National Park Service
U.S. Department of the Interior

Northeast Region
Philadelphia, Pennsylvania

Bat Inventory of Four Eastern Rivers and Mountains Network National Parks

Technical Report NPS/NER/NRTR—2007/098

ON THE COVER

Images, from top left, clockwise: *Pipistrellus subflavus* taken at Friendship Hill NHS; *Lasiurus borealis* taken at Allegheny Portage Railroad NHS; *Glaucomys volans* taken at Johnstown Flood NM; and *Myotis septentrionalis* taken at Fort Necessity NB. Photographs by: Joshua B. Johnson.

Bat Inventory of Four Eastern Rivers and Mountains Network National Parks

Technical Report NPS/NER/NRTR—2007/098

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November 2007

U.S. Department of the Interior
National Park Service
Northeast Region
Philadelphia, Pennsylvania

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This report was accomplished under Cooperative Agreement 1443CA309701200, Task Agreement No. J-3097-04-102 with assistance from the NPS. The statements, findings, conclusions, recommendations, and data in this report are solely those of the author(s), and do not necessarily reflect the views of the U.S. Department of the Interior, National Park Service.

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Please cite this publication as:

Gates, J. E., and J. B. Johnson. November 2007. Bat Inventory of Four Eastern Rivers and Mountains Network National Parks. Technical Report NPS/NER/NRTR—2007/098. National Park Service. Philadelphia, PA.

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Acknowledgments

We thank A. Sherman, M. Wampler, W. White, and K. Zielinski for their hard work and determination in the field. We appreciate the park tours, logistics assistance, and overall great help from K. Penrod and C. Ranson of the National Park Service. Allegheny Portage Railroad National Historic Site and Fort Necessity National Battlefield granted us access to park housing. We are grateful for insightful comments on an earlier draft of this report offered by J. Keefer, M. Marshall, K. Penrod, N. Piekielek, and C. Ranson. The National Park Service Eastern Rivers and Mountains Network Inventory and Monitoring Program provided funding for this inventory.

Project Highlights

Eastern Rivers and Mountains Network National Parks

We documented six common bat species in all four Eastern Rivers and Mountains Network (ERMN) park units that we inventoried. The most common species were big brown bat (*Eptesicus fuscus*), little brown myotis (*Myotis lucifugus*), and northern myotis (*M. septentrionalis*); similar to what has been documented in other areas of the Appalachian Mountains. At least five of the species used the parks for roosting and foraging habitat and for raising young. The mosaic of forests, fields, and waterways provide a wide variety of habitat conditions for the diversity of bat species occurring among the parks. We did not capture the Pennsylvania state-threatened eastern small-footed myotis (*Myotis leibii*) or the federally endangered Indiana myotis (*M. sodalis*).

Allegheny Portage Railroad National Historic Site

Most bat activity was concentrated at lower elevations, especially the Level 10 homesite pond and the railroad trace between Muleshoe Curve and Ranger Lane. This park had the highest overall bat activity among the four inventoried ERMN park units. Some big brown bats roost around the chimney on the exterior of the Lemon House. This park has the highest likelihood of eastern small-footed myotis and Indiana myotis presence of the four inventoried ERMN park units because of its proximity to known hibernacula and historic records of these species; however, they probably currently either do not occur at the park, or occur in such low numbers as to go undetected by our inventory.

Fort Necessity National Battlefield

This park consists mostly of intact forest and had the highest northern myotis capture rate of the four inventoried ERMN park units. The northern myotis is considered a forest-interior species. Most bat activity was concentrated near the ponds at the Great Meadows Center. There were other concentrations of bat activity along forested roads and over parking lots.

Friendship Hill National Historic Site

This park had the highest species diversity, taking into account species richness and evenness, among the four inventoried ERMN park units. Big brown bats routinely roosted behind shutters of the Gallatin House. Sophie's Pond was the site with the highest bat activity in the park, possibly because bats were attracted to emerging aquatic insects. The pond also serves as a water source for bats and other wildlife.

Johnstown Flood National Memorial

This park had the highest species evenness, but lowest diversity among the four inventoried ERMN park units, due to low species richness as determined by mist netting. Locating ideal situations within this park to mist net was difficult, but acoustic monitoring revealed that this park had the highest hoary bat (*Lasiurus cinereus*) activity among the four inventoried ERMN

park units and high overall bat activity, second only to Allegheny Portage Railroad National Historic Site.

Abstract

Bats perform important roles within ecosystems in the mid-Atlantic region because they are significant consumers of nocturnal insects. Determining bat species composition in an area is a critical first step in managing for this important resource. We inventoried bats within four Eastern Rivers and Mountains Network (ERMN) park units in southwestern Pennsylvania during 2004–2005, using mist nets, acoustic monitoring equipment, and visual observations. Our efforts included 363 mist net nights at 32 sites and 49 sites monitored with Anabat II bat detectors among the four parks. We captured 330 bats representing five species including 121 little brown myotis (*Myotis lucifugus*), 96 northern myotis (*M. septentrionalis*), 85 big brown bats (*Eptesicus fuscus*), 19 eastern red bats (*Lasiurus borealis*), eight eastern pipistrelles (*Pipistrellus subflavus*), and one unidentified *Myotis* sp. The *Myotis* sp. escaped from the mist net before handling and identification could be ascertained; it most likely was not an eastern small-footed myotis (*M. leibii*) or Indiana myotis (*M. sodalis*), but rather a little brown myotis or northern myotis. Of the 3,422 echolocation passes we collected using Anabat II bat detectors, we were able to identify 2,848 to species or species group, including hoary bats (*Lasiurus cinereus*), which were not captured in mist nets. We were able to identify echolocation passes from big brown bats, eastern red bats, hoary bats, little brown myotis, northern myotis, and eastern pipistrelles. Acoustic monitoring consistently detected all species captured in mist nets and species that were not captured; therefore, acoustic monitoring provided a more complete documentation of bat communities during this study. The four inventoried ERMN park units contained habitat suitable for most bat species common in the mid-Atlantic region. Reproduction and recruitment (i.e., addition of new individuals to the population) occurred at the four inventoried ERMN park units. Big brown bats, little brown myotis, and northern myotis were the most ubiquitous, and probably the most abundant, bat species at the four inventoried ERMN park units. We documented bat species that are considered common in the mid-Atlantic region, Pennsylvania, and among the four ERMN park units in the inventory. Bat species that are known to occur in Pennsylvania but were not documented during this inventory either occur incidentally in the state (e.g., Seminole bat [*Lasiurus seminolus*]), are restricted to the southeastern part of the state (e.g., evening bat, [*Nycticeius humeralis*]), migrate through the parks in spring and autumn (e.g., silver-haired bat, [*Lasionycteris noctivagans*]), or either do not occur at the parks or occur in such low numbers as to go undetected by our inventory (e.g., eastern small-footed myotis and Indiana myotis). Although we documented no rare or endangered bats, historic records and hibernacula of eastern small-footed myotis and Indiana myotis occurred in proximity to Allegheny Portage Railroad National Historic Site, indicating that these species could occur in low numbers in this park.

Introduction

Much recent attention has focused on the conservation and management of bats because of their roles in ecosystems and as possible indicator species (Fenton 2003; Miller et al. 2003). About 1,000 bat species occur worldwide on every continent except Antarctica. Bats represent about 25% of all mammalian species. In the United States, 45 bat species representing four families and 19 genera occur. Of these, six are either endangered species or subspecies and 20 are considered species of special concern. Population declines typically are attributed to habitat loss or colony disturbance (Harvey et al. 1999).

Bats occurring in the mid-Atlantic region of the United States are beneficial components of ecosystems, primarily because they are insectivores. Bats may consume over half their body weight in insects each night and take a wide variety of insect prey, including harmful forest and crop pests (Griffith and Gates 1985; Harvey et al. 1999). Bats in the mid-Atlantic region are nocturnal and use ultrasonic echolocation to navigate and locate food.

Life histories of bat species occurring in the mid-Atlantic region are somewhat similar. During summer, the females of some species form maternity colonies and others roost singly. Males of most species roost singly or in small groups and are typically segregated from females. Bats roost in caves, mines, tunnels, buildings, bridges, hollow trees, tree foliage, and under leaf litter and exfoliating bark (Barbour and Davis 1969; Appendix A). In late June and July, females give birth to their young, which are weaned, in most cases, in three to six weeks. In late summer and early autumn, mating occurs, sometimes at entrances of caves, mines, and tunnels, where hundreds of individuals may congregate and exhibit a behavior known as swarming (Cope and Humphrey 1977). Some bat species may roost at these swarming sites, while others may migrate hundreds of kilometers to winter hibernacula (Fenton 1969). Delayed fertilization allows females to mate in autumn and postpone pregnancy until the following spring (Barbour and Davis 1969; Harvey et al. 1999).

In Pennsylvania, 11 bat species have been documented, including big brown bats (*Eptesicus fuscus*), silver-haired bats (*Lasionycteris noctivagans*), eastern red bats (*Lasiurus borealis*), Seminole bats (*L. seminolus*), hoary bats (*L. cinereus*), eastern small-footed myotis (*Myotis leibii*), little brown myotis (*M. lucifugus*), northern myotis (*M. septentrionalis*), Indiana myotis (*M. sodalis*), evening bats (*Nyticeius humeralis*), and eastern pipistrelles (*Pipistrellus subflavus*) (Harvey et al. 1999; Appendix B). Of these, nine potentially occur at the four inventoried ERMN park units. Two incidental records of Seminole bats (*L. seminolus*) are known from Pennsylvania; one from Berks County and one from Lancaster County (Poole 1932, 1949). Evening bats are restricted to southeastern Pennsylvania (NAUS 2006). The eastern small-footed myotis is a state-listed threatened species that occurs mostly in the Allegheny Mountains Section and Allegheny Front Section of the Appalachian Plateau physiographic province (Dunn and Hall 1989). Indiana myotis is a federally listed endangered species and, in Pennsylvania, is known to hibernate in caves, mines, and tunnels located in the Ridge and Valley and Appalachian Plateau physiographic provinces, but their summer ranges remain largely unclear (Dunn and Hall 1989). Big brown bats, silver-haired bats, eastern red bats, hoary bats, little brown myotis, northern myotis, and eastern pipistrelles are considered common species and probably occur throughout the state during summer months (Harvey et al. 1999).

At least some of the species common in Pennsylvania likely occur at the four inventoried ERMN park units and exploit the parks' resources in different ways (Menzel 2003; Ford et al. 2004, 2005). Big brown bats and hoary bats are the most likely species to be found foraging in open areas or above the forest canopy because they have high wing-loading and high-amplitude, low-frequency echolocation calls (Barclay 1985). The myotine bats (i.e., little brown myotis, northern myotis, Indiana myotis, eastern small-footed myotis) most likely will be encountered in forest interiors because of their low wing-loading and low-amplitude, high-frequency echolocation calls (Kalcounis and Brigham 1995; Owen et al. 2003). The other four species have intermediate wing-loading and medium-frequency echolocation calls (i.e., silver-haired bats, eastern red bats, eastern pipistrelles, and evening bats) and, therefore, may use open and forested areas (Hutchinson and Lacki 1999; Carter et al. 2004). Typically, bat foraging activity is highest in riparian areas where water and insect resources are plentiful (Owen et al. 2003).

