

**Inventory of Distribution, Composition, and Relative Abundance of Bats at Hopewell  
Culture National Historical Park**

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## Table of Contents

<u>List of Figures</u> .....	iii
<u>List of Tables</u> .....	iii
Summary .....	iv
Acknowledgements.....	v
Introduction.....	1
Study Area .....	2
Materials and Methods.....	4
Results.....	5
Discussion/Conclusion.....	9
Literature Cited .....	10

### List of Figures

Figure 1. Map of Hopewell Culture National Historical Park, Ross County, Ohio. ....	11
Figure 2. Map of Mound City indicating bat inventory plots. ....	12
Figure 3. Map of Hopeton Earthworks indicating bat inventory plots. ....	13
Figure 4. Map of Hopewell Mounds indicating bat inventory plots. ....	14
Figure 5. Map of Seip Earthworks indicating bat inventory plots. ....	15
Figure 6. Map of High Bank Works indicating bat inventory plots. ....	16

### List of Tables

Table 1. Unit, habitat, and sampling location data for bat inventory plots (NAD83). ....	17
Table 2. List of potential bat species and their status at Hopewell Culture NHP. ....	18
Table 3. Species documented as present by park unit at Hopewell Culture NHP. ....	19

## Summary

An inventory of the presence/absence of bats was conducted at the five units at Hopewell Culture National Historical Park from May 15-19, 2004. Seven of 12 (58%) expected bat species previously documented from Ohio were documented via mist-nets and Anabat II detectors. Three of these previously documented species are represented by fewer than three historical records, none within the last 35 years. One additional species is considered to be migratory, and commonly found only during the spring and fall migrations. This results in the documentation of seven of eight species (87.5%) reasonably expected to be present. Species collected and/or recorded are typical of eastern deciduous forests and riparian corridors. No state or federally listed species were observed.

## Acknowledgements

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## Introduction

The U.S. Congress passed the 1998 National Parks Omnibus Management Act in response to concerns about the condition of natural resources within the national parks. The act requires each park to gather baseline inventory data on pertinent natural resources, data that will provide a pivotal step toward establishing an effective monitoring program, and further our ability to effectively manage and protect park resources. The National Park Service (NPS) responded with the Natural Resource Challenge program, including the establishment of biome-based inventory and monitoring networks. The Heartland Network, as part of the NPS Inventory and Monitoring (I&M) program, has undertaken inventories of vascular plants and vertebrates within fifteen parks in eight Midwestern states.

Hopewell Culture National Historical Park was established to preserve, protect, and interpret the remnants of the Hopewell, thereby increasing understanding of their culture. Since the establishment of the park in 1923, focus has been on the archeological remnants of the Hopewell culture. Work and study of the natural resources in the park however, has been limited and incomplete.

A comprehensive survey of the bats that may utilize Hopewell Culture National Historical Park was initiated to determine species diversity and create a baseline inventory of the species present in the park. The collection of this information will then be incorporated into park monitoring and management plans in order to successfully manage for healthy and diverse populations of mammals. Terrestrial mammals were not included in the survey as they were inventoried in a separate study (Vick 2004).

Throughout the state of Ohio 12 species of bats have been documented (Whitaker and Hamilton 1998) and are listed in Table 2. Three of these species have not been documented in the state since 1970, and never documented in Ross County (Whitaker and Hamilton 1998). Only one species, the Indiana bat (*Myotis sodalis*) is on the endangered species list. This species could potentially be found throughout Ohio (Belwood 1998), but has not been documented from Ross County.

The goal of the inventory is to document 90% of the species that are reasonably expected to occur at the park (Boetsch et al 2000). This inventory is a census of the five park units and will provide data on bat species composition, distribution, and relative abundance.

## Study Area

Hopewell Culture National Historical Park is composed of five non-contiguous park units totaling more than 445.3 ha (1,100 ac) in size. The park units are Mound City Group, Hopeton Earthworks, Hopewell Mound Group, High Bank Works, and Seip Earthworks (Figures 1-6) and are located around the town of Chillicothe, Ross County, Ohio. Two phytogeographic regions of Ohio meet along a NE/SW line. The northwest portion of the park and Ross County is composed of calcareous, glaciated till plain, while the southeast is made up of non-glaciated area (Braun 1989). The meeting of two regions may result in higher diversity of flora and fauna.

