

# The Tawawa Woods Natural Landmark: I. Survey of Flora and Land Use History<sup>1</sup>

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**ABSTRACT.** The Tawawa Woods Natural Landmark, Wilberforce, Xenia Township, Greene County, OH (39° 43' N, 83° 52' W), and the associated riparian forest corridor along Massies Creek has nurtured at least five human cultures over the past three millennia: Native Americans (Adena ca. 1000 BC, Hopewell ca. 100 BC, and Shawnee in the 17<sup>th</sup> to early 19<sup>th</sup> centuries), European Americans, and African Americans. The purpose of this study was to document the land use patterns of these cultures and their influences on the hydrological and botanical characteristics of Tawawa Woods as a basis for understanding the current dynamics of the woods. Archival accounts from photographs, correspondence, departmental board minutes, surveys, maps, and existing physical structures were used to reconstruct prior land use patterns. Historic tree species diversity was estimated using land surveys from 1799-1856. Current tree species composition of Tawawa Woods was estimated using a combination of plot and point-centered quarter sampling methods. Tree and herbaceous species outside plot sample areas were identified by walk-through surveys and documented with photographs. Historic accounts suggest that the number of springs and flow rates had significantly decreased by the beginning of the 20<sup>th</sup> century. Release of pollutants into Massies Creek, deposits of refuse into the woods, and continued demand for lumber during the late 19<sup>th</sup> and early 20<sup>th</sup> centuries may have altered both water tables and biodiversity. Witness tree data identify 15 different tree species, while current surveys recognize 31 tree species and at least 79 herbaceous and vine/shrub species.

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## INTRODUCTION

As part of a growing commitment to preservation of natural areas in Ohio, the Nature Conservancy commissioned Hunt (1956) to identify the most significant natural areas in the state. Hunt identified approximately 30 "choice sites," one of which was Tawawa Woods (Wilberforce Beech Woods), Wilberforce, OH. This site borders Central State University and the former site of Wilberforce University, and is owned by Central State University. During the ensuing decade, the list of identified natural areas grew to over two hundred; in 1973 Herrick was commissioned to compile and publish an up-to-date list. Herrick's survey and another one commissioned by the United States Department of Interior (Stein 1974) described the Tawawa Woods as a climax beech (*Fagus grandifolia*) forest with herbaceous flora. Because of extensive damage by an F5 tornado on 3 April 1974, this forest offers a unique potential for studies of natural forest recovery and succession. Therefore, 22.0 ha of the woods officially were designated the Tawawa Woods Natural Landmark in 1990 in a joint agreement between the Ohio Department of Natural Resources—Division of Natural Areas and Preserves and Central State University (CSU) (Merkh and Silvius 1990). Tawawa Woods is linked to a riparian forest that forms an essentially unbroken 13.0 km forest corridor along Massies Creek from Indian Mound Park at Cedarville, OH, to its confluence with the Little Miami River near Oldtown, OH.

The Tawawa Woods Natural Landmark, Xenia Twp., Greene Co., OH (39° 43' N, 83° 52' W) is bounded by Wilberforce-Clifton Road on the west, Massies Creek on the north, and the CSU campus to the south and southeast (Fig. 1). Massies Creek is a major tributary of the Little Miami National Scenic River. The Tawawa Woods Natural Landmark has an area of approximately 22.0 ha and includes a riparian forest adjacent to Massies Creek and an upland forest community on north-facing slopes ranging from approximately 270.0 to 300.0 m.a.s.l. near the forest edge bordering the CSU campus (Fig. 1). A 5- to 100-m zone nearest the CSU campus and to the south and east of the current Landmark boundaries has a long history of more intense human usage and disturbance, and will be referred to as the "perimeter region" (Fig. 1).

Greene County, OH, is part of the Southern Ohio Loamy Till Plain (Brockman 1998). The current drainage of Massies Creek in a westerly direction through this valley was established when meltwater from the receding Wisconsin glacier cut deeply across the broad Cuba End Moraine (Gordon 1969), leaving a rather narrow floodplain bordered by steep slopes and ravines composed of deep gravelly soils. The slopes range from 10 to 50%, and steep ravine slopes may attain 70%. The soils of the slopes are included in the Miamian series and consist of Miamian or Hennepin soils, or both soils in various proportions; whereas, the floodplain is composed of deep, loamy alluvial Genesee soils (Garner and others 1978). Because of their glacial history, soils are calcareous and depth to bedrock is in excess of 1.5 m. The combination of north-facing slopes, deep ravines, and frequent intermittent sharp ridges with well-drained