The various bat species that may occur within the four inventoried ERMN park units not only have different foraging strategies, but have different roosting strategies as well. Some bat species, including big brown bats and little brown myotis, frequently roost in buildings (Barbour and Davis 1969). Other bat species, including hoary bats, eastern red bats, and eastern pipistrelles, roost among tree foliage (Barclay 1989; Menzel et al. 1998; Veilleux et al. 2003). Other bat species, including silver-haired bats, northern myotis, and evening bats often roost in tree cavities and crevices and under exfoliating bark (Campbell et al. 1996; Menzel et al. 2001a, Menzel et al. 2002c). Caves, mines, and tunnels are used as hibernacula by big brown bats, eastern small-footed myotis, little brown myotis, northern myotis, Indiana myotis, and eastern pipstrelles (Gates et al. 1984). Parks with a variety of cover types and roosting structures may have higher bat species diversity than parks with homogeneous cover and roosting structures (Humphrey 1975). Bat population densities on a geographic and landscape scale may further influence species diversity in ERMN park units. Although a general assessment of bat species diversity at ERMN park units can be determined by examining geographic ranges, verifying the presence and relative frequency of species through an inventory process facilitates more informed and accurate management decisions.

Many bat species that are of special concern, threatened, or endangered occur on federal lands, including those administered by the National Park Service (NPS) (Johnson et al. 2003b, 2005; Johnson and Gates 2007). National Park Service lands can serve as contiguous tracts of protected land in otherwise fragmented landscapes (Gates and Johnson 2005). Therefore, identifying sensitive species in parks not only facilitates informed management of species within the park, but further supports conservation efforts on a landscape and geographic scale.

A paucity of information exists concerning bat communities at the four ERMN park units in southwestern Pennsylvania. For example, to our knowledge, only one study has identified bats at FONE and FRHI, and that study was based on visual observations (Yahner et al. 2004). Winter hibernacula censuses have been conducted at Staple Bend Tunnel at Allegheny Portage Railroad National Historic Site (C. Butchkoski, Wildlife Biologist, Pennsylvania Game Commission, unpublished data, February 1997). Therefore, our objectives were to inventory bat species at four ERMN park units located in southwestern Pennsylvania, identify unique habitats, examine species distributions, estimate relative frequencies of species, and make recommendations for management and monitoring of bats.

Study Areas

We conducted bat inventories at four National Park Service parks within the Eastern Rivers and Mountains Network located in southwestern Pennsylvania (Figure 1). Allegheny Portage Railroad National Historic Site (ALPO), located in Blair and Cambria counties, Fort Necessity National Battlefield (FONE) in Fayette County, Friendship Hill National Historic Site (FRHI) in Fayette County, and Johnstown Flood National Memorial (JOFL) in Cambria County. All four parks are in the Appalachian Plateau physiographic province and encompass about 1,223 ha (3,022 ac) of various habitats.

Allegheny Portage Railroad National Historic Site is comprised of two units; the main unit between Summit and Foot-of-Ten, which is located about 6 km (3.7 mi) southwest of Altoona, and the Staple Bend Tunnel unit, which is located about 6 km (3.7 mi) northeast of Johnstown. The main unit encompasses 434 ha (1,072 ac), consisting mostly of deciduous forests (330 ha [815 ac]) and early succession habitats (74 ha [182 ac]), but also coniferous forest (4 ha [10 ac]), a small (<1 ha [2.5 ac]) pond, numerous intermittent streams, and a perennial stream (Blair Gap Run). Elevation at the main unit ranges from 335 m (1,099 ft) at Foot-of-Ten to 744 m (2,440 ft) at the Summit. The drastic elevation change, as compared to the other three ERMN park units in our inventory, is a result of this park's location on the Allegheny Front. The Staple Bend Tunnel tract encompasses 84 ha (207 ac) of deciduous forest, a small weir-contained pool, and the 275 m (902 ft) long Staple Bend Tunnel. Elevation ranges from 427–457 m (1,400–1,499 ft) at the Staple Bend Tunnel unit.

Fort Necessity National Battlefield is comprised of three units; the main unit, the Braddock's Grave unit, and the Jumonville Glen unit. The main unit is located about 14 km (8.7 mi) east of Uniontown and encompasses 353 ha (872 ac), including deciduous forest (>200 ha [494 ac]), meadow (>100 ha [247 ac]), coniferous forest (35 ha [86 ac]), several small (<1 ha [2.5 ac]) ponds, and a few small perennial and intermittent streams. Elevation at the main park unit ranges from 560–640 m (1,837–2,099 ft). The 9 ha (22 ac) Braddock's Grave unit is located about 1 km (0.6 mi) northwest of the main park unit and is comprised of deciduous forest, open grassy areas, a parking lot, and a perennial stream (Braddock Run). Elevation at the Braddock's Grave unit is about 585 m (1,919 ft). The Jumonville Glen unit is located about 5 km (3 mi) east of Uniontown and is comprised of 11 ha (27 ac) of deciduous forest, open areas associated with a parking lot and access road, a small rock outcropping, and an intermittent stream. Elevation at the Jumonville Glen unit ranges from 665–710 m (2,181–2,329 ft).

Friendship Hill National Historic Site is located about 2 km (1.25 mi) north of Point Marion and is comprised of 267 ha (659 ac) of deciduous and coniferous forest (198 ha [489 ac]), mowed fields (19 ha [47 ac]), and small wetlands, four intermittent and perennial streams, and a small (1 ha [2.5 ac]) pond. Some of the streams have been affected by acid mine drainage (C. Ranson, Natural Resource Specialist, National Park Service, pers. comm., October 2004). The Monongahela River borders the park on its northern and western boundaries. Elevation at this park ranges from 244–354 m (800–1,161 ft).

Johnstown Flood National Memorial is located about 11 km (6.8 mi) northeast of Johnstown and encompasses about 65 ha (160 ac) of early succession habitat (28 ha [69 ac]), deciduous forest

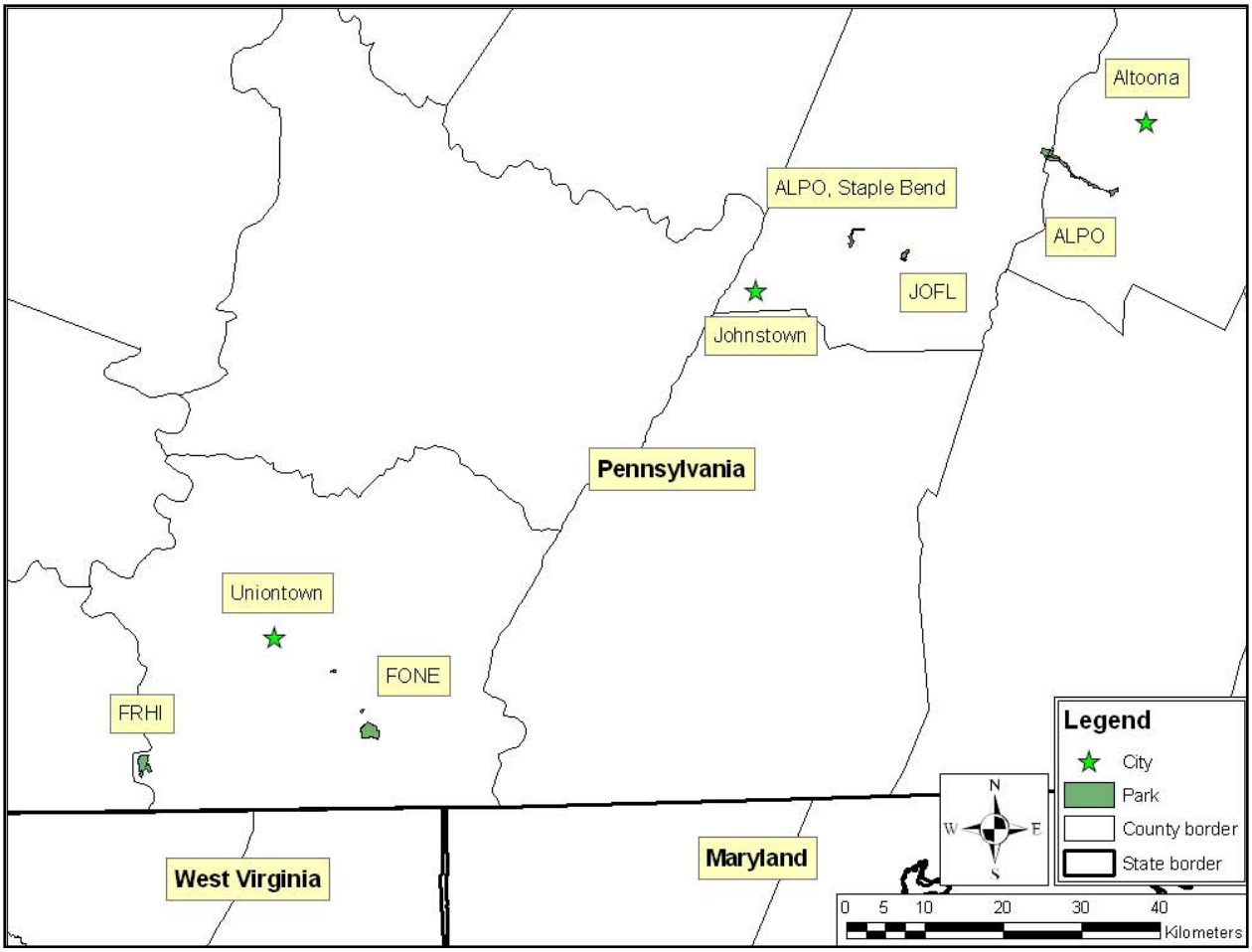


Figure 1. The four Eastern Rivers and Mountains Network park units inventoried for bats, 2004–2006, included Allegheny Portage Railroad National Historic Site (ALPO), Fort Necessity National Battlefield (FONE), Friendship Hill National Historic Site (FRHI), and Johnstown Flood National Memorial (JOFL).

(21 ha [51 ac]), open grassy areas (15 ha [37 ac]), and the South Fork of the Little Conemaugh River, which has been affected by acid mine drainage (K. Penrod, Natural Resource Manager, National Park Service, personal communication, April 2005). Elevation at JOFL ranges from 475–555 m (1,558–1,820 ft).

All four inventoried ERMN park units are located near Altoona and Uniontown in southwestern Pennsylvania. Altoona has a mean annual precipitation of 93.3 cm (36.7 in) and mean summer (June–August) temperature of 21.0°C (69.8°F) (NOAA 2005). Uniontown has a mean annual precipitation of 110.5 cm (43.5 in) and mean summer (June–August) temperature of 21.1° C (70°F) (NOAA 2005).

Methods

We used a combination of capture and acoustic methods, and visual observations to inventory bats during 2004–2005. We examined buildings for bat use in summer and autumn.