Portions of the following text were excerpted from Vick (2004).

Mound City Group (Mound City) is located at 16062 State Route 104, Chillicothe (Figure 2). This park unit contains five buildings, 1.6 km. (1 mi) of trails, and 1.2 km (0.74 mi) of road. The entire unit contains 48.6 ha (120 ac), with 12.1 ha (30 ac) actively mowed, 18.2 ha (45 ac) mowed periodically for hay, and 18.2 ha (45 ac) of early successional mixed mesophytic forest. The Scioto River flows along the eastern edge of Mound City and is known to contain a wide diversity of aquatic and riparian habitats. Severe erosion occurs in many areas of this river, in part due to the six dams in its upper reaches. The river flows approximately nine-tenths of a kilometer (0.6 mi) along the park boundary, with a portion causing extensive erosion. Some areas along the river are flooded periodically, while others are located at upper terraces. Nets and detectors were set in the riparian forest and along the forest edge near the Scioto River. One detector was set facing over the river.

Hopeton Earthworks (Hopeton) is located at the 1100 block of Hopeton Road, Chillicothe (Figure 3) This is one of the largest parcels encompassing approximately 151.9 ha (375.4 ac). The majority of the area, 96.0 ha (237.3 ac), is mainly composed of orchard grass (*Dactylis glomerata*) and alfalfa (*Medicago sativa*) and has been harvested for hay in the recent past. A relatively young fence row bisects the property and is composed mainly of hackberry, with some wild black cherry. Currently there is an active gravel mining operation located on the western half of the property. The Scioto River flows along a portion of the western side of the gravel mining operation. Another 1.6 ha (4 ac) contains mowed grass and black walnut trees, while the remaining area is composed of early successional mixed deciduous open forest, with an intermittent stream, Dry Run, flowing through the 5.5 ha (13.6 ac) parcel. It was along this stream that nets and detectors were set.

Hopewell Mound Group (Hopewell) is located at 4731 Sulphur Lick Road, Chillicothe (Figure 4). An intermittent stream, Sulphur Lick, runs near the northern and eastern boundary of this 125.6 ha (310 ac) site, with the North Fork of Paint Creek bordering the southern edge. Currently the property is mainly composed of 73.0 ha (180.4 ac) of orchard grass pasture. The northern portion of the property includes 33.6 ha (83.0 ac) of semi-mature mixed mesophytic forest with a 1/3-acre impoundment located on the eastern edge within these woods. Nets and detectors were set near this pond, and along the North fork of Paint Creek on the southern border of the unit.

Seip Earthworks (Seip) is located on US 50 bordering Seip State Memorial, near Paint Valley High School, Bainbridge (Figure 5). The property is divided into two parcels, with Ohio Historical Society land located between the units. The southern border of this 67.0 ha (165.6 ac) site lies alongside Paint Creek. The creek is bordered by a 5.9 ha (14.6 ac) wooded riparian corridor. Nets and detector were set in this riparian corridor.

High Bank Works (High Bank) is a 67.5 ha (166.8 ac) parcel located at the end of County Road 900, off US 35 south of Chillicothe (Figure 6). Approximately 20.2 ha (50 ac) of this site is composed of alfalfa/orchard grass, with a slightly larger parcel left fallow. These fields have been mowed at least once a year. Another 5.3 ha (13.0 ac) is composed of winter wheat (*Triticum aestivum*), and yet another 2.8 ha (7.0 ac) was chemically treated early in 2003. The Scioto River borders the western edge of this property, where a 11.8 ha (29.0 ac) riparian woodland exists. Nets and detector were set in the riparian zone adjacent to the Scioto River.

## Materials and Methods

Bats were surveyed in all likely habitats, including forest corridors or service roads in forests, and wetlands, including ponds and riparian corridors May 15-19, 2004 (Table 1, Figures 1-6). Mist-nets were the primary survey method, but Anabat II detectors were placed in these same areas. Qualitative and quantitative analyses for species identifications were performed on all recorded call sequences (Murray et al. 1999, 2001; Britzke et al. 2002).