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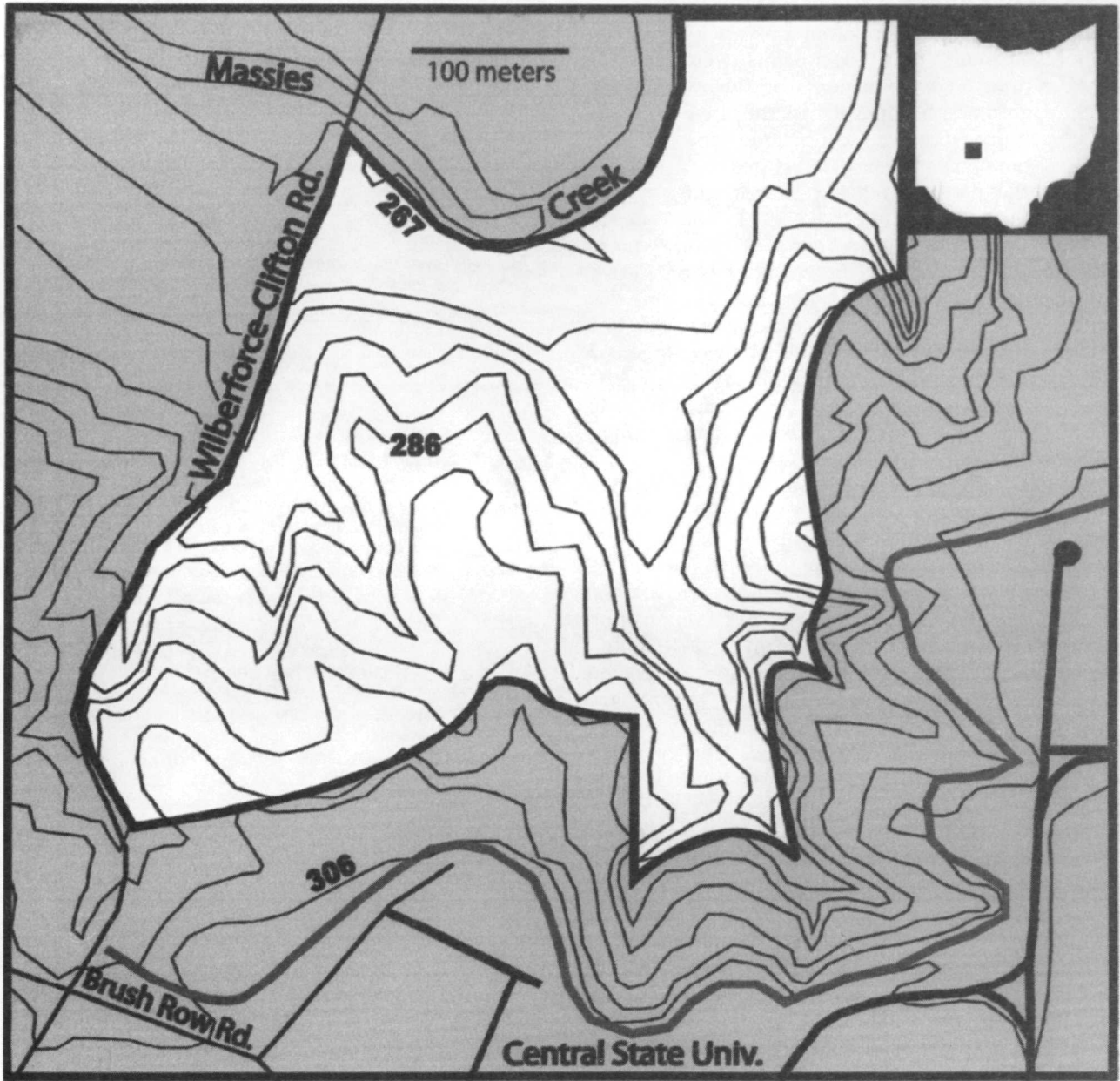


FIGURE 1. Topographic map of the Tawawa Woods Natural Landmark (unshaded). The forest edge adjacent to the Central State University campus is delineated by the line that roughly follows the 300.0 m.a.s.l. contour line. Contour interval = 4.0 m. Redrawn from the US Geological Survey 7.5-minute Xenia, OH, Quadrangle Map.

soil produces a variety of microclimates and soil substrata favorable for a forest with high biodiversity (Keddy and Drummond 1996; Peet 1978; Whittaker 1956).

Several spring horizons are found along the Massies Creek Valley. Historic reports state that some springs tasted like salt (Campbell and others 1973) and contained iron and sulfur (Weisenburger 1962). Water from this system has a total hardness range of 350-400 mg/L dissolved solids. Drilling into bedrock yields little water. Water that is present generally occurs in the top meter of strata and is high in sulfides or chlorides (Regional Planners 1974).

Other than incidental observations, there are no published surveys of the floral composition and successional changes of Tawawa Woods following the 1974 tornado. After preliminary field studies of Tawawa Woods, we

decided to initiate a series of ecological studies of the woods (Silvius and others 2003). It soon became evident that the ecological status of the woods could not be understood without consideration of the geologic and land use history of this landscape. Tawawa Woods holds historic value because of its integral part in the development of the Wilberforce community, including both Wilberforce and Central State universities, and has ecological value through its provision of habitat and watershed protection. This study relied on historical archives and field surveys to compile a detailed timeline of the major human and natural historic events, and to document the land use patterns and other anthropological factors that shaped the Tawawa Woods into a unique historical and ecological treasure.

## MATERIALS AND METHODS

Primary archival-based photographs, maps, surveys, correspondence and other documents were used to reconstruct prior land use patterns of Tawawa Woods. Aerial and ground photographs of the area from the early 20<sup>th</sup> century were used to document the extent of tree cover, buildings, physical structures, and tornado damage in the natural area and surrounding woods (CSU Campus Aerial Photo 1947, 1974; The Forcean 1924, 1936, 1939). Late 18<sup>th</sup> and early 19<sup>th</sup> century maps of Ohio were used to place the boundaries of Wilberforce University, the Tawawa Woods, and the ravine that separated Wilberforce and Central State universities into historic perspective (Keys 1943; Riddell 1896; Rogerson and Murphy 1855; Sanborn Map Company 1901, 1910; Wilberforce, Xenia Township Map 1920; Xenia Township Map 1887). Correspondence, minutes of board meetings, and personal accounts by Brown, Currier, Dubois, and Galloway were used to document anthropogenic changes to the woods from the late 19<sup>th</sup> to early 20<sup>th</sup> centuries (Board of Trustees Minutes 1888-1913; Brown 1937; Currier 1916; Dubois 1940; Galloway 1909). These sources were used to guide field studies aimed at corroborating historical accounts. Historic tree species composition was estimated using land surveys from 1799-1856 and 49 listed witness trees for the land currently designated as the Tawawa Woods (Surveyor's Record 1 1849; Surveyor's Record 3 1851, 1856; Virginia Military Survey 1799). These land surveys also gave accounts of buildings, fences, and other structures in the woods from 1799 to 1856.