Mist Netting

To capture bats, we used 50-denier, 2-ply, 38 mm mesh mist nets (Avinet, Dryden, NY, USA) measuring 2.6 m (8.5 ft) high and 6, 9, or 12 m (19.6, 29.5, or 39.4 ft) long. Mist nets typically were erected over stream corridors, small pools, hiking trails, and service roads. Bats commonly forage over water sources where insects are concentrated and use trails and roads as traveling and foraging corridors. We mist netted in as many of these situations as we could locate within the park units and focused additional mist netting efforts at sites where we had high capture rates. We used 1-tier, 2-tier, and 3-tier mist net arrangements. A 1-tier mist net arrangement consisted of a single mist net stretched between two 3-m (9.8-ft) poles. A 2-tier mist net arrangement, often referred to as a canopy net, consisted of two mist nets stacked vertically and suspended between a rope and pulley system tied to two trees (Kunz and Kurta 1988). A 3-tier mist net arrangement consisted of three mist nets stacked vertically and suspended between a rope and pulley system on two 10-m (32.8-ft) telescoping poles (Gardner et al. 1989; Figure 2A). Mist netting typically was conducted for five hours following sunset. No bat inventories were conducted during periods of heavy rain, high wind (≥20 kph [12 mph]), or cold temperatures (<9°C [48°F]). The species of each captured bat was determined (Menzel et al. 2002b) as well as its weight, forearm length, sex, age, and reproductive condition before being released. We determined weight (g) with a spring scale (Pesola, Switzerland). Forearm length was measured to the nearest 0.5 mm using a bird wing rule (Avinet, Dryden, New York, USA). We determined age (i.e, adult or juvenile) by examining the level of epiphyseal-diaphyseal fusion in finger bones (Kunz and Anthony 1982). Reproductive condition of female bats was determined by palpating the abdomen and inspecting mammary glands (Racey 1988). We used an Olympus Camedia C-5050 digital camera (5 megapixels; New York, NY) to create voucher photographs of every species captured at every park (Figures 2B–4). In 2006, bats were marked with non-toxic, temporary paint pens to facilitate identification of recaptures within a sampling night.

Acoustic Monitoring

We used Anabat II (Titley Electronics, Ballina, Australia) broadband, frequency-division, bat detectors to acoustically monitor for bat echolocation passes. We acoustically monitored at multiple sites within various land covers and vegetative structures at each park to take advantage of the various foraging strategies exhibited by bat species that potentially occur in the parks (Menzel 2003; Ford et al. 2004, 2005). We conducted acoustic monitoring for 20 minutes at each site between sunset and 0200 hours. Each acoustic monitoring site was sampled two times each year. Echolocation passes were recorded to an Anabat CompactFlash storage Zero-Crossing Analysis Interface Module (ZCAIM), downloaded to a computer, and analyzed using Analook 4.8p software (Corben 2001). We used qualitative and quantitative echolocation call identification methods (Fenton and Bell 1981; O'Farrell et al. 1999; Murray et al. 2001). We identified echolocation passes of some species by comparing our unknowns to a library comprised of echolocation passes collected from hand-released bats marked with

(A)

(B)

Figure 2. (A) A high net located near the Gallatin House, Friendship Hill National Historic Site, 14 June 2005. (B) Big brown bat (*Eptesicus fuscus*) captured at Friendship Hill National Historic Site, 14 June 2005.

(A)

(B)

Figure 3. (A) Eastern red bat (*Lasiurus borealis*) captured at Allegheny Portage Railroad National Historic Site, 30 June 2005. (B) Little brown myotis (*Myotis lucifugus*) captured at Allegheny Portage Railroad National Historic Site, 22 June 2005.

(A)

(B)

Figure 4. (A) Northern myotis (*Myotis septentrionalis*) captured at Fort Necessity National Battlefield, 18 May 2005. (B) Eastern pipistrelle (*Pipistrellus subflavus*) captured at Friendship Hill National Historic Site, 17 June 2005.

chemiluminescent tags collected throughout the southeastern and mid-Atlantic United States (Menzel et al. 2002a; Figures 5(A–F). We only identified echolocation passes containing ≥3 call pulses. Currently, no techniques exist to reliably distinguish male/female or adult/juvenile bat echolocation calls.

Summer Roost Evaluations

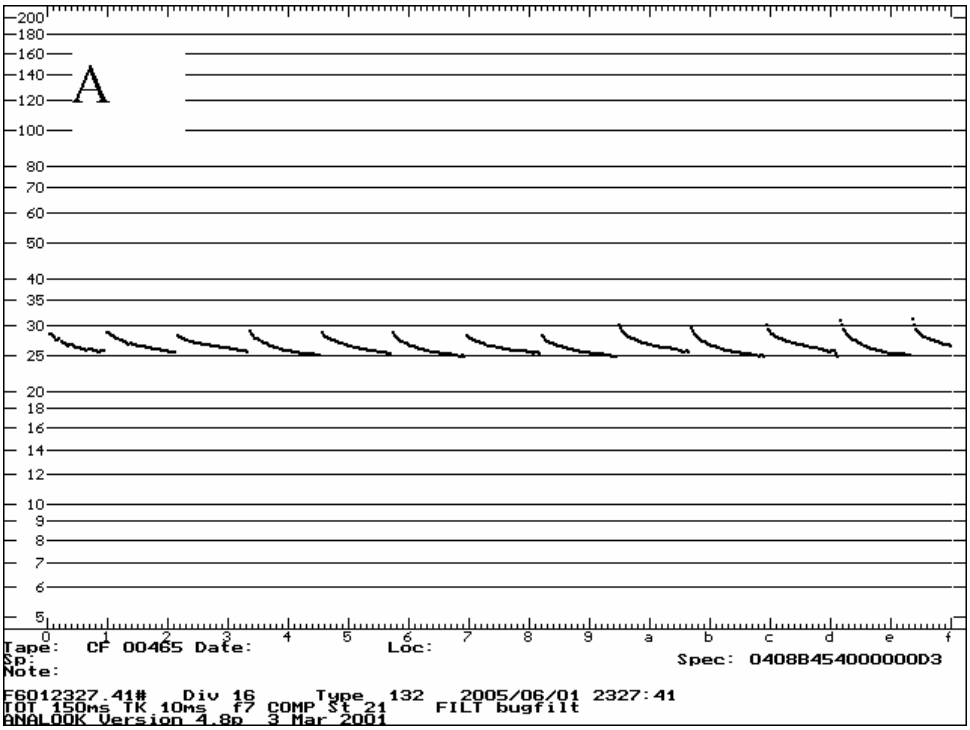
We assessed potential summer roost sites (e.g., buildings) for bat use. We selected which buildings to examine, primarily, based on information provided by NPS personnel. We examined the exterior of buildings, primarily behind shutters, during late afternoon, and conducted exit counts of colonies when we suspected bats were in areas where they could not be observed. At sunset, observers aided by bat detectors surrounded a building and watched for emerging bats. Buildings were observed for >30 minutes around sunset. We determined species by recording and analyzing echolocation passes of emerging bats.

Global Positioning System Data

The geographic locations of our acoustic monitoring and mist net sample sites were determined with a Thales MobileMapper (Santa Clara, CA) global positioning system (GPS). We attempted to limit position data capture to when Positional Dilution of Precision (PDOP) was ≤6.0 and when receiving position data from ≥4 satellites. We collected position data for ≥1 minute at each sample site. Unlike Trimble GeoExplorer GPS (Sunnyvale, CA), Thales MobileMapper GPS is unable to suspend position data collection when PDOP and satellite criteria are not met. Differential correction of position data was conducted when possible using data from nearby continuously operating reference stations (Pittsburgh or State College, PA). We noted the location of our inventory sites in relation to recognizable park features (e.g., trails, roads, streams, etc.).

Data Analyses

To determine if we inventoried all species of the bat community at each park, we used the rarefaction method, which examines the expected number of species given *N* captures (Krebs 1999). Moreover, rarefaction standardizes all samples from different communities to a common sample size of the same number of individuals. Although rarefaction analyses may not be completely appropriate for a small number of species, it is the best method available under our circumstances (Krebs 1999). We examined the number of new species recorded per mist net or acoustic monitoring site at each park. Simpson's species diversity index (1-*D*) and measure of evenness ($E_{1/D}$), where *D* is Simpson's index of diversity, were calculated for each park we inventoried and for the four parks as a whole (Krebs 1999). Species diversity and evenness were calculated with capture data only. We used acoustic survey data to determine species presence and relative activity levels. We could not ascertain the number of individual bats recorded acoustically, and ,therefore, could not calculate species diversity and evenness based on these data. Measuring bat species abundance, i.e., actual numbers or densities, at ERMN park units would be extremely difficult, because bats violate many assumptions of abundance models (Krebs 1999). However, we can evaluate relative frequencies among bat species based on activity levels and number of sites where each bat was recorded acoustically. We used Horn's index of similarity (HIS) to compare bat species composition among the four inventoried ERMN