Mist nets were made of the finest, lowest visibility commercially available 2 ply, 50 denier nylon (denoted 50/2) of approximately 38 mm. These nets conform to the USFWS standards recommended for Indiana bat surveys. Nets were placed in corridors such as streams or trails approximately perpendicular across the corridor. Nets were set to fill the corridor from side to side and from stream (or ground) level up to the overhanging canopy. A typical set was seven meters high consisting of nets "stacked" on top one another and up to 18 meters wide (different width nets were used as the situation dictates).

The typical equipment described in the section above may be inadequate for these situations, requiring innovation on the part of the observers. The number of net sets depended on the available habitat at each park unit. The number of net nights (one net set up for one night = one net night) per area depended on size of the unit, available habitat, weather, and capture rate.

Sample period began at sunset and continued until captures ceased, or activity ceased based on the bat detectors. Nets were checked at intervals of no longer than 20 minutes and disturbance was minimized near the nets, other than to check nets and remove bats. Netting and recording occurred during periods of no precipitation, when temperatures were above 10 degrees Celsius, with little wind, and under the canopy if the moon was half full or more.

The number of sampling sites and locations within the units were chosen based on discussions with park personnel and previous experience. Therefore, all plots were non-random. Location data were collected with a Garmin eTrex Global Positioning System (NAD83 CONUS).

Picture vouchers were collected for most bats. Specimens were identified following Whitaker and Hamilton (1998).

## Results

Of the 12 bat species that were listed as possibly present at the park, seven (58%) were documented. Three of the five species yet to be documented in the park are represented by fewer than three historical records, none within the last 35 years. One additional species is considered to be migratory, and commonly found only during the spring and fall migrations. This results in the documentation of seven of eight species (87.5%) reasonably expected to occur at the park.

Five species were documented with mist nets: big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), northern long-eared bat (*Myotis septentrionalis*), evening bat (*Nycticeius humeralis*), and little brown bat (*Myotis lucifugus*). The big brown bat, red bat, and northern long-eared bat were most common (19, 12, and 10 nettings, respectively) and only one netting occurred for the evening bat and little brown bat.

Pregnancy ratios varied among species mist netted. Eleven of the 19 big brown bats were female and eight of these were pregnant; nine of the 12 red bats were female and four were pregnant; six of the ten northern long-eared bats were female and one was pregnant; only one evening bat was pregnant.

Seven species, represented with approximately 400 call sequences, were detected with the Anabat II detector. The eastern pipistrelle (*Pipistrellus subflavus*) and red bat appeared to be the most detectable. On six occasions, eastern pipistrelles were detected with >20 sequences and red bats detected with >20 sequences on four occasions. Big brown bats and northern long-eared bats were detected with the next highest occurrences of >20 sequences (two and one occasions, respectively). The hoary bat (*Lasiurus cinereus*), little brown bat, and evening bats were the least detectable. Hoary bats were detected only on one occasion with >10 sequences. Fewer detections were made for the little brown bat and evening bat as each were detected with less than five sequences per occasion.

## Discussion

The original expected species list (Boetsch et al 2000) listed 12 species of bats that might occur at Hopewell Culture NHP. Of these, three are unconfirmed since they have not been documented in the state in the last 30 years (and then by fewer than three records). Two species are listed as probably present since habitat exists (see Table 2).

There have only been two records of Rafinesque's big eared bat (*Corynorhinus rafinesquii*) in Ohio, in Adams Co. 1953 and 1960. There has only been one record of the eastern small-footed bat (*Myotis leibii*) in Ohio, from Erie Co. in 1842. There have only been two records of Mexican free-tailed (*Tadarida brasiliensis*) in Ohio, a male captured in a barn in Scioto Co. on July 31, 1958 and a female found in a house in Montgomery Co. on November 6, 1970.

One species, the silver-haired bat (*Lasionycteris noctivagans*) is found throughout the United States, including Ohio, but is encountered in Ohio only during the spring and fall migration periods. It might be encountered in the Park in April and early May, and again from August to November, but they are most often encountered on the sides of large buildings in cities in Ohio during these migratory periods (Belwood 1998; Whitaker and Hamilton 1998).