Current tree species composition of Tawawa Woods was estimated in 1988 and 1999 using a combination of plot sampling and point-centered quarter sampling methods along major slopes often extending into or across ravines (Cottam and Curtis 1956). Sampling avoided forest and the somewhat degraded forest areas adjacent to the CSU campus, both of which are outside the designated natural area (Fig. 1). Shrubs, vines, and herbaceous flora were registered but not included in the random sampling. Tree and herbaceous species outside plot areas (both inside and outside the natural area) were identified by biweekly walk-through surveys (between 2 to 4 hr each) of the forest from mid-April through September, and were documented by digital camera. These surveys of the entire Tawawa Woods also were used to document and photograph historic anthropogenic disturbances such as debris, roads, fences, and structures (buildings, sewage treatment plant, pipes).

## RESULTS AND DISCUSSION

### Land Use Prior to the 20<sup>th</sup> Century

Tawawa Woods is a convergence point for the cultural heritage of Ohio in that it provided a backdrop for the cultures of Native Americans from pre-historic times to 1813, and of European and African Americans during the past two centuries. The Indian Mound Park, Greene Co., OH, 4.8 km east of the Tawawa Woods, shows evidence that at least two different, prehistoric Native American cultures thrived along the Massies Creek corridor (Campbell and others 1973; Prufer 1997; Woodward and

McDonald 1986). From about 1000 BC to approximately 200 AD, the Adena Indians lived along the Massies Creek corridor and built the Williamson Mound, while the Hopewell Indians inhabited this area between 100 BC and 500 AD and built the Pollard Earthworks (Table 1)

TABLE 1

*Timeline of anthropogenic and natural disturbance agents acting on Tawawa Woods in the context of historic events for the state of Ohio, Greene County, Wilberforce University and Central State University.*

Date	Historic Event
1000 BC–200 AD	Adena Indians build the Williamson Mound along Massies Creek, three miles from the Tawawa Woods.
100 BC–500 AD	Hopewell Indians build the Pollock Earthworks along Massies Creek, three miles from the Tawawa Woods.
1600s	Shawnee Indians inhabit the area with large population (1,100) and establish an outpost along Massies Creek at the current location of Oldtown, north of Xenia, OH.
1769	Shawnee Indian Chief Tecumseh is born near Oldtown.
1780–1790	Series of colonial sorties to control the Shawnee
1799	Survey of 1,000 acres on Massies Creek as part of Virginia Military Warrant #346
1803	Ohio becomes a state. Reports of runaway slaves in area. Greene County is established and organized into townships.
1805	Greene County redefines its boundaries. Xenia Township is organized.
1813	Shawnee Chief Tecumseh dies; Shawnee move to Oklahoma.
1840	At least one station reported in Xenia for the Underground Railroad. Underground Railroad activity throughout the Wilberforce and Cedarville area
1848	Survey of land along Massies Creek including the current Tawawa Woods
1851	Survey of land incorporated into Tawawa Woods. Land is sold to Xenia Springs Company with the Tawawa House.
1852	Xenia Springs Health Resort opens.
1855	Xenia Springs Health Resort closes.
1856	Methodist Episcopal Church purchases the resort and starts Wilberforce University. Survey is done of the land currently incorporated into Tawawa Woods.
1887	Combined Normal and Industrial Arts Department is established and becomes state supported. This is the beginning of Central State University.
1890–1920	Expansion of physical plant of the University begins with building along the edge of the Tawawa Woods.
1892	Industrial pollution of Massies Creek by 5 sawmills, 2 flour mills, 1 lime kiln and quarry, and 1 strawboard and paper company
1927	Wilberforce University builds a wastewater treatment facility in the woods along Massies Creek.
1947	College of Education and Industrial Arts separates from Wilberforce University.
1965	The College of Education and Industrial Arts becomes Central State University.
1967	Wilberforce University begins relocating its campus from its original site on the north edge of the Tawawa Woods to a site to the south east across US Highway 42.
1974	An F5 tornado destroys a portion of Tawawa Woods and much of the CSU Campus.
1982	Wastewater treatment facility in Tawawa Woods is abandoned.
1988	First systematic vegetation survey of the upland portions of Tawawa Woods
1990	Ohio Department of Natural Resources, Division of Natural Areas grants Natural Landmark status to portions of Tawawa Woods.
1999	Second systematic vegetation survey of the upland portions of Tawawa Woods

(Campbell and others 1973; Prufer 1997; Woodward and McDonald 1986). The proximity of these structures at the Indian Mound Park suggests that these Indians traveled along the Massies Creek corridor and the nearby Tawawa Woods. Evidence of intervening human habitation of the Massies corridor is non-existent until European explorers entered the area in the 17<sup>th</sup> century. The Shawnee inhabited the Massies Creek corridor in the 17<sup>th</sup> century. As many as 1,100 Shawnee colonized the area near the confluence of Massies Creek with the Little Miami River known as “Old Chillicothe” (now Oldtown, OH). They also established a manned outpost at the limestone cliffs in the Indian Mound Park (Campbell and others 1973). The Shawnee leader Tecumseh was born just outside Oldtown.