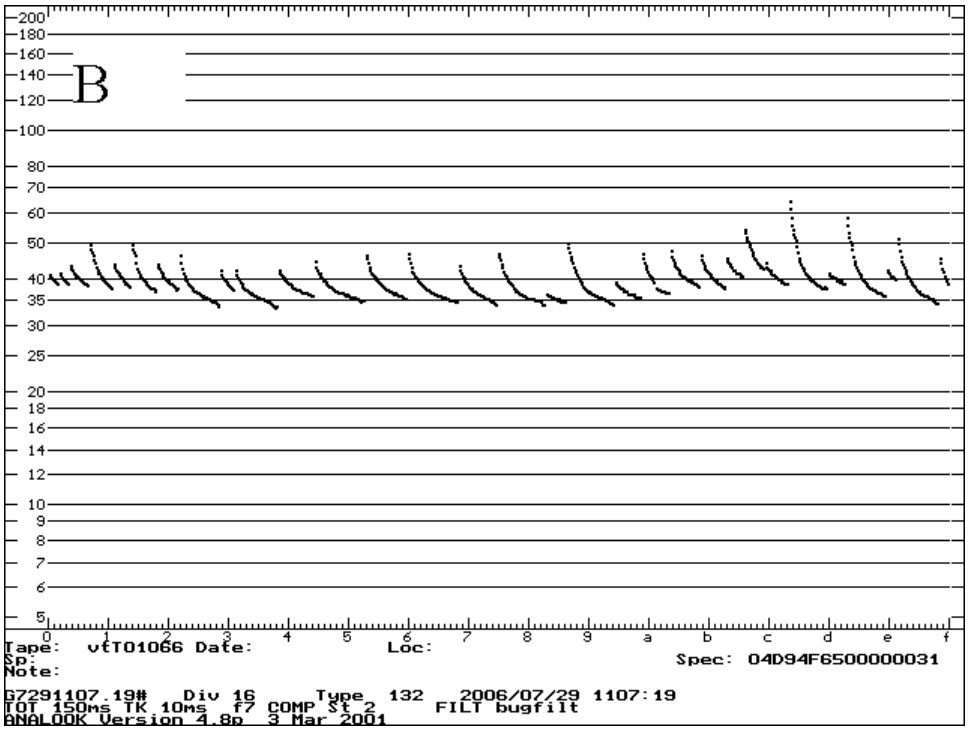
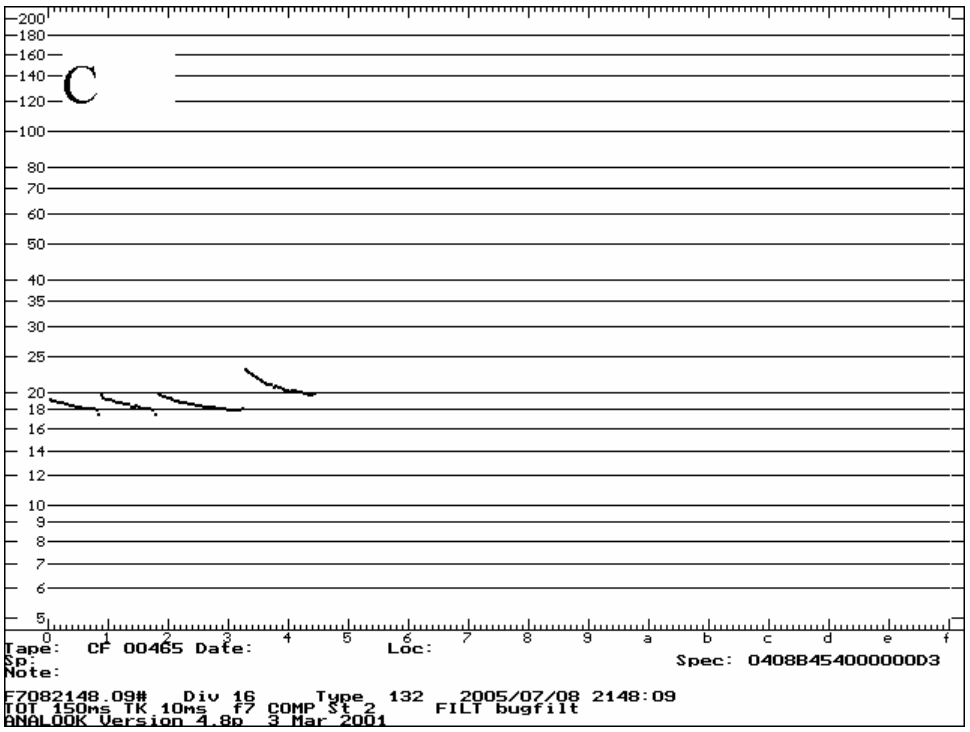
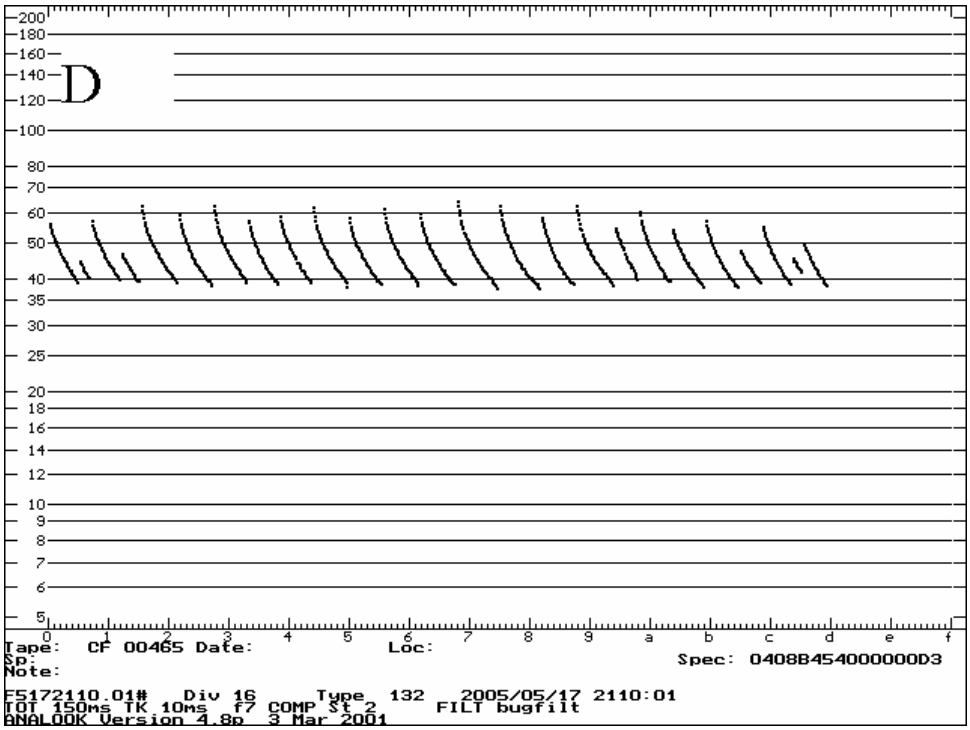


Figure 5. Graphical displays in Analook software of typical search-phase echolocation calls of (A) big brown bat (*Eptesicus fuscus*), (B) eastern red bat (*Lasiurus borealis*), (C) hoary bat (*Lasiurus cinereus*), (D) little brown myotis (*Myotis lucifugus*), (E) northern myotis (*Myotis septentrionalis*), and (F) eastern pipistrelle (*Pipistrellus subflavus*).





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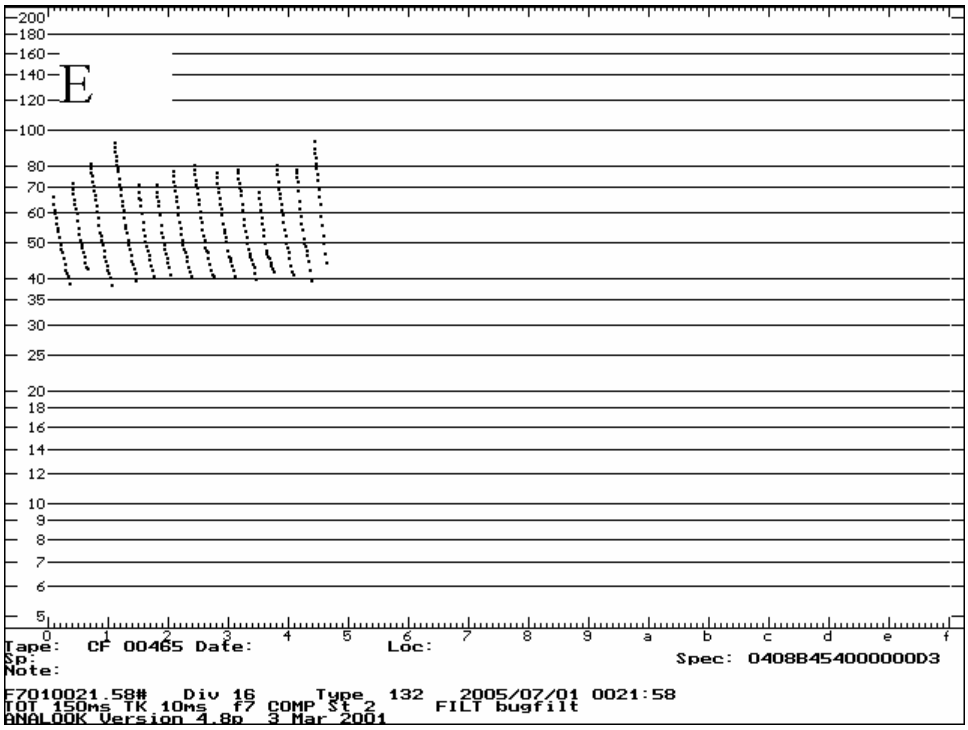

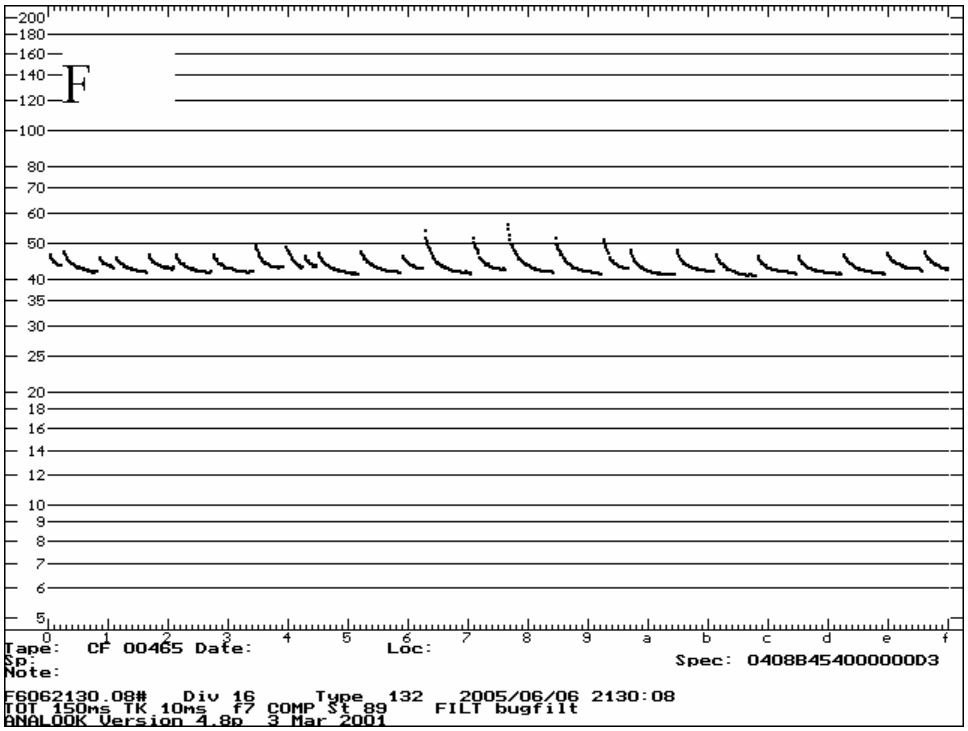

Figure 5. Graphical displays in Analook software of typical search-phase echolocation calls of (A) big brown bat (*Eptesicus fuscus*), (B) eastern red bat (*Lasiurus borealis*), (C) hoary bat (*Lasiurus cinereus*), (D) little brown myotis (*Myotis lucifugus*), (E) northern myotis (*Myotis septentrionalis*), and (F) eastern pipistrelle (*Pipistrellus subflavus*) (continued).

park units (Krebs 1999). HIS uses relative frequency data collected using acoustic monitoring and mist nets. HIS ranges from 0–1; a higher number indicates that the parks' species relative frequencies and compositions are more similar. We also used HIS to compare species relative frequencies and compositions detected using acoustic monitoring and mist netting (Krebs 1999). A HIS value close to 1 between the two methods indicates that they are complementary and relative frequencies obtained by each method are similar, which is useful, in that we can obtain some information concerning relative frequencies of bat species not captured in mist nets.