The endangered Indiana bat has recently been documented as a summer breeding resident (1996), and a winter hibernator (1994). Both locations are in the southwestern portion of the state (Belwood 1998). It is possible that this species could occur somewhere on the Park during the summer, especially because of the presence of large snags with exfoliating bark. This is the most common location for summer roosts including maternity colonies. Neither netting nor acoustical survey methods employed in this survey indicated the presence of this species during the survey period.

### Mound City

Mist-nets were set at four locations consisting of forest edge and forest trails in and near the riparian forest bordering the Scioto River (Figure 2). Anabat II detectors were placed at two locations, one at the forest edge and one facing over the Scioto River. On May 15, one net (two stacked and two single) was set at each of four locations and two detectors were set for the same duration. The weather was cool and misty, but the temperature did not fall below 10 degrees C until after 11:00 PM. The riparian forest edge and a larger (12 meter) forest opening yielded the most bats and the highest number of species captured. Seven adult big brown bats, five males and two females, eight adult eastern red bats, two males and six females, and one northern long-eared bat, one adult female were captured in the two stacked nets. The two 6 meter single nets set across small forest trails yielded two adult female northern bats. The two female big brown bats were pregnant as were three red bats and one northern bat. The detector set at the larger forest opening recorded echolocation sequences from numerous red bats, a few each from big brown bats and northern bats, and one sequence each from an eastern pipistrelle and a hoary bat. The detector set to record over the Scioto River recorded numerous sequences from eastern pipistrels and hoary bats, with a few sequences from big brown bats, red bats, and evening bats.

## Hopeton

Mist nets were set at two locations consisting of one single net blocking off stream corridor as it came from under a bridge, and two single nets blocking the stream corridor in the riparian forest. One detector was set on the bridge to record bats flying along the road corridor as it passed through the riparian forest. Nets and detector were set the night of May 19 from sundown to 12:30 AM. Two adult male northern bats and one adult female red bat were captured in one net set across the stream in the interior portion of the riparian forest and one adult male big brown bat was captured in the net blocking the opening under the bridge. Numerous sequences were recorded of big brown bats, red bats, eastern pipistrels, and little brown bats as they flew down the road corridor.

## Hopewell

Mist nets and detectors were set at two locations at the Hopewell Mounds Group. On May 17, two stacked nets and one detector were set near and over a pond located in a forested area on the northwest side of the unit. Nets and detector were set for only one hour and removed because of rain. No bats were captured during this time, but the detector pointing over the pond recorded numerous sequences from big brown bats, red bats, eastern pipistrelles, and little brown bats, and one sequence from a hoary bat.

On May 19 a detector was set over the same pond and three stacked nets and a detector were set over a wide stream bed on the east side of the property. This stream bed had a narrow riparian strip on each side. Two adult female red bats and one adult female little brown bat were captured over the water and numerous sequences of big brown bats, red bats, eastern pipistrelles, and little brown bats were recorded at the same location. Sequences from big brown bats, red bats, eastern pipistrelles, and little brown bats were recorded over the pond. Nets and detectors were set from sundown to midnight.

## Seip Earthworks

Mist nets and a detector were set along the riparian zone adjacent to Paint Creek on May 16. One stacked net and three single nets were set across openings and standing water in this area. The detector was set in the forested area and pointed across Paint Creek. No bats were captured, but numerous sequences were recorded for big brown bats, eastern red bats, eastern pipistrelles, northern bats and a few sequences were recorded for hoary bats. Operations ceased when temperature dropped to near 10 degrees C and activity was no longer detected.

## High Bank

On May 16, two stacked nets were set over a small backwater area near the Scioto River and one single net was set over a dry wash. On May 17, four single nets were set in the same area. Detectors were set facing over the open water and corridor associated with this backwater area. We captured a total of nine adult big brown bats, eight females and one male, with six females showing pregnancy, five adult northern bats, three females and two males, and one adult female evening bat, which was pregnant. The detectors recorded numerous call sequences big brown

bats, red bats, eastern pipistrelles, with a few sequences each from evening bats, hoary bats, and northern bats.

