **species** of fish documented.

The Paleo-environment of the Cross Creek Watershed

Data from pollen, wood, charcoal, fruits, and seed excavated at Meadowcroft Rockshelter indicates that the **ecology** of the area did not change drastically throughout the 16,000 years represented by the **floral** remains. The presence in earliest time periods of Oak, Walnut, and Hickory **species** argues against the prevalence of boreal or tundra conditions within the site's vicinity during late glacial times. All **species** present in the fossil record are also present in the contemporary **flora** of the area. A similar picture has developed quite independently from an examination of the vertebrate **fauna** at the site; **faunal species** present at the end of glaciation did not drastically decline in numbers until overhunting during the Historic Period.

Much of the **evidence** about the paleo-environment of Meadowcroft comes from **floral** and **faunal** remains found in lower Stratum IIa. All the identified **species** are found in **temperate climates** today. Eleven bone fragments were recovered from this level, including white-tailed deer, eastern chipmunk, southern flying squirrel, deer mouse, passenger pigeon, toad and colubrid snake (Guilday and Parmalee 1982:171). The chipmunk and possibly the deer mouse burrowed down into these levels. **Floral** remains from the earliest levels are similarly sparse, but generally are representative of **temperate climate species**. Walnut and oak wood charcoal and walnut nutshells were identified from lower Stratum IIa (Cushman 1982:214).

Floral Remains

Meadowcroft Rockshelter is one of the few well-documented **archaeological** sites in the northeastern United States from which several types of fossil botanical material have been recovered. Material includes seeds, fruits, pollen, wood, and charcoal, with the collection spanning a chronological period of approximately 16,000 years.

To extract botanical data from the **excavation** site, soil samples for pollen analysis were taken from four squares (two inside the **dripline** and two outside the **dripline**) through all **strata**. A sample of 10% of all sorted macrobotannical material recovered from the site was analyzed, consisting of more than 30,000 separate pieces of plant remains. Twelve additional columns (Strata I-XI) were taken. Sediment from these columns was floated in hydrogen peroxide solution to separate heavy fractions (larger seeds and nutshells) from light fractions (smaller seed and charcoal) of botanical material. Most of the data about prehistoric trees was drawn from charcoal. The majority of fruit and seed remains, including some portions of nutshell are non-carbonized. This type of material does not often survive in **archaeological** sites outside of a carbonized form. However, at Meadowcroft, much of the non-carbonized plant material was enclosed in sealed, clay-lined storage pits constructed by the First Peoples. The **context** of most of fruits and seeds was associated with uncontaminated **cultural features** (Cushman 1982: 218).

Several **species** of plant remains recovered from Meadowcroft represent probable human foods. These include hackberries, walnuts, hickory nuts, blackberries/ raspberries, cherries, grapes, and goosefoot. Uppermost Stratum III and Stratum IV produced the earliest domesticated plants yet known for the Upper Ohio valley: *Cucurbita* sp. (squash) and sixteen row Zea mays (corn).

Paleo-botanists examined the botanical materials to determine prevailing **ecological** and **environmental** conditions in southwestern Pennsylvania during this period. The data indicates that vegetation in proximity to Meadowcroft was a mixed conifer-hardwood nature throughout the 16,000 years documented. In the earlier periods, oak and walnut **species** dominated, arguing against the boreal or tundra conditions expected in this proximity to the glaciers. The data supports that of the **faunal** remains: a **temperate**, **Carolinian environment** like that in the region today (Cushman 1982: 207-240).

Vertebrate Faunal Remains

The vertebrate **faunal** remains from Meadowcroft indicate a vigorous raptor (primarily owl) roost and a continuing but intermittent Indian occupation throughout the **faunal sequence**. **Ecological** analysis by **stratum** suggests that the major **features** of the **temperate** biota, and by inference the vertebrate resources of the human inhabitants of the Rockshelter, remained unaffected by minor climatic adjustments from 11,000 B.P. until the Historic Period.