Tawawa Woods received its name from the Tawawa Springs, a series of five mineral springs so named by the Shawnee who used the area for bathing until the late 1700s. The largest spring was called “The Bath of Gold” by the Shawnee because the water ran over gold colored rocks (Galloway 1909). The European American pioneers called the spring the “Shawnee Baths.” South of the main spring was another large spring, arising from a gravel bank that the Indians called “Tears of Silver” because it reportedly was located near a silver mine used by these Native Americans (Galloway 1909). Land use records compiled from files at the State of Ohio, Auditor’s Office indicate that land in Wilberforce was issued for agriculture to Virginia soldiers during the Revolutionary War (Virginia Military Survey 1799). Maps as early as 1855 show that Wilberforce had a strong agricultural base that has continued to the present (Regional Planners 1974; Rogerson and Murphy 1855; Shields 1931).

The pioneers settled the Massies Creek watershed beginning in the late 18<sup>th</sup> century just before Ohio achieved statehood in 1803 (Robinson 1902). These settlers altered the faunal biodiversity of the area by harvesting herbivores such as passenger pigeons (*Ectopistes migratorius*), whitetail deer (*Odocoileus virginianus*), elk (*Cervus elaphus*), and bison (*Bison bison*). Hunting also depleted populations of predators such as panther (*Puma concolor*), bear (*Ursus americanus*), and gray wolf (*Canis lupus*) (Cutler 1812; Robinson 1902). Five sawmills were built along Massies Creek, one of which was located in Tawawa Woods (Fig. 2B). As early as 1851, one lime kiln was operating in Cedarville; by 1881, there were five such kilns operating (Dils 1881). In addition, two flour mills and, in 1892, one paper mill that manufactured paper from straw, were built in Cedarville (Campbell and others 1973). Wastewater from the paper mill was diverted downstream to avoid polluting a limestone gorge (now Cedarville Falls and Indian Mound Park), but pollution in Massies Creek frequently caused death of fish and other aquatic life. One active sawmill, a landfill, and two wastewater treatment plants remained active in the Cedarville–Wilberforce area until the early 1980s. Today only one wastewater treatment plant, located near Cedarville, is active along the Massies Creek corridor.

The Tawawa Woods was part of the original Military Survey Lot #929 (404.7 ha on Massies Creek to John Fowler). A 21.0 ha parcel of this land was sold to the

Xenia Springs Company in 1851 (Greene County Deed Record 27: 594-96) (Table 1). The property description included the “Tawawa House,” 33 lots for cottages, a stable, and fountains. At this point, the Tawawa Springs was renamed “Xenia Springs” (Tawawa House 1851, 1852). These springs will be referred to as “Tawawa Springs” in the current study. The Tawawa House and a few cottages were completed in 1851 as a health resort with a boarding house and hotel. A land survey of 28 May 1851 (Surveyor’s Record 3 Greene County 1851) also mentions two roads and a corner store 32.6 m from the top of the ravine that bisects Tawawa Woods.

Tawawa Woods includes part of the Xenia Springs property and adjacent farmland. The health resort was completed in 1851, opened in 1852, and functioned until 1855 (Table 1). It was located on the north part of a wooded bluff with a ravine to the east of the main buildings (Galloway 1909). In the ravine, the springs were incorporated into a pool and fountain with a gazebo and large water wheel, and the south portion of the area was converted into a park traversed by paths for bathers from the resort (Fig. 2A) (Hustlar and Simmons 1999). Surveyor records from 1851 mention four springs and several hollows (Surveyor’s Record 3 1851). The main spring area had eight sides, for a total area of approximately 5.0 m<sup>2</sup>. The spring fed from a pipe to a six-sided pond with dimensions 6.1, 11.0, 14.9, 30.5, 29.7, and 6.4 m, respectively.

The 1851 survey also identifies one existing stone foundation as a “milkhouse” or spring house (Surveyor’s Record 3 1851). As seen today, this building was built over one of the springs with a series of six openings for trap doors to access the spring. Another foundation of a two-story building of stone and cement is approximately 9.0 m × 30.0 m and shows signs of multiple modifications over the years. Remains of the Tawawa Springs pool, gazebo, water wheel, and paths (at least one is cement) have been located and identified. The remains of the pool are located in a deposit of rubbish.

The Cincinnati Conference of the Methodist Episcopal Church authorized the purchase of the Xenia Springs resort in 1855 to establish “The Ohio African University.” When the transaction was formalized in 1856, the university was renamed “Wilberforce University” after English abolitionist William Wilberforce and became an institution dedicated to the higher education of African Americans (Fig. 2B; Table 1). Wilberforce University reportedly was an important station on the Underground Railroad during this time (Galloway 1909). The campus consisted of 21.0 ha with a forest, including a few evergreens. Farmland and buildings to the south and southwest of Wilberforce University were originally owned by Robert Kendall and, in 1887, were donated by his son, Dr. Clark Kendall, to build the Combined Normal and Industrial Arts Department (CN&I) at Wilberforce (later known as Central State University) (Brown 1937; Mulhern 1996). The deep woodland ravine noted earlier separated Wilberforce University proper from the buildings of the CN&I Department (Keys 1943). The land was heavily timbered up until 1863 and a sawmill was located in the woods along the main stream (and ravine) that flows north