## Conclusion

This park was established to preserve, protect, and interpret the remnants of the Hopewell, thereby increasing understanding of their culture. All management options should take into consideration the potential impact to cultural resources at this park. With this in mind, certain habitats cannot be managed for as they may have adverse impact to the cultural resources. An example is restoring agricultural fields to forested areas, as tree roots may damage cultural resources below ground and increase the difficulty of access for researchers to certain sites. The current management in the disjunct units that make up the Hopewell Culture NHP, including the maintenance of the riparian landscape adjacent to the streams and rivers that border or transect the various areas, seem to provide adequate habitat for the typical eastern deciduous forest bats.

This inventory documented the occurrence of seven species of bats at the park. All seven of these species have been described as roosting and having their young in association with forest trees, either in the foliage, in cavities, or under loose bark. One potential species that was not documented (Indiana bat) also uses loose bark as summer roosts and maternity roosts. This species may be present in the study area, but there are no historical records for the park or for Ross County. Maturation of the riparian forests, with the accompanying increase in the number of snags with different amounts of persistent bark, may attract this endangered species to the area. However, I see no change in management that would immediately impact this species. I do encourage the managers to leave all dead or dying trees in place unless they could endanger park visitors or present a potential threat to buildings, roads, or trails. If future studies document this species in Ross or adjacent counties, additional surveys would be recommended. One species, the silver haired bat, undoubtedly occurs within the park boundaries during the spring and fall migratory periods, however there is no evidence to indicate that this species is present or breeds in the area during the summer months. The remaining three species of bats (Table 2) have been documented within the state, but should not be considered as potentially occurring within the park.

The stated goal of this inventory was to document 90% of the species reasonably expected to be present within the park during the inventory period. This inventory documented 87.5% of these species.

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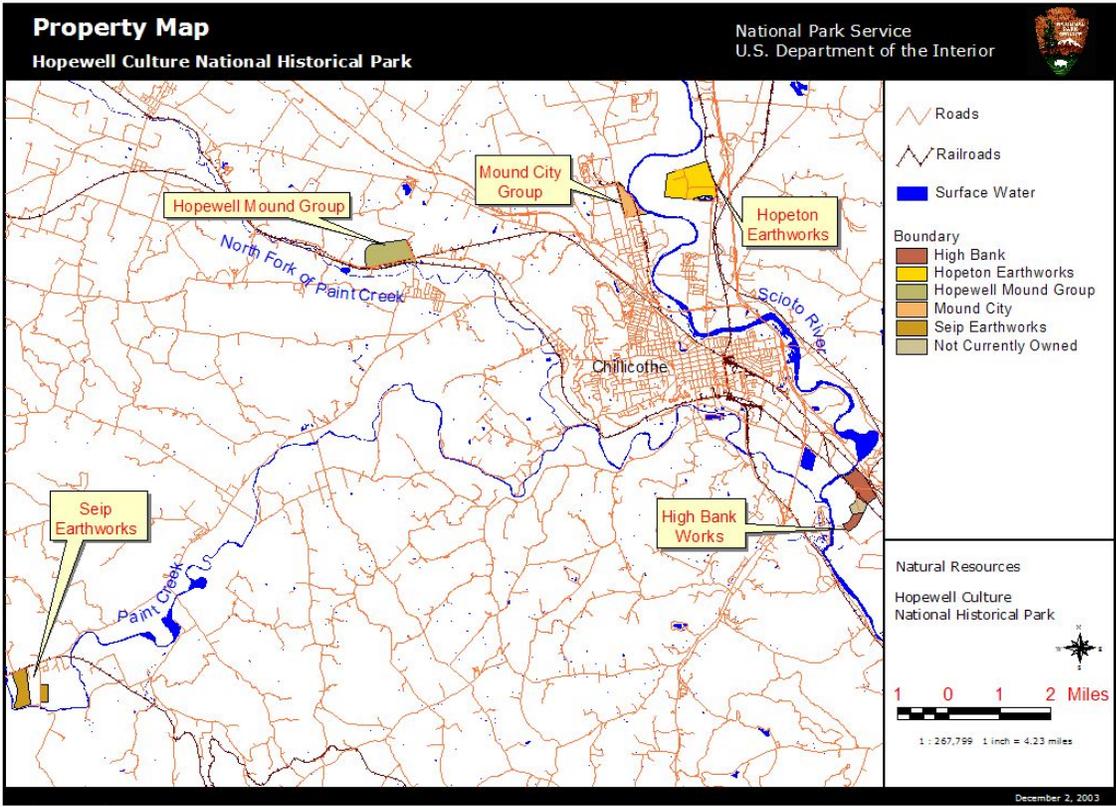