Vertebrate Faunal Remains at Meadowcroft Rockshelter

Types	Number of species	% of total
Birds	66	44.3
Mammals	44	29.5
Reptiles	27	17.4
Fish	8	5.3
Amphibians	5	3.7

In comparison with Meadowcroft Rockshelter, no other North American **archaeological** site has yielded the remains of so many vertebrate **species**, enabling Meadowcroft's research team to accurately reconstruct the prehistoric **fauna** of the site. Remains of 5,634 individual vertebrates (115,166 bones or fragments) were examined. The **faunal** remains derive from three sources: 1) the feeding activities of birds of prey, 2) hunting by Native Americans, and 3) **species** that lived or died in or about the accruing deposit. Approximately 93% of the remains are in the form of digestive pellets regurgitated by raptorial birds roosting on the cliff face (the percentage varies by **strata**). Approximately 7% of the identified remains were detritus from Native American foods. A tiny percentage of the remains were from the **species** that lived or died in the deposit (Guilday1982: 163-165).

Fish remains at Meadowcroft were rare. All the **species** were found locally in Cross Creek into the Historic Period. Fish bones are mostly from minnow-sized individuals that appear in the raptor garbage of the site. Toad bones also appear in raptor garbage; of the 7,021 amphibian bones, 96% are toad. However, one amphibian, the giant aquatic hellbender salamander, appears in the vertebrate record at Meadowcroft and at other western Pennsylvania **archaeological** sites, indicating that it was likely a minor food item for Native Americans. Reptile remains include four **species** of turtles still found near Meadowcroft, three small lizard **species** (two which can still be found nearby), and twenty **species** of snakes (four which no longer live nearby).

The avian **assemblage** is essentially modern except for the passenger pigeon and trumpeter swan, with all other **species** still occurring in western Pennsylvania as late as the beginning of the twentieth-century. Three **habitat** types are reflected by the diversity of birds: forest, mixed forest-edge (brush/ grassland), and aquatic/ semi-aquatic. About 75% of all bird remains are from passenger pigeon which

formerly inhabited the mast forests in tremendous numbers. Butchering marks on turkey bones indicate that some individuals served as food for native people.

The mammalian bone record is dominated by raptor debris: 71% of the mammal bones recovered at Meadowcroft were southern flying squirrels that served as prey for the owls roosting in the Rockshelter. The presence of large numbers of flying squirrels indicates two points about the **ecology** of prehistoric Meadowcroft: 1) high populations indicate a mature mast (nut bearing) forest setting consistent with the mixed oak-elm-hickory forest around Meadowcroft and 2) no northern flying squirrels, a **species** characteristic of the Canadian biotic province, were found at Meadowcroft based on measurements of 719 complete adult flying squirrel humeri found in the **sequence**.

Indian refuse is dominated by the remains of white-tailed deer, with a minimum of fourteen adults and at least ten fawns present. No valid cultural observations can be based on this sample because it is relatively small considering the depth and timespan of the site. However, butchering marks were noted on deer, elk, turkey, ruffed grouse, and hooded merganser bones. Deer and turkey bone awls, deer bone beamer fragments, and six partial box turtle carapace cups were also recovered.

The vertebrate **evidence** from Meadowcroft presents a straightforward picture of a **temperate** "modern" **biota** from the early Historic Period to as far back as 11,300 B.P. In **strata** older than this, ground conditions were not as conducive to bone preservation, so **faunal** remains are rare. Of the one hundred and forty-nine vertebrate **species** represented at Meadowcroft, twenty- one no longer occur at or near the site; fifteen of these are due to human-induced **ecological** changes and six are reptile **species** whose range now lies further to the south and west of the site. The presence of these six-reptile **species** in the middle **strata** of Meadowcroft indicates milder **environmental** conditions during portions of the Woodland Period.

Invertebrate Faunal Remains

Changes in regional paleo-ecology were documented through a study of terrestrial gastropods (land snails) and naids (freshwater mussels). The findings corroborated those of the paleo-vertebrate and paleo-botanical studies: prehistoric Meadowcroft had a **temperate ecology**. The recovery of land snail remains provided information on the vegetation, amount of moisture, shade, and physical **habitat** available at prehistoric Meadowcroft. These attributes were used to reconstruct the **ecology** of the site and its **environments** for each **stratigraphic** level of the Rockshelter. Snails of all ages were found in the Rockshelter, suggesting natural **deposition**. Curiously, the malacologists (scientist who study gastropods and mollusks) surmise that most of the snails were drawn to feed in the Rockshelter due to the concentration of garbage from native peoples. The **habitat** requirements of freshwater mussels also demonstrated **temperate** conditions. However, the naids found in Meadowcroft were brought to the site by humans, skewing the sample of represented **species** and revealing more about native foodways than about **ecology**.