Results

Mist Netting

We mist netted for 363 mist net nights at 32 sites among the four ERMN park units (Table 1). We captured 330 bats representing five species, including: 121 little brown myotis, 96 northern myotis, 85 big brown bats, 19 eastern red bats, eight eastern pipistrelles, and one unidentified *Myotis* sp. (Table 2, 3, Appendix C). We recaptured four bats in 2006, including one adult male big brown bat at FRHI, one adult female big brown bat at FRHI, one adult female big brown bat at ALPO, and one adult male little brown myotis at FONE. Bats were captured at all parks and at 75% of mist net sites (Table 4). We captured all five species at FONE and FRHI. Eastern red bats were not captured at JOFL and eastern pipistrelles were not captured at ALPO or JOFL. Overall catch per unit effort (CPUE) for the parks was 0.0075 (Table 5). A typical night of mist netting consisted of monitoring six 9-m (29.5-ft) nets (three low nets, one high net) equaling 140.4 m^2 (1,511.25 ft^2) for five hours (702 mist net hours). A CPUE of 0.0075×702 mist net hours equals about five bats captured per night. Little brown myotis and northern myotis had a higher CPUE than big brown bats, but were captured at fewer mist net locations throughout the parks.

Acoustic Monitoring

We acoustically monitored at 49 locations among the four inventoried ERMN park units (Figure 6; Appendix D). Of the 3,422 echolocation passes we collected, we were able to identify 2,848 (83.2%) to species or species group. We were able to identify echolocation passes from big brown bats, eastern red bats, hoary bats, little brown myotis, northern myotis, and eastern pipistrelles (Table 6). All six species were detected at all four inventoried ERMN park units. Big brown bats were the most frequently detected species, comprising 38.7% of identifiable passes at 81.6% of all acoustic monitoring sites. Hoary bats were the least frequently detected species, comprising 0.7% of identifiable echolocation passes at 14.3% of all acoustic monitoring sites (Table 7).

Allegheny Portage Railroad National Historic Site

We mist netted at nine sites totaling 102 mist net nights at ALPO (Figures 6–8). We captured 113 bats, including: 59 little brown myotis, 28 big brown bats, 19 northern myotis, and seven eastern red bats (Table 3; Figures 9–24). We captured reproductively active female big brown bats, little brown myotis, and northern myotis. We captured juvenile big brown bats, little brown myotis, and northern myotis.

We conducted acoustic monitoring at 17 sites at ALPO and collected 1,618 echolocation passes from six species (Table 6, Figures 6–8). Overall, eastern red bats were recorded at more sites than any other recorded species, but we recorded the most echolocation passes from big brown bats (Tables 6–7). We acoustically detected, but did not capture, hoary bats and eastern pipistrelles at ALPO (Figures 9–24).

Table 1. Mist net site descriptions and acoustic monitoring locations at four Eastern Rivers and Mountains Network park units, 2005–2006.

Allegheny Portage Railroad National Historic Site	
Mist net site	Description
Site A	Hiking trails near picnic area
Site B	Treeline and pond at Level 10 homesite
Site C	Hiking trails and railroad trace near picnic area
Site D	Railroad trace, approximately 1.0 km east from Muleshoe Curve
Site E	Trail and Blair Gap Run near Mill Road
Site F	Railroad trace, approximately 2.8 km south from Staple Bend Tunnel entrance gate
Site G	Railroad trace and small pool above weir, approximately 1.8 km south from Staple Bend Tunnel entrance gate
Site H	Railroad trace, approximately 0.35 km east from Muleshoe Curve entrance
Site I	Railroad trace and trail, approximately 0.70 km north from the Ranger Lane access
Acoustic monitoring (Anabat) sites	Location
Site 1	Lemon House
Site 2	Hiking trail in woods northwest of Visitor Center
Site 3	Railroad trace north of picnic area
Site 4	Picnic area
Site 5	Hiking trail west of picnic area
Site 6	Blair Gap Run near Mill Road
Site 7	Blair Gap Run headwaters
Site 8	Mulesho e Curve
Site 9	Railroad trace, east of Muleshoe Curve
Site 10	Level 10 homesite pond
Site 11	Railroad trace near Ranger Lane access
Site 12	Railroad trace near culvert 1692
Site 13	Staple Bend Tunnel parking lot
Site 14	Half-mile marker on Staple Bend Tunnel railroad trace
Site 15	One-mile marker on Staple Bend Tunnel railroad trace
Site 16	One and one-half mile marker on Staple Bend Tunnel railroad trace
Site 17	Staple Bend Tunnel
Fort Necessity National Battlefield	
Mist net site	Description
Site A	Ponds adjacent to Great Meadows Center
Site B	Picnic loop road north of picnic area
Site C	Walkway between Visitor Center (now demolished) and Mount Washington Tavern
Site D	Reservoir Road before switchback
Site E	Braddock Run and Braddock Road Trace adjacent to Braddock Run
Site F	Walkway and abandoned road at Jumonville Glen
Site G	Reservoir Road near water tanks
Site H	Walkway between new Visitor Center and Fort Necessity
Site I	Picnic loop road south of picnic area
Site J	Walkway south of Mount Washington
Site K	Braddock's Grave parking lot
Site L	Picnic area
Site M	Sharp curve in Reservoir Road

Table 1. Mist net site descriptions and acoustic monitoring locations at four Eastern Rivers and Mountains Network park units, 2005–2006 (continued).

Fort Necessity National Battlefield (continued)	
Acoustic monitoring (Anabat) sites	Location
Site 1	Pond adjacent to Great Meadows Center
Site 2	Fort Necessity
Site 3	Traffic circle at entrance to gravel picnic area road
Site 4	Picnic area road near southwest gate
Site 5	Picnic area road near picnic area
Site 6	Administration building parking lot
Site 7	Jumonville Glen parking lot
Site 8	Jumonville Glen rock outcropping
Site 9	Braddock's Grave parking lot
Site 10	Braddock Run
Site 11	Footpath between Visitor Center and Mount Washington Tavern
Site 12	Past southwestern gate on picnic area road
Site 13	Reservoir Road
Site 14	Braddock Road Trace
Friendship Hill National Historic Site	
Mist net site	Description
Site A	Hiking trails adjacent to Ice Pond Run
Site B	Hiking trails near Sophia Pond, on Sophia Pond dam, and in adjacent treeline
Site C	Main Cutoff trail near ranger residence
Site D	New Geneva Spur hiking trail
Site E	Treeline in front of Gallatin House
Site F	Hiking trails near Dublin Run and School Spur
Site G	Between Gallatin House and old barn
Site H	Behind Gallatin House
Acoustic monitoring (Anabat) sites	Location
Site 1	Gallatin House
Site 2	Sophia Pond
Site 3	Maintenance building
Site 4	Hiking trails adjacent to Ice Pond Run
Site 5	Main loop hiking trail adjacent to Dublin Run
Site 6	New Geneva Spur hiking trail
Site 7	Thomas Clare Cemetary
Site 8	Dublin Run near railroad tracks
Site 9	Ice Pond Run near railroad tracks
Site 10	Main Loop Trail northwest of Albert Gallatin House
Site 11	Main Loop Trail near South Run
Site 12	Service road on eastern tract
Johnstown Flood National Memorial	
Mist net site	Description
Site A	Hiking trail and picnic area
Site B	South abutment of dam
Acoustic monitoring (Anabat) sites	Location
Site 1	South abutment
Site 2	South Fork of the Little Conemaugh River
Site 3	Picnic area hiking trail
Site 4	South gate to picnic area and south abutment
Site 5	North abutment parking lot
Site 6	Visitor Center

Table 2. Bat species inventoried at four Eastern Rivers and Mountains Network park units, 2005–2006, using mist netting (N) and acoustic monitoring (A) methods.

	Species					
Park[a]	*Eptesicus fuscus*	*Lasiurus borealis*	*Lasiurus cinereus*	*Myotis lucifugus*	*Myotis septentrionalis*	*Pipistrellus subflavus*
ALPO	A N	A N	A	A N	A N	A
FONE	A N	A N	A	A N	A N	A N
FRHI	A N	A N	A	A N	A N	A N
JOFL	A N	A	A	A N	A N	A

[a]ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.

Table 3. Bat captures at four Eastern Rivers and Mountains Network park units, 2005–2006.

				Male		Female	
Location[a]	Year	Species	No. captures[b]	A	J	A	J
ALPO	2005	*Eptesicus fuscus*	11	8	0	3	0
		Lasiurus borealis	3	2	0	0	0
		Myotis lucifugus	26	7	0	17	0
		Myotis septentrionalis	13	6	0	7	0
	2006	*Eptesicus fuscus*	17	10	0	6	1
		Lasiurus borealis	4	4	0	0	0
		Myotis lucifugus	33	15	2	8	8
		Myotis septentrionalis	6	1	2	3	0
	Total	*Eptesicus fuscus*	28	18	0	9	1
		Lasiurus borealis	7	6	0	0	0
		Myotis lucifugus	59	22	2	25	8
		Myotis septentrionalis	19	7	2	10	0
FONE	2005	*Eptesicus fuscus*	1	1	0	0	0
		Myotis septentrionalis	33	9	0	24	0
	2006	*Eptesicus fuscus*	8	6	0	2	0
		Lasiurus borealis	10	6	0	2	1
		Myotis lucifugus	23	20	1	2	0
		Myotis septentrionalis	29	9	4	9	6
		Pipistrellus subflavus	2	2	0	0	0
	Total	*Eptesicus fuscus*	9	7	0	2	0
		Lasiurus borealis	10	6	0	2	1
		Myotis lucifugus	23	20	1	2	0
		Myotis septentrionalis	61	17	4	33	6
		Pipistrellus subflavus	2	2	0	0	0
FRHI	2005	*Eptesicus fuscus*	9	5	0	4	0
		Lasiurus borealis	1	0	0	1	0
		Myotis lucifugus	24	4	0	19	0
		Myotis septentrionalis	9	7	0	2	0
		Unidentified *Myotis* sp.	1	0	0	0	0
		Pipistrellus subflavus	2	0	0	2	0
	2006	*Eptesicus fuscus*	26	17	2	7	0
		Lasiurus borealis	1	0	0	1	0

Table 3. Bat captures at four Eastern Rivers and Mountains Network park units, 2005–2006 (continued).