Figure 1. Map of Hopewell Culture National Historical Park, Ross County, Ohio.

Figure 2. Map of Mound City indicating bat inventory plots.

Figure 3. Map of Hopeton Earthworks indicating bat inventory plots.

Figure 4. Map of Hopewell Mounds indicating bat inventory plots.

Figure 5. Map of Seip Earthworks indicating bat inventory plots.

Figure 6. Map of High Bank Works indicating bat inventory plots.

Table 1. Unit, habitat, and sampling location data for bat inventory plots (NAD83).

<b>Unit</b>	<b>Habitat</b>	<b>Plot</b>	<b>Easting</b>	<b>Northing</b>
High Bank	Riparian corridor	5	334350	4352133
Hopeton	Creek bed	8	329428	4360713
Hopeton	Creek bed	9	329519	4360757
Hopewell	Pond/forest	7	319181	4359121
Hopewell	stream bed	10	320479	4358984
Mound City	Riparian Edge	1	327503	4360469
Mound City	Forest Trail	2	327440	4360632
Mound City	Small Forest Trail	3	327575	4360454
Mound City	Small forest trail	4	327518	4360334
Seip	Riparian corridor	6	307880	4344796

Table 2. List of potential bat species and their status at Hopewell Culture NHP

<b>Scientific Name</b>	<b>Common Name</b>	<b>Park Status</b>	<b>Abundance</b>	<b>Residency</b>
<i>Eptesicus fuscus</i>	Big Brown Bat	Present	Common	Breeder
<i>Lasiurus borealis</i>	Eastern Red Bat	Present	Common	Breeder
<i>Myotis lucifugus</i>	Little Brown Bat	Present	Uncommon	Breeder
<i>Myotis septentrionalis</i>	Northern Long-eared Bat	Present	Common	Breeder
<i>Nycticeius humeralis</i>	Evening Bat	Present	Uncommon	Breeder
<i>Pipistrellus subflavus</i>	Eastern pipistrelle	Present	Common	Breeder
<i>Corynorhinus rafinesquii</i> *	Rafinesque's Big Eared Bat	Unconfirmed	Unknown	Unknown
<i>Lasionycteris noctivagans</i>	Silver-haired Bat	Probably Present	Unknown	Unknown, migratory
<i>Lasiurus cinereus</i>	Hoary bat	Present	Uncommon	Unknown
<i>Myotis leibii</i> **	Eastern Small-footed Bat	Unconfirmed	Unknown	Unknown
<i>Myotis sodalis</i>	Indiana Bat	Probably Present	Unknown	Unknown
<i>Tadarida brasiliensis</i> ***	Mexican freetail	Unconfirmed	Unknown	Unknown

\* There have only been two records of this species in Ohio, in 1953 and 1960.

\*\* There has only been one record of this species in Ohio, in 1842.

\*\*\* There have only been two records of this species in Ohio, in 1958 and 1970.

Table 3. Species documented as present by park unit at Hopewell Culture NHP.

<b>Scientific Name</b>	<b>Mound City</b>	<b>Hopeton</b>	<b>Hopewell</b>	<b>Seip</b>	<b>High Bank</b>
<i>Eptesicus fuscus</i>	X	X	X	X	X
<i>Lasiurus borealis</i>	X	X	X	X	X
<i>Myotis lucifugus</i>		X	X		
<i>Myotis septentrionalis</i>	X	X		X	X
<i>Nycticeius humeralis</i>	X				X
<i>Pipistrellus subflavus</i>	X	X	X	X	X
<i>Lasiurus cinereus</i>	X		X	X	X