The presence of particular **species** indicates a preference for particular **habitat**. Three gastropod **habitat** requirements were used to gauge **environmental** change at prehistoric Meadowcroft: humidity, vegetation, and physical **environment**. The data from gastropod recovery indicates a stable **environment** for at least the past 11,000 years, before which time insignificant data could be gathered to allow for **environmental** reconstructions. During the Archaic Period, conditions were very moist, with maple and willow appearing in the mixed oak forest. In the Transitional and Early Woodland Periods, the **environment** was slightly cooler, evidenced by increased numbers of gastropods common in mixed forests that include pines. By the Late Woodland Period, slightly drier conditions resulted in mature mixed oak forests.

Summary

The prevalence of **temperate floral** and **faunal species** recovered from the **excavation** at Meadowcroft Rockshelter indicates that the transition from boreal to **temperate** conditions at the end of the Pleistocene occurred quickly in the Upper Ohio Valley, despite the geographic proximity to the glaciers. The well-documented paleo-botanical and paleo-zoological record support claims that the Cross Creek drainage would have been an attractive location for the occupation of prehistoric cultural groups from the late Pleistocene and continuing through the present day.

Geography, Ecology, and Human Settlement Patterns

The **geography** and **ecological** characteristics of the Cross Creek **watershed** directly affect the pattern of human behavior in the region. Much of Cross Creek can be easily accessed by roads running parallel to the main branches of the creek. Most students who visit Meadowcroft Rockshelter will travel there via either Cross Creek road (which parallels the north branch of the creek) or Pennsylvania State Route 50 (which parallels the south branch). Students exploring the site virtually can see these transportation routes clearly on maps or by searching in Google Maps for street views. The flat ground along the creeks was a natural location for human travel in a landscape otherwise crossed by ridges and steep valleys.

As you drive through or virtually explore the **watershed**, you might note significant alteration to the landscape, with strange patterns of trees growing in seemingly natural areas. Abandoned agricultural fields are common and are in various states of **succession** depending on the previous use and time since that use. Old pastures quickly become forests, while cultivated fields are slower to return to woodland. Old agricultural areas follow a general rejuvenation pattern. First, a variety of grasses and herbaceous plants appear, followed by thickets of woody shrubs, briars and young shade intolerant trees, including red maple, black cherry, aspen, and tulip tree. As primary trees mature, shade-tolerant such as oak, sugar maple, beech, cucumber, hickories and gum begin growth. This final phase results in permanent forest cover of one of the previous types. This progression can be seen in many abandoned agricultural fields with extensive thickets of young black locust and hawthorn, while old fence rows are now lines of black locust and wild black cherry trees. Slowly, the forests are rejuvenating. Strip mines are another

common alteration to the landscape, though some reclamation has been attempted. Old spoil banks have scattered growth of black locust. More recent mines have been regraded and planted with a variety of pines and spruces. The vegetation patterns can explain human activity in the Cross Creek **watershed**.

Ecology and **Geography** have a direct impact on archaeology. Waterways were the roads of prehistoric peoples. Mature drainage basins like Cross Creek offered a direct path to the natural resources that people use to make tools and create shelter. Similarly, the **temperate** pre-historic **ecology** ensured abundant food sources, particularly in the autumn when nuts are abundant and game animals are plump. The Cross Creek **watershed** reveals clues about human behavior in the past and in the present. Meadowcroft Rockshelter is just one site of human occupation in the Cross Creek valley; surveys of the **watershed** yielded numerous villages, hunting camps, burial mounds, and other prehistoric cultural sites. The waterways of the region reveal patterns of human movement and help us understand the significance of sites like Meadowcroft. And, since the Cross Creek **watershed** drains into the Ohio **watershed**, and the Ohio into the Mississippi **watershed**, the **archaeology** at Meadowcroft Rockshelter provides a piece of the story about the settlement patterns of early people in the central United States. This pattern is most strongly seen in the similarities between Midwestern Adena **cultures** and those of the Cross Creek Valley from the Middle Woodland Period through the Historic Period.