Location[a]	Year	Species	No. captures[b]	Male A	Male J	Female A	Female J
		Myotis lucifugus	6	2	1	3	0
		Myotis septentrionalis	5	4	0	1	0
		Pipistrellus subflavus	4	2	0	2	0
	Total	*Eptesicus fuscus*	35	22	2	11	0
		Lasiurus borealis	2	0	0	2	0
		Myotis lucifugus	30	6	1	22	0
		Myotis septentrionalis	14	11	0	3	0
		Unidentified *Myotis* sp.	1	0	0	0	0
		Pipistrellus subflavus	6	2	0	4	0
JOFL	2005	*Myotis lucifugus*	6	3	0	3	0
		Myotis septentrionalis	1	0	0	1	0
	2006	*Eptesicus fuscus*	13	5	3	4	1
		Myotis lucifugus	3	1	0	1	1
		Myotis septentrionalis	1	1	0	0	0
	Total	*Eptesicus fuscus*	13	5	3	4	1
		Myotis lucifugus	9	4	0	4	1
		Myotis septentrionalis	2	1	0	1	0
All parks	2005	*Eptesicus fuscus*	21	13	0	7	0
		Lasiurus borealis	4	2	0	1	0
		Myotis lucifugus	56	14	0	39	0
		Myotis septentrionalis	56	34	0	22	0
		Unidentified *Myotis* sp.	1	0	0	0	0
		Pipistrellus subflavus	2	0	0	2	0
	2006	*Eptesicus fuscus*	64	38	5	19	2
		Lasiurus borealis	15	10	0	3	1
		Myotis lucifugus	65	38	4	14	9
		Myotis septentrionalis	40	14	6	13	6
		Pipistrellus subflavus	6	4	0	2	0
	Total	*Eptesicus fuscus*	85	52	5	26	2
		Lasiurus borealis	19	12	0	4	1
		Myotis lucifugus	121	52	4	53	9
		Myotis septentrionalis	96	48	6	35	6
		Unidentified *Myotis* sp.	1	0	0	0	0
		Pipistrellus subflavus	8	4	0	4	0

[a]ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.
[b]Discrepancies in total number of bats captured and sum of males and females are because bats escaped before sex was determined.
[c]Unidentified *Myotis* sp. escaped from mist net before species could be determined.

Table 4. Percentage of mist net sites at four Eastern Rivers and Mountains Network park units, 2005–2006, at which each bat species was captured.

			Species[c]					
Park[a]	Year	*n*[b]	Any	EPFU	LABO	MYLU	MYSE	PISU
ALPO	2005	7	100.0	85.7	28.6	85.7	71.4	0.0
	2006	8	87.5	62.5	37.5	75.0	50.0	0.0
	Total	9	100.0	88.9	55.6	88.9	66.7	0.0
FONE	2005	7	57.1	14.3	0.0	0.0	57.1	0.0
	2006	9	66.7	55.6	55.6	22.2	22.2	11.1
	Total	13	53.8	38.5	38.5	15.4	30.8	7.7
FRHI	2005	6	83.3	33.3	16.7	66.7	66.7	16.7
	2006	6	83.3	83.3	16.7	50.0	50.0	33.3
	Total	8	87.5	62.5	25.0	62.5	75.0	37.5
JOFL	2005	2	50.0	0.0	0.0	50.0	50.0	0.0
	2006	1	100.0	100.0	0.0	100.0	100.0	0.0
	Total	2	100.0	50.0	0.0	50.0	50.0	0.0
All parks	2005	22	77.3	40.9	13.6	50.0	63.6	4.5
	2006	24	79.2	66.7	37.5	50.0	41.7	12.5
	Total	32	75.0	59.4	37.5	50.0	53.1	12.5

[a]ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.
[b]Number of mist net sites.
[c]Any = any species;
EPFU = *Eptesicus fuscus*;
LABO = *Lasiurus borealis*;
MYLU = *Myotis lucifugus*;
MYSE = *Myotis septentrionalis*;
PISU = *Pipistrellus subflavus*.

Table 5. Number of bats captured per unit effort [no. captures/(mist net surface area × hours)] at four Eastern Rivers and Mountains Network park units, 2005–2006.

Park[a]	Year	*n*[b]	No. nights[c]	Mist net nights[d]	Mist net hours[e]	Species[f]					
						All	EPFU	LABO	MYLU	MYSE	PISU
ALPO	2005	7	8	42	5401.89	0.0091	0.0020	0.0006	0.0048	0.0024	–
	2006	8	10	60	6556.29	0.0092	0.0026	0.0006	0.0050	0.0009	–
	Total	9	18	102	11958.18	0.0091	0.0023	0.0006	0.0049	0.0016	–
FONE	2005	7	9	46	5668.65	0.0060	0.0002	–	–	0.0058	–
	2006	9	12	78	9048.00	0.0078	0.0009	0.0011	0.0025	0.0031	0.0002
	Total	13	18	124	14716.65	0.0071	0.0006	0.0007	0.0016	0.0041	0.0001
FRHI	2005	6	8	54	6361.99[g]	0.0072	0.0014	0.0002	0.0038	0.0014	0.0003
	2006	6	9	57	7025.93	0.0060	0.0037	0.0001	0.0009	0.0007	0.0006
	Total	8	17	111	13387.92[g]	0.0066	0.0026	0.0001	0.0022	0.0010	0.0004
JOFL	2005	2	2	12	1676.00	0.0042	–	–	0.0036	0.0006	–
	2006	1	2	14	1806.48	0.0094	0.0072	–	0.0017	0.0006	–
	Total	2	4	26	3482.48	0.0069	0.0037	–	0.0026	0.0006	–
All parks	2005	22	27	154	19108.53	0.0071	0.0011	0.0002	0.0029	0.0029	0.0001
	2006	24	33	209	24436.70	0.0078	0.0026	0.0006	0.0027	0.0016	0.0002
	Total	32	60	363	43545.23	0.0075	0.0020	0.0004	0.0028	0.0022	0.0002

[a]ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.
[b]Number of mist net sites.
[c]Number of nights spent afield.
[d]Number of mist nets × number of nights.
[e]Mist net hours = mist net surface area (m^2) × hours.
[f]All = all species combined;
EPFU = *Eptesicus fuscus*;
LABO = *Lasiurus borealis*;
MYLU = *Myotis lucifugus*;
MYSE = *Myotis septentrionalis*;
PISU = *Pipistrellus subflavus*.
[g]Includes 1 unidentified *Myotis* spp. capture.

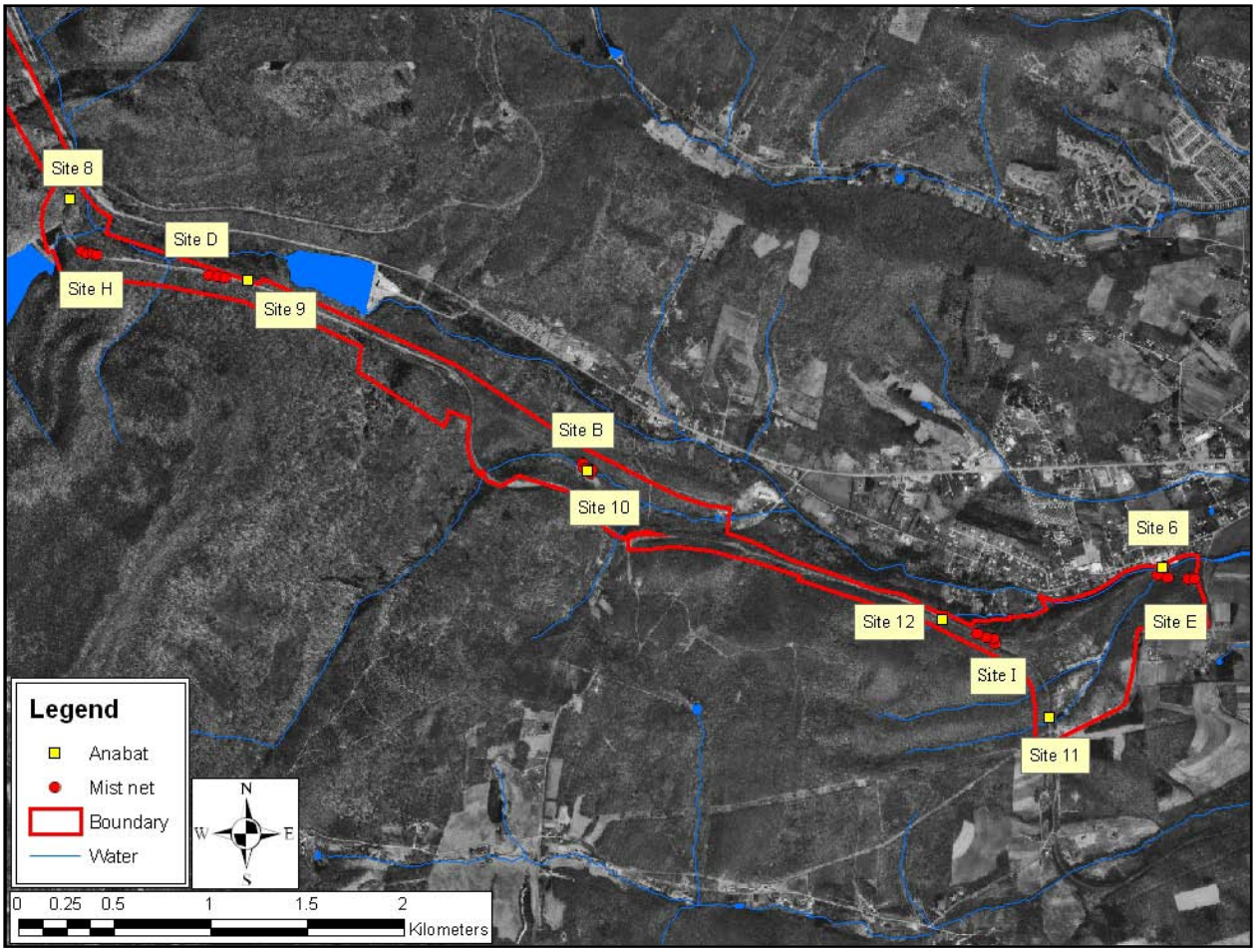

Figure 6. Mist net and acoustic monitoring (Anabat) sites at eastern portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

Table 6. Bat echolocation passes recorded at four Eastern Rivers and Mountains Network park units, 2005–2006.

Park[a]	*n*	Year	Total	NOID[b]	EPFU	EPFU FB	EPFU LACI	LABO	LABO FB	LACI	MYLU	MYLU FB	MYSE	MYSE FB	MYsp	MYsp FB	PISU	PISU FB
ALPO	17	2005	854	160	250	8	0	54	4	2	103	7	16	0	161	4	108	38
		2006	764	60	288	6	0	13	0	0	167	47	24	2	158	20	55	24
		Total	1,618	220	538	14	0	67	4	2	270	54	40	2	319	24	163	62
FONE	14	2005	197	59	3	0	0	60	1	1	46	9	11	0	17	0	0	0
		2006	405	51	130	14	0	82	0	0	65	13	19	0	53	2	5	3
		Total	602	110	133	14	0	142	1	1	111	22	30	0	70	2	5	6
FRHI	12	2005	386	84	58	5	17	66	3	6	3	0	1	0	22	0	129	21
		2006	343	42	245	10	0	26	0	0	2	0	2	0	10	1	16	3
		Total	729	126	303	15	17	92	3	6	5	0	3	0	32	1	145	24
JOFL	6	2005	356	99	90	10	7	49	7	2	87	11	4	0	14	0	4	1
		2006	117	19	38	1	0	7	0	10	23	3	4	0	15	0	1	0
		Total	473	118	128	11	7	56	7	12	110	14	8	0	29	0	5	1
All parks	49	2005	1,793	402	401	23	24	229	15	11	239	27	32	0	214	4	241	60
		2006	1,629	172	701	31	0	128	0	10	257	63	49	2	236	23	77	30
		Total	3,422	574	1,102	54	24	357	15	21	496	90	81	2	450	27	318	90

[a]ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.
[b]NOID = Unidentifiable bat call;
EPFU = *Eptesicus fuscus*;
EPFU/LACI = undetermined *E. fuscus* or *Lasiurus cinereus* call;
LABO = *Lasiurus borealis*;
LACI = *Lasiurus cinereus*;
MYLU = *Myotis lucifugus*;
MYSE = *Myotis septentrionalis*;
MYsp = *Myotis* spp. call;
PISU = *Pipistrellus subflavus*;
FB = feeding buzz.