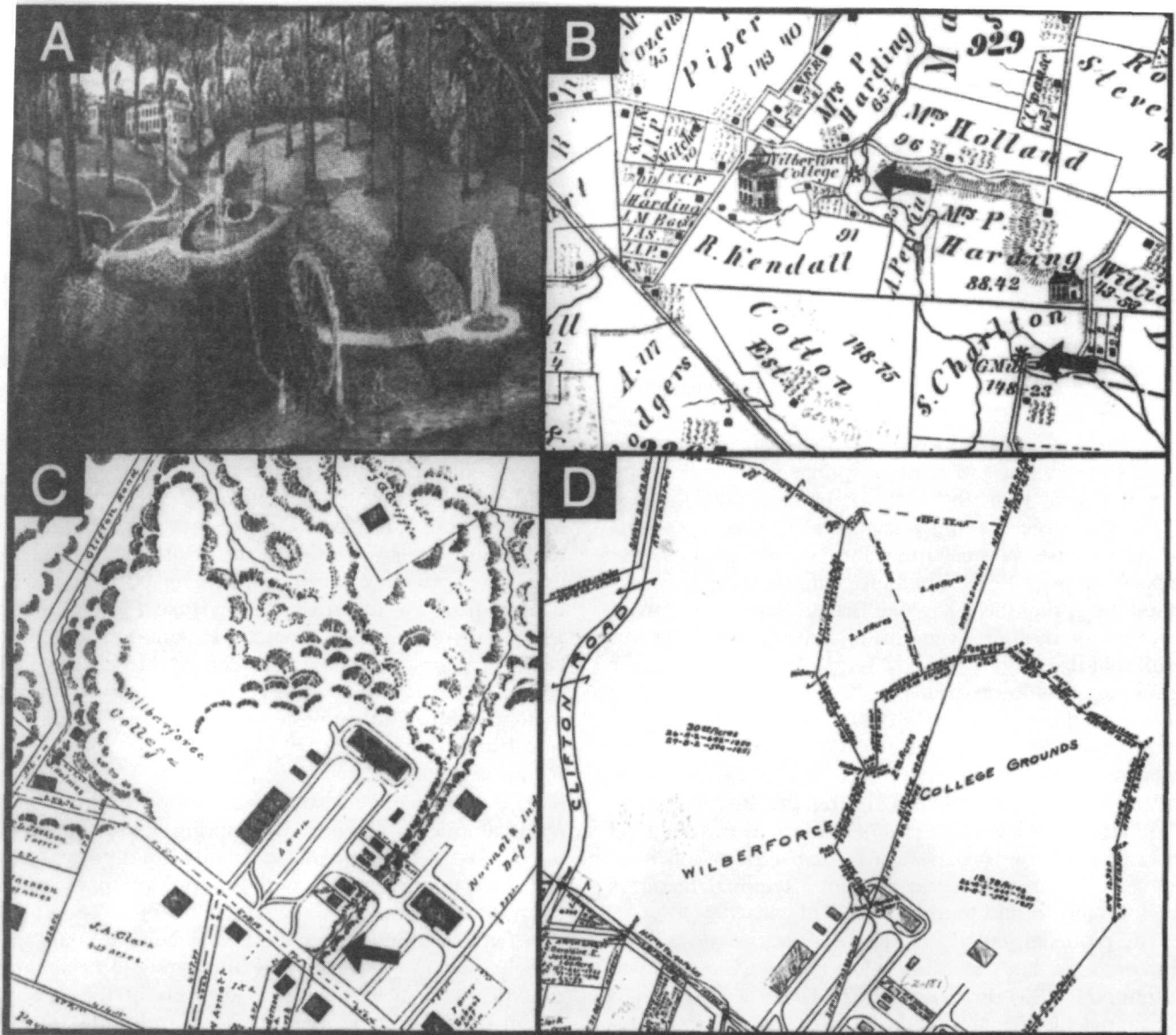


FIGURE 2. Pictorial History of Tawawa Woods and Surrounding Areas. (A) Xenia Springs Resort. Picture from 1852 advertisement poster for the resort depicting the springs, park, a fountain, gazebo, and decorative wheel. The Tawawa House is in the background and the ravine is to the left (Tawawa House: Xenia Springs 1852). (B) Wilberforce University, 1887, from map of Xenia Township, 1887 (Map #1). Map shows Wilberforce University (listed as College) and the grounds behind the main building. These grounds became part of Tawawa Woods. Incorporated into this area, along the main stream feeding into Massies Creek, is a sawmill (arrow). A second sawmill is located upstream along Massies Creek (arrow). The area was heavily lumbered until 1863, and references of continued use of the woods for lumber by the University are as late as 1887. Close-up of land owned by the Kendalls that was sold to the CN&I Department in 1887 for expansion of the Department. Today, a portion of this land is incorporated into Tawawa Woods. (C) Wilberforce University, 1896. Topographical map of the campus showing the extent of the ravine before it was partially filled in (arrow) (from Riddell 1896). The ravine separated the Wilberforce campus from the CN&I Department that would later become Central State University. (D) Wilberforce, Xenia Twp., ca. 1920 (Map #140). Close-up of Wilberforce University Campus showing the different survey lots incorporated into Tawawa Woods. Interestingly, witness tree data from the original surveys were added along the lot lines.

through the woods to Massies Creek (Fig. 2B). The university continued to use the trees for lumber for buildings including the library (Board of Trustees Minutes, 20 August 1897). By 1870, the five springs were reduced to three as a result of timber cutting for fuel and other purposes (Payne 1891). By 1895, the campus was reportedly having difficulty supplying water to the buildings along the edge of Tawawa Woods (Board of Trustees Minutes, 21 February 1895).

As early as 1894, the campus was using the woods as a refuse dump (Dubois 1940). By 1909, the campus

consisted of 141.6 ha (Washington 1907). School buildings were built along the forest edge on either side of the ravine (Broadstone 1918; Sanborn Map Company 1901) (Table 1). In the 1890s, the woods surrounding the ravine included large trees (*Quercus* and *Ulmus* spp.) and widened into green meadows near Massies Creek. The ravine extended through the campus to what is now Brush Row Road (Fig. 2C). In 1897, Wilberforce University and the CN&I cooperated to fill part of the ravine between the two schools (Board of Trustees Minutes, 4 November 1897).