The **archaeologists** at Meadowcroft focused on how prehistoric people adapted to changes in the natural world. Cultural evolution occurs because humans adapt to changes in natural and cultural **environments**. The **ecofacts** and **geofacts** gathered during the **excavation** provided **evidence** about *what* prehistoric people may have been reacting to as they adapted. The material remains of **artifacts**, **features**, and settlement patterns are the **evidence** used by **archaeologists** to trace *how and why* adaptations by prehistoric cultural groups occurred. Used together, all the data from the site informs interpretations of the technology, settlement patterns and populations, and subsistence patterns. The interpretations would be severely limited by ignoring **ecological** data because the factors of change would be missing from the equation. Due to the **methodical**, **multi-disciplinary excavation** of Meadowcroft, the **archaeological evidence** supports a complete and fascinating story about prehistoric cultural adaptation.

Tables

Contemporary Flora in the Cross Creek Drainage

	Trees (Dominant and Common)	Shrubs	Herbaceous Layer
Mixed Oak Forests	White Oak (D) Red Oak (D) Red maple, Sugar maple, Hickories, Black birch, American beech, Tulip tree, Chestnut Oak, Black oak, Scarlet Oak	Juneberry, Maple-leaved viburnum, Flowering dogwood, Poison ivy, Summer grape, Mountain Laurel	In spring: Early saxifrage, Rupanemone, Starry campion Later seasons: Shinleaf (D), Spotted wintergreen(D), Tick trefoil (D), Black snakeroot (D) Common grasses: Linear leaf panicum, Bushy panic grass, Canada brome grass.
Riverine Forests	Sycamore (D), Black Willow (D), Sugar Maple, American beech, White basswood, On the **floodplain**: Box elder, Sweet buckeye, Black Walnut, Silver maple	Elder, Ninebark, Willows, Hoptree, Bladdernut, Silky dogwood, Smooth alder	
Mixed Mesophytic Forests	Sugar maple (D), American beech (D), Tulip tree (D), White oak (D), Red oak (D), White basswood (D) Red maple, Yellow birch, Hickories, White ash, Black walnut, Cucumber tree, Black gum, Wild black cherry, Eastern hemlock	Juneberry, Flowering Dogwood, Witch-hazel, Spicebush, Pawpaw, Virginia Creeper, Wild Plum, Redbud	Vernal and Pre-vernal: Trillium, Violets, Blue Phlox, Trout Lilly, Larkspur, Spring Beauty, Toothwarts, Solomon's Seal, Jack-in-the pulpit

Gastropods and Environmental Change at Meadowcroft Rockshelter

Stratum	*Period/ Years Before Present*	*Preferred Habitat and Conditions*
Stratum XI		Oak-elm-hickory forest is preferred. Conditions were like prevailing conditions today.
Stratum X	685 B.P. Late Woodland	Oak-elm-hickory forest is preferred. Conditions were slightly drier, with a decrease in pine populations in the immediate area.
Stratum IX	685 B.P. Late Woodland	Oak-elm-hickory forest is preferred. Conditions were like those in Stratum XI.
Stratum VIII	Late Woodland, 685 B.P.- 690 B.P.	Oak-elm-hickory forest is preferred. Open woods were the predominant **habitat**, with drier conditions.
Stratum VII	Late Woodland, 925 B.P.- 1,290 B.P.	Oak-elm-hickory forest is preferred. Not enough data to comment on conditions; likely similar to Stratum XI.
Stratum VI	1665B.P.- 1290 B.P.	Moist areas of oak-elm-hickory forest situated on bluffs and in open woods.
Stratum V	Early/ Middle Woodland, 2155 B.P.- 1665 B.P.	Moist conditions within an oak-elm-hickory forest with a mixture of pine, maple, and willow. Conditions were slightly cooler than today.
Stratum IV	Transitional/ Early Woodland, 3050 B.P.- 2290 B.P.	Oak-elm-hickory forest is preferred. Conditions like Stratum XI, with a somewhat higher level for Cross Creek during this time.
Stratum III	Archaic/ Transitional, 3,255 B.P.-2,930 B.P.	Oak-elm-hickory forest dominates with an increase in maple and willows. Moist to very moist conditions. Levels of Cross Creek were likely higher, accounting for the increase in maples and willows.
Stratum IIb	Archaic, 5,300 B.P. – 3,210 B.P.	No significant trends. Likely similar to conditions today.
Stratum IIa	Paleo-Indian and Early Archaic, 19,600 B.P. – 8,010 B.P.	Oak-elm-hickory forest with some pines. Cross Creek was at its highest level, indicated by the dominance of **species** preferring moist conditions on flood plains.

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