Table 7. Percent of acoustic sampling locations at four Eastern Rivers and Mountains Network park units, 2005–2006, that each bat species was detected.

			Species[b]						
Park[a]	Year	*n*	Any	EPFU	LABO	LACI	MYLU	MYSE	PISU
ALPO	2005	17	100.0	88.2	88.2	5.9	41.2	35.3	41.2
	2006	17	100.0	82.4	35.3	0.0	64.7	23.5	23.5
	Total	17	100.0	88.2	94.1	5.9	70.6	52.9	41.2
FONE	2005	14	92.9	14.3	50.0	7.1	35.7	50.0	0.0
	2006	14	100.0	78.6	42.9	0.0	35.7	42.9	14.3
	Total	14	100.0	78.6	71.4	7.1	64.3	71.4	14.3
FRHI	2005	12	100.0	66.7	41.7	16.7	16.7	8.3	41.7
	2006	12	100.0	75.0	33.3	0.0	16.7	16.7	25.0
	Total	12	100.0	83.3	50.0	16.7	33.3	25.0	41.7
JOFL	2005	6	100.0	66.7	100.0	33.3	33.3	16.7	33.3
	2006	6	100.0	66.7	50.0	50.0	83.3	33.3	16.7
	Total	6	100.0	66.7	100.0	50.0	83.3	33.3	50.0
All parks	2005	49	98.0	67.3	59.2	12.2	32.7	30.6	28.6
	2006	49	100.0	38.8	77.6	6.1	46.9	28.6	20.4
	Total	49	100.0	81.6	77.6	14.3	61.2	49.0	34.7

[a]ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.
[b]Any = any species;
EPFU = *Eptesicus fuscus*;
LABO = *Lasiurus borealis*;
LACI = *Lasiurus cinereus*;
MYLU = *Myotis lucifugus*;
MYSE = *Myotis septentrionalis*;
PISU = *Pipistrellus subflavus*.

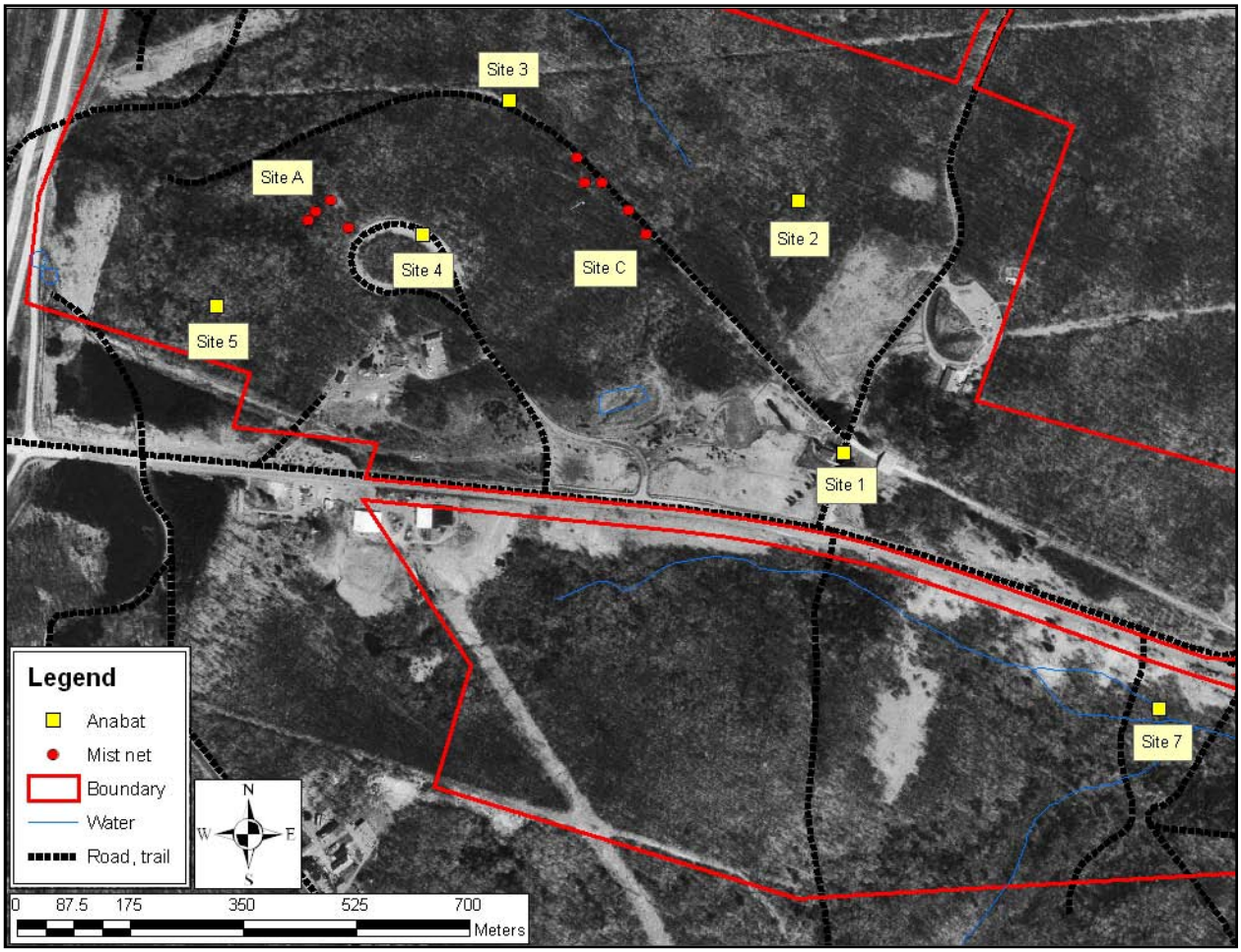

Figure 7. Mist net and acoustic monitoring (Anabat) sites at western portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

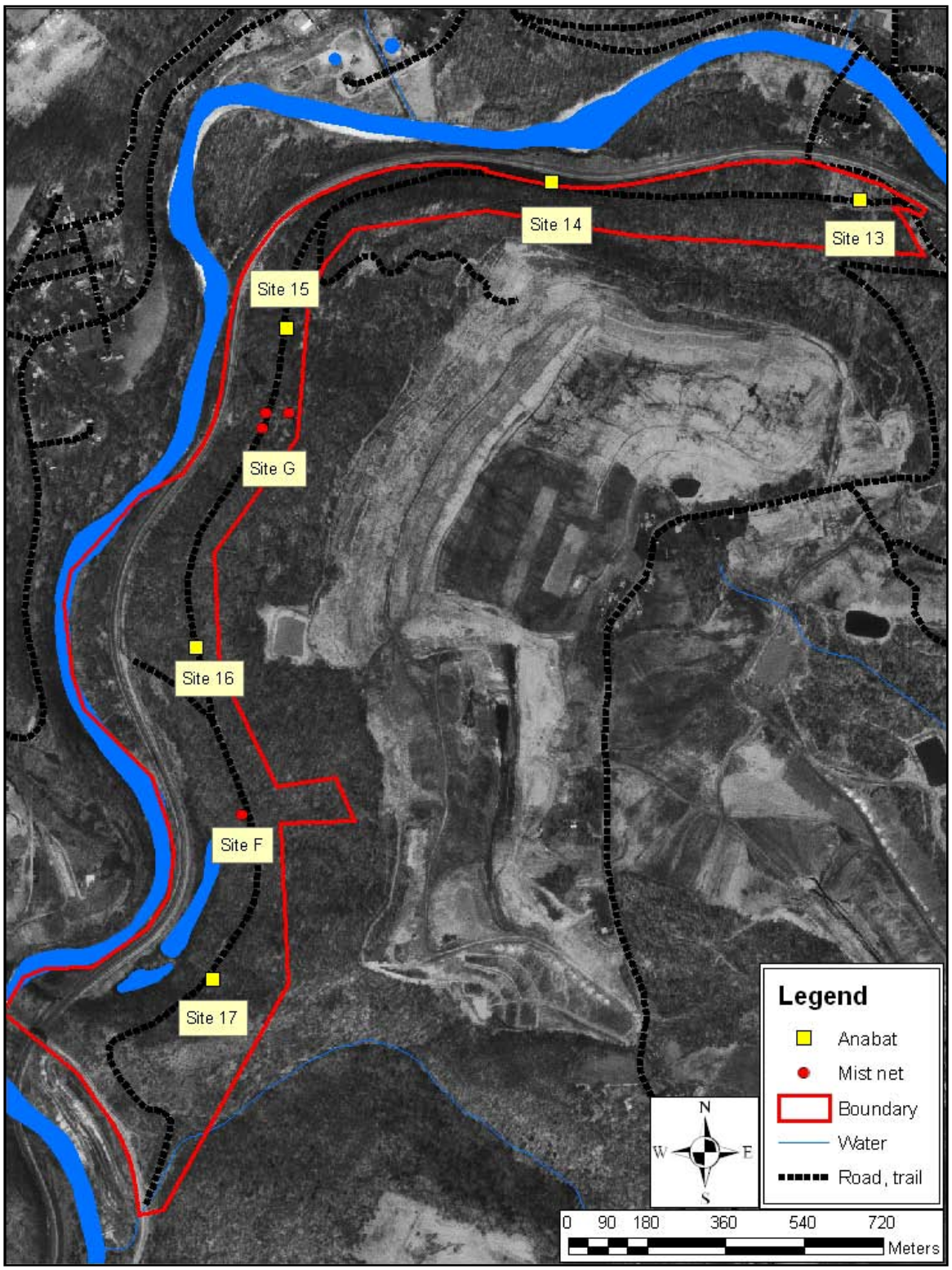

Figure 8. Mist net and acoustic monitoring (Anabat) sites at Allegheny Portage Railroad National Historic Site, Staple Bend Tunnel unit, 2005–2006.