### Land Use in the 20<sup>th</sup> and 21<sup>st</sup> Centuries

From the late 1930s to 1940, an effort was made to fill in more of the ravine to make a road (Dubois 1940). Aerial, panoramic, and close-up photos from the 1920s to the late 1940s show that the northwest area of the Tawawa Woods, now included in the natural landmark designation, and the remaining portion of the ravine were heavily wooded, whereas, the east and south included a waste water treatment plant, a power plant, and an access road (CSU Campus Aerial Photo 1947; The Forcean 1924, 1936, 1939).

In 1941, the CN&I Department became the College of Education and Industrial Arts, split from Wilberforce University in 1947 (Table 1), and was given the name Central State College by the State of Ohio. The College became CSU in 1965 (Mulhern 1996). By 1974, CSU was the largest landholder in the Wilberforce Community, controlling 210.5 ha (19.4%), a total of 56.3 ha for campus and 154.2 ha of vacant land (Regional Planners 1974). Beginning in 1967, Wilberforce University gradually moved its campus from its original site on the north part of a wooded bluff along the edge of the Tawawa Woods to a site to the SE, across US Highway 42 (Mulhern 1996).

In recent decades, human impact upon Tawawa Woods can be traced to three principal sources—water acquisition and treatment, the 1974 tornado and cleanup, and campus expansion. Water supply for a portion of the Wilberforce community and Central State University was provided by five wells located along Massies Creek at the northern edge of the woods. Total capacity was 2,180 kl/day, with an average of 1,308 kl pumped daily. A wastewater treatment plant for Wilberforce and Central State Universities was located at the foot of the slopes near the sharp bend in the creek. The facility was constructed in 1927 by Wilberforce University, with minor improvements made in 1946 and 1965 (Regional Planners 1974; Xenia, OH Sanitary Sewers 1978) (Table 1). The design capacity of the plant was 938 kl/day, although peak demand was as much as 2,250 kl/day (Regional Planners 1974). Maximum capacity was increased to 3,146 kl/day in 1979. A new wastewater sewer was completed in spring 1981, and the treatment plant was abandoned about 1982 (Webber 1979). Portions of the original structure remain in the woods.

Today, numerous abandoned water pipes and sewage lines run south and east through the woods from the abandoned wastewater plant to the old Wilberforce University and the CSU campuses. The forest also is dissected by a right-of-way for an electric utility line between the abandoned wastewater plant and the power plant of the CSU campus. Remains of a gravel access road leading to the abandoned wastewater plant are located at the NW edge of Tawawa Woods along Massies Creek. The road bends south and up the slope to the southern edge of the old Wilberforce University campus. Another abandoned road enters the woods from Wilberforce-Clifton Road just north of and parallel to Brush Row Road. An old barbed wire fence runs parallel to this abandoned road suggesting that the SW portion of the woods may have been used to graze livestock.

During the 1974 tornado, buildings and debris were blown into the woods. In the subsequent tornado cleanup, campus debris was dumped at the heads of ravines located in the southern perimeter regions to the south and east of the Natural Landmark (Fig. 1). Some of these deposits are located in association with broken walls and foundations of historic buildings dating as far back as the early 1850s. A large landfill of cement and solid rubbish was formed along the northeast corner of the woods.

Post-tornado construction efforts on the CSU campus also impacted the local landscape. The ravine that formally separated Wilberforce and Central State universities was filled to support construction of the Afro-American Museum in 1988. Runoff water that formerly entered the ravine was collected and transported in buried sewer lines in order to control erosion; the area was stabilized with concrete in 1996. Beginning in 1998 and completed in 1999, Shorter Hall, formerly of the old Wilberforce University campus, was demolished and debris was bulldozed into the outer perimeter adjacent to the northwest boundary of the Natural Landmark (Fig. 1; Table 1).

### Historic Description of Flora

The pre-European American settlement forest was interspersed with eastern redcedar (*Juniperus virginiana*), especially along the Massies Creek corridor (Campbell and others 1973). Our survey detected a few large redcedars, now dead, in the area previously described as having been used for pasture, an association consistent with the habitat of redcedar in Greene County today. Descriptions of the area from the late 18<sup>th</sup> to early 19<sup>th</sup> century suggest that there was an unlimited supply of fruits, nuts, seeds, and wild game from the beech and oak forests along Massies Creek and around Xenia, OH (Campbell and others 1973; Currier 1916; Cutler 1812). The streams supported fish and mussels (Campbell and others 1973; Cutler 1812).

Witness tree data obtained from land surveys made in Tawawa Woods during the period 1799 to 1856 included citations of 49 individual trees comprising 15 different tree species (Table 2) (Surveyor's Record 1 1849; Surveyor's Record 3 1851, 1856; Virginia Military Survey 1799). These records, including the witness trees, were handwritten on a 1920s map of Wilberforce University and the adjacent woods (Fig. 2D) (Wilberforce, Xenia Township Map, ca. 1920). Hickory (*Carya* sp.) was the most frequent (33%) followed by sugar maple (*Acer saccharum*, 12%) and elm (*Ulmus* sp., 8%). The remaining species were each mentioned no more than three times during the 57 years spanning the surveys (Table 2). Representatives of the hickories, sugar maple, ash (*Fraxinus* sp.), and poplar (presumably *Liriodendron tulipifera*) were large trees ranging from 30.0 to 61.0 cm diameter, while two sycamore trees (*Platanus occidentalis*) were listed as "large." Two ash trees were 12.7 cm in diameter. One hickory was listed as a stump and one red oak was cut down, suggesting anthropogenic influences on mature trees. Finally, one ironwood, presumably *Ostrya virginiana*, was reported dead and one sycamore was described as leaning.

Table 2

*Tree species recorded as witness trees in historic Tawawa Woods.\**

Tree Species	No. Occurrences	Percentage (%)
<i>Carya</i> sp.**	16	33
<i>Acer saccharum</i> Marsh.	6	12
<i>Ulmus</i> sp.	4	8
<i>Quercus velutina</i> Lam.	3	6
<i>Quercus alba</i> L.	3	6
<i>Fraxinus</i> sp.	3	6
<i>Platanus occidentalis</i> L.	3	6
<i>Cornus florida</i> L.	2	4
<i>Morus</i> sp.	2	4
<i>Liriodendron tulipifera</i> L.	2	4
<i>Quercus macrocarpa</i> Michx.	1	2
<i>Quercus rubra</i> L.	1	2
<i>Fagus grandifolia</i> Erhb.	1	2
<i>Ostrya virginiana</i> (Miller) K. Koch	1	2
<i>Juglans cinerea</i> L.	1	2

\* From: Land Surveys made in 1799, 1849, 1851, and 1856 (Virginia Military Survey Greene County 1799; Surveyor's Record 1 Greene County 1849; Surveyor's Record 3 Greene County 1851, 1856).

\*\* Names and botanical authors according to Gleason and Cronquist 1991.

The natural diversity of microclimates and associated flora of Tawawa Woods was significantly altered by the 1974 tornado and subsequent clean-up. Stein (1974) reported that trees with boles 38.0 cm or higher were snapped or uprooted. Aerial photographs show that much of the damage occurred along the perimeter region to the south and southeast (adjacent to the campus) (CSU Campus Aerial Photos 1974; The Ohio Tornadoes 1974). In regions where only certain trees were killed by the tornado, the tree canopy was opened to form gaps of varying size that would have increased solar radiation levels reaching the forest floor. In gap areas, soil temperature, moisture, and atmospheric humidity were altered (Moore and Vankat 1986; Phillips and Shure 1990). The remaining subcanopy trees, tree seedlings, and herbaceous layer were thus exposed to more or less favorable conditions for growth depending upon individual tolerances for the altered light, moisture, and soil fertility (Whittaker 1956). While herb species richness has been shown to remain unaffected by gap formation in mature beech-maple forests, woody species richness increased with gap age (Moore and Vankat 1986). At the same time, metallic and synthetic debris was blown into the forest during the tornado, and additional debris from devastated buildings was discarded along the south perimeter of the forest adjacent to the

CSU campus. It is unknown how this debris alters the microenvironment of the woods. A more detailed analysis of the effects of the tornado on the plant ecology of Tawawa Woods is reported in a companion paper (Silvius and others 2003).

### Current Description of Flora

Twenty-seven tree species were recorded in sampling along upland slopes within the Tawawa Woods Natural Landmark in 1988 and 28 were reported in 1999 (Table 3). Vine and shrub species totaled 12 (Table 4). The riparian forest portion of these woods includes sycamore (*Platanus occidentalis*), elm (*Ulmus* sp.), cottonwood (*Populus deltoides*), honeylocust (*Gleditsia triacanthos*), and boxelder (*Acer negundo*). Included

TABLE 3

*Trees species of Tawawa Woods Natural Landmark and perimeter regions.*

<i>Fagus grandifolia</i> Erhb.
<i>Quercus velutina</i> Lam.
<i>Quercus muehlenbergii</i> Engelm.
<i>Quercus rubra</i> L.
<i>Quercus alba</i> L.
<i>Ulmus rubra</i> Muhl.
<i>Ulmus americana</i> L.
<i>Celtis occidentalis</i> L.
<i>Acer negundo</i> L.
<i>Acer platanoides</i> L.
<i>Acer saccharum</i> Marsh.
<i>Carya cordiformis</i> (Wangenh.) K. Koch
<i>Carya ovata</i> (Miller) K. Koch
<i>Carya tomentosa</i> Nutt.
<i>Carya glabra</i> (Miller) Sweet
<i>Juglans nigra</i> L.
<i>Platanus occidentalis</i> L.
<i>Prunus serotina</i> Ehrh.
<i>Crateagus phaenopyrum</i> (L. f.) Medikus
<i>Morus rubra</i> L.
<i>Cornus florida</i> L.
<i>Liriodendron tulipifera</i> L.
<i>Sassafras albidum</i> (Nutt.) Nees.
<i>Asimina triloba</i> (L.) Dunal.
<i>Gleditsia triacanthos</i> L.
<i>Robinia pseudo-acacia</i> L.
<i>Cercis canadensis</i> L.
<i>Fraxinus americana</i> L.
<i>Fraxinus quadrangulata</i> Michx.
<i>Ostrya virginiana</i> (Miller) K. Koch
<i>Carpinus caroliniana</i> Walter

TABLE 4

*Herbaceous plant species common in  
Tawawa Woods and perimeter regions.*

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<i>Actaea pachypoda</i> Ell.
<i>Agrimonia pubescens</i> Wallr.
<i>Alliaria petiolata</i> Andrz.
<i>Allium canadense</i> L.
<i>Allium tricoccum</i> Ait
<i>Allium vineale</i> L.
<i>Anemonella thalictroides</i> (L.) Spach.
<i>Arisaema atrorubens</i> (Ait.) Blume
<i>Asarum canadense</i> L.
<i>Botrychium virginianum</i> (L.) Sw.
<i>Cardimine douglassii</i> (Torr.) Britt.
<i>Carex albersina</i> Sheldon
<i>Carex blanda</i> Dewey
<i>Carex davisii</i> Schwein. & Torr.
<i>Carex birtifolia</i> Mackenzie
<i>Carex jamesei</i> Schwein
<i>Carex sparganioides</i> Muhl.
<i>Carex stricta</i> Lam.
<i>Caulophyllum thalictroides</i> (L.) Michx.
<i>Circaea quadrisculata</i> (Maxim.) Franch. & Sav.
<i>Claytonia virginica</i> L.
<i>Conopholis americana</i> (L.) Wallr.
<i>Cryptotaenia canadensis</i> (L.) DC.
<i>Cystopteris fragilis</i> (L.) Bernh.
<i>Dentaria laciniata</i> Muhl.
<i>Elymus hystrix</i> L.
<i>Eupatorium rugosum</i> Houtt.
<i>Galium aparine</i> L.
<i>Geranium maculatum</i> L.
<i>Geum canadense</i> Jacq.
<i>Glechoma hederacea</i> L.
<i>Hepatica acutiloba</i> DC.
<i>Hesperis matronalis</i> L.
<i>Heuchera americana</i> L.
<i>Hydrophyllum macrophyllum</i> Nutt.
<i>Impatiens capensis</i> Meerb.
<i>Impatiens palida</i> Nutt.
<i>Laportea canadensis</i> (L.) Wedd.
<i>Lysimachia nummularia</i> L.
<i>Ornithogalum umbellatum</i> L.
<i>Osmorbiza claytonii</i> (Michx.) Clark
<i>Osmorbiza longistylis</i> (Torr.) DC.
<i>Oxalis grandis</i> Small
<i>Phlox divaricata</i> L.
<i>Phryma leptostachya</i> L.
<i>Phytolacca americana</i> L.

TABLE 4 (Cont.)

*Herbaceous plant species common in  
Tawawa Woods and perimeter regions.*

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<i>Pilea pumila</i> (L.) Gray
<i>Podophyllum peltatum</i> L.
<i>Polygonatum biflorum</i> (Walt.) Ell.
<i>Polygonatum canaliculatum</i> (Muhl.) Pursh.
<i>Polystichum acrostichoides</i> (Michx.) Schott.
<i>Prenanthes</i> spp.
<i>Ranunculus abortivus</i> L.
<i>Sanguinaria canadensis</i> L.
<i>Sanicula gregaria</i> Bickn.
<i>Sanicula trifoliata</i> Bickn.
<i>Silene virginica</i> L.
<i>Sisyrinchium montanum</i> Greene
<i>Smilactina racemosa</i> (L.) Desf.
<i>Tradescantia virginica</i> L.
<i>Trillium flexipes</i> Raf.
<i>Trillium grandiflorum</i> (Michx.) Salisb.
<i>Trillium sessile</i> L.
<i>Uvularia perfoliata</i> L.
<i>Viola lanceolata</i> L.
<i>Viola papilionacea</i> Pursh.
<i>Viola pubescens</i> Aiton.

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in a moist alluvial area near Wilberforce-Clifton Road were pawpaw (*Asimina triloba*) and blue ash (*Fraxinus quadrangulata*). The remaining tree species were prevalent on upland slopes and ridges. Shrub species were represented by wild hydrangea (*Hydrangea arborescens*), common buckthorn (*Rhamnus cathartica*), bladdernut (*Staphylea trifolia*), gooseberry (*Ribes* sp.), common elder (*Sambucus canadensis*), spicebush (*Lindera benzoin*), multiflora rose (*Rosa multiflora*), and bush honeysuckle (*Lonicera maackii*). A more detailed analysis of current tree diversity in Tawawa Woods is reported by Silvius and others (2003).

Sixty-five herbaceous plant species were identified from walk-through surveys of Tawawa Woods in 1988 and 1999 (Table 4) with most of the diversity occurring within the less disturbed interior. These species are very similar to those reported by DeMars and Runkle (1992) for Wright State University (WSU) Woods (Bath Twp., Greene Co., OH), an oak-sugar maple forest 16.0 km W-NW of Wilberforce. The Tawawa Woods is habitat for the following *Carex* species: *C. blanda*, *C. birtifolia*, *C. sparganioides*, *C. jamesei*, *C. albersina*, *C. stricta* and *C. davisii*. A diverse herbaceous understory that includes sedges has been linked with the gradual invasion of forest onto old pasture sites, as is the case in the riparian portion of the Tawawa Woods (Glitzenstein and others 1990).



Greater human disturbance along the perimeter region prior to the tornado, coupled to the impact of windblown and discarded debris from the tornado has caused the forest floor of the perimeter region to be dominated by invasive species like garlic mustard (*Alliaria petiolata*), periwinkle (*Vinca minor*), and bush honeysuckle (*Lonicera maackii*); whereas, the understory and immature tree canopy consists of American elm (*Ulmus americana*), boxelder (*Acer negundo*), black locust (*Robinia pseudoacacia*), white ash (*Fraxinus americana*), and honeylocust (*Gleditsia triacanthos*). Vine species include Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), wild grape (*Vitis* sp.), and greenbriar (*Smilax* sp.).

## CONCLUSIONS

Gordon (1969) designated central Greene County, including Tawawa Woods, within the mixed oak forest type on the basis of witness tree data from a broad sampling of land surveys. Reports by Herrick (1974) and Stein (1974) described the Tawawa Woods as a climax beech forest with good herbaceous flora. Based upon our admittedly small but more localized pool of witness tree data (Table 2) and the current prominence of American beech within Tawawa Woods (Silvius and others 2003), it appears that this forest does not fit the typical mixed oak designation described by Gordon. Gordon (1969) speculated that the high percentage of beech might have resulted from both natural and anthropogenic forces that favored the persistence of this species.

The Tawawa Woods Natural Landmark and its perimeter region have unique historical significance for the cultural heritage of Native, European, and African Americans in the Ohio valley dating back to the first century BC (Table 1). This report has compiled a detailed timeline of the major events that have unfolded in and around the woods and surrounding area during the past two millennia. Additional archival and field research (for example, Silvius and others 2003) will no doubt further explain the significance of known and yet-to-be-discovered cultural artifacts preserved within the woods.

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