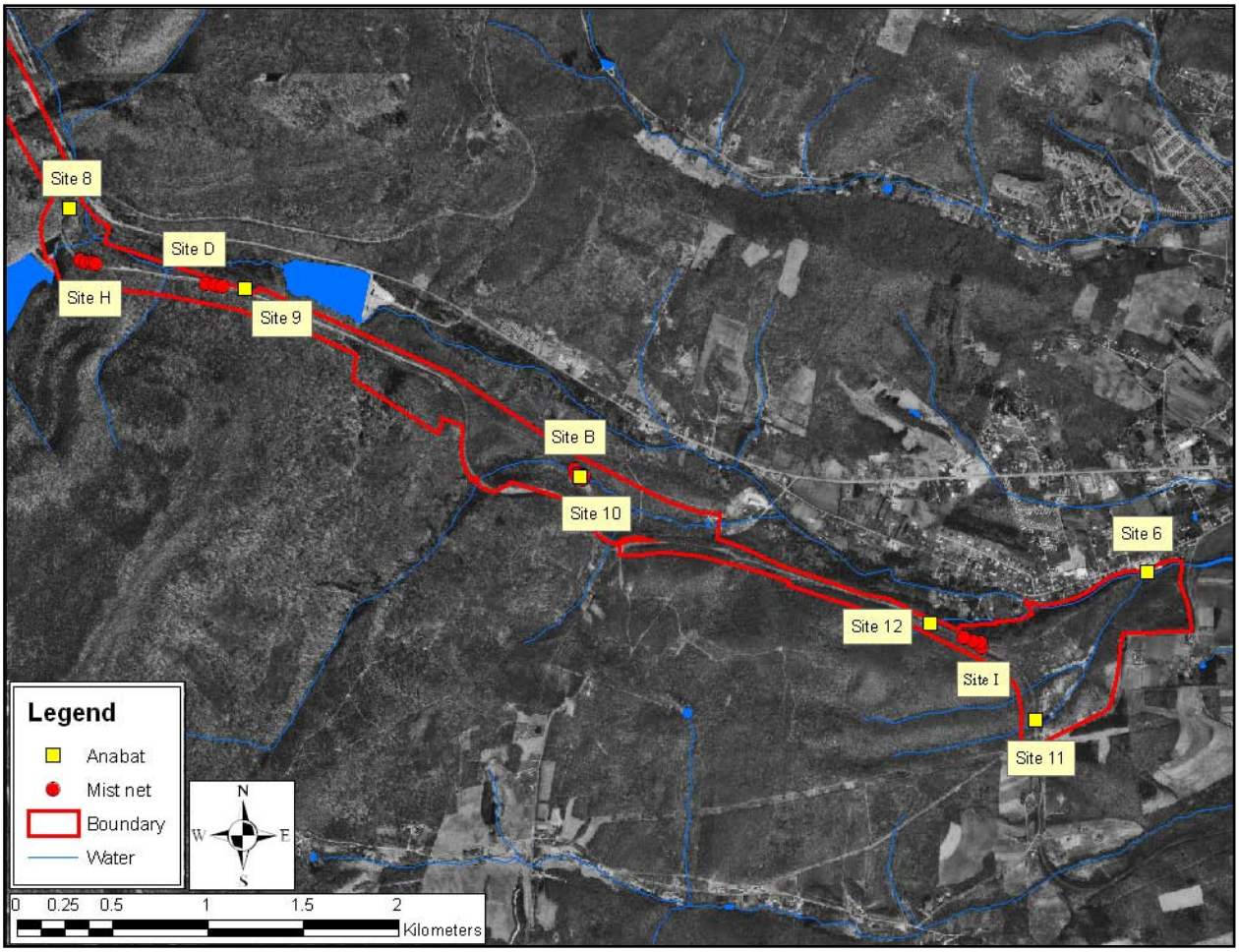

Figure 9. Mist net and acoustic monitoring (Anabat) sites where big brown bats (*Eptesicus fuscus*) were recorded at the eastern portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

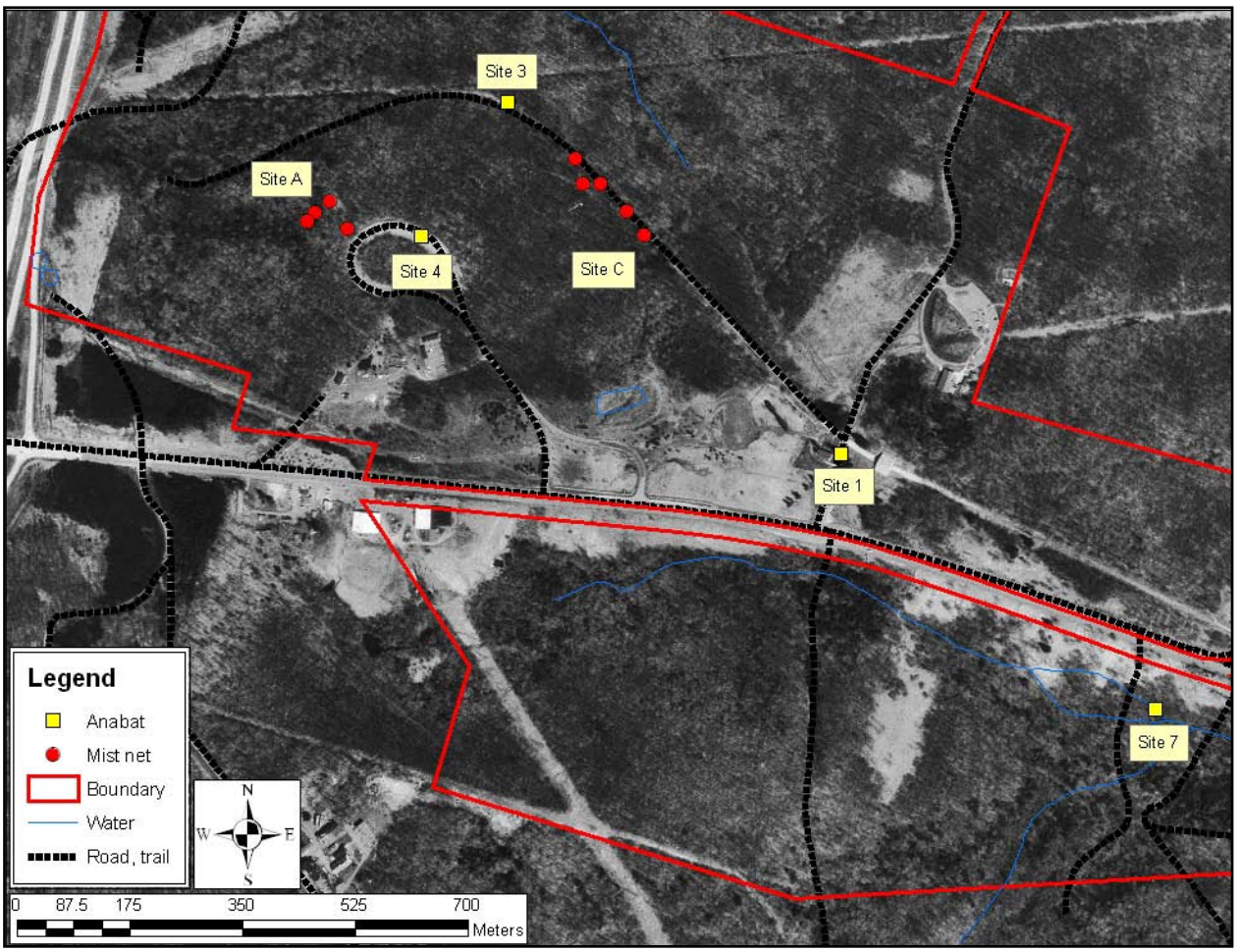

Figure 10. Mist net and acoustic monitoring (Anabat) sites where big brown bats (*Eptesicus fuscus*) were recorded at western portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

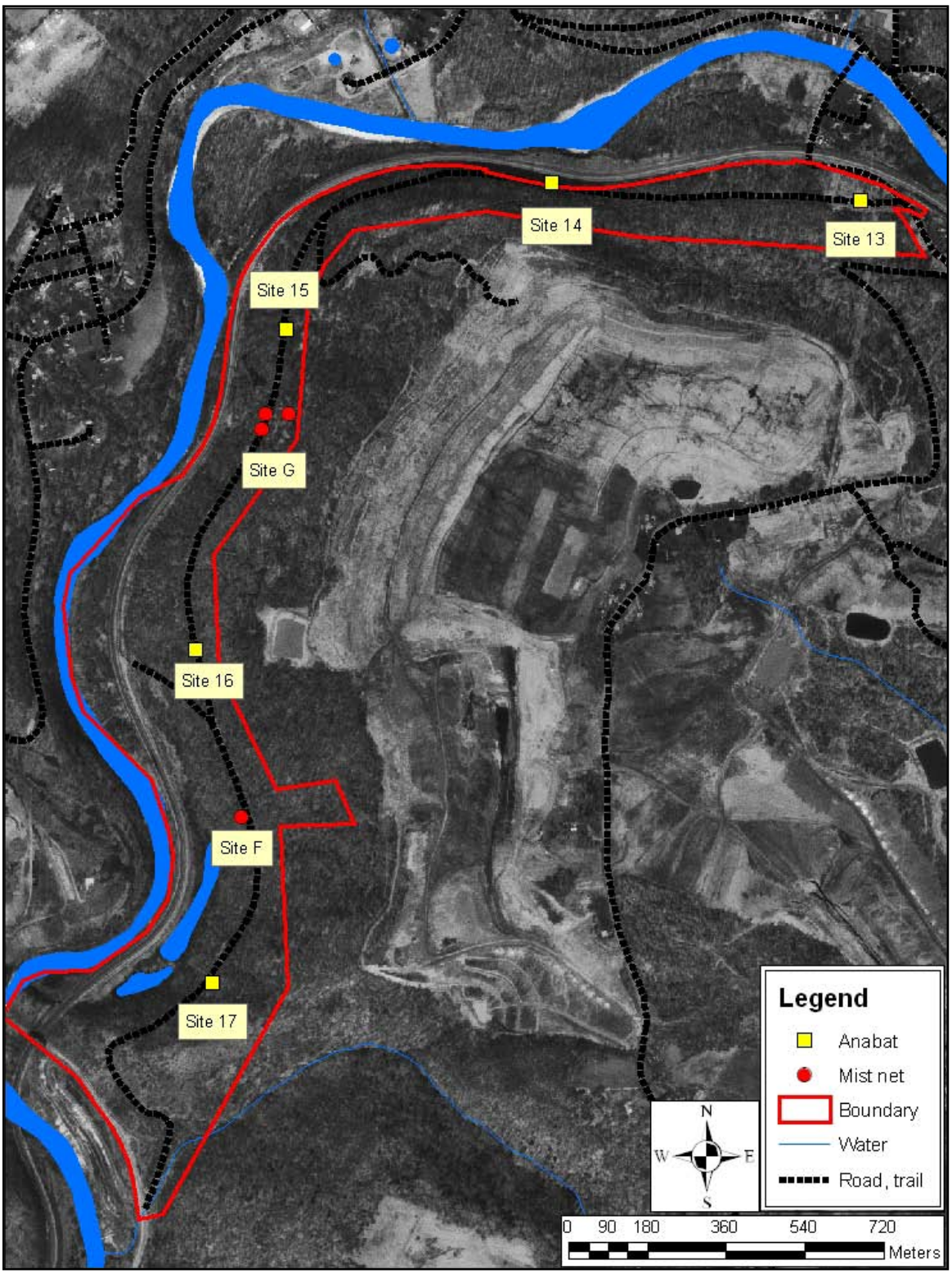

Figure 11. Mist net and acoustic monitoring (Anabat) sites where big brown bats (*Eptesicus fuscus*) were recorded at Allegheny Portage Railroad National Historic Site, Staple Bend Tunnel unit, 2005–2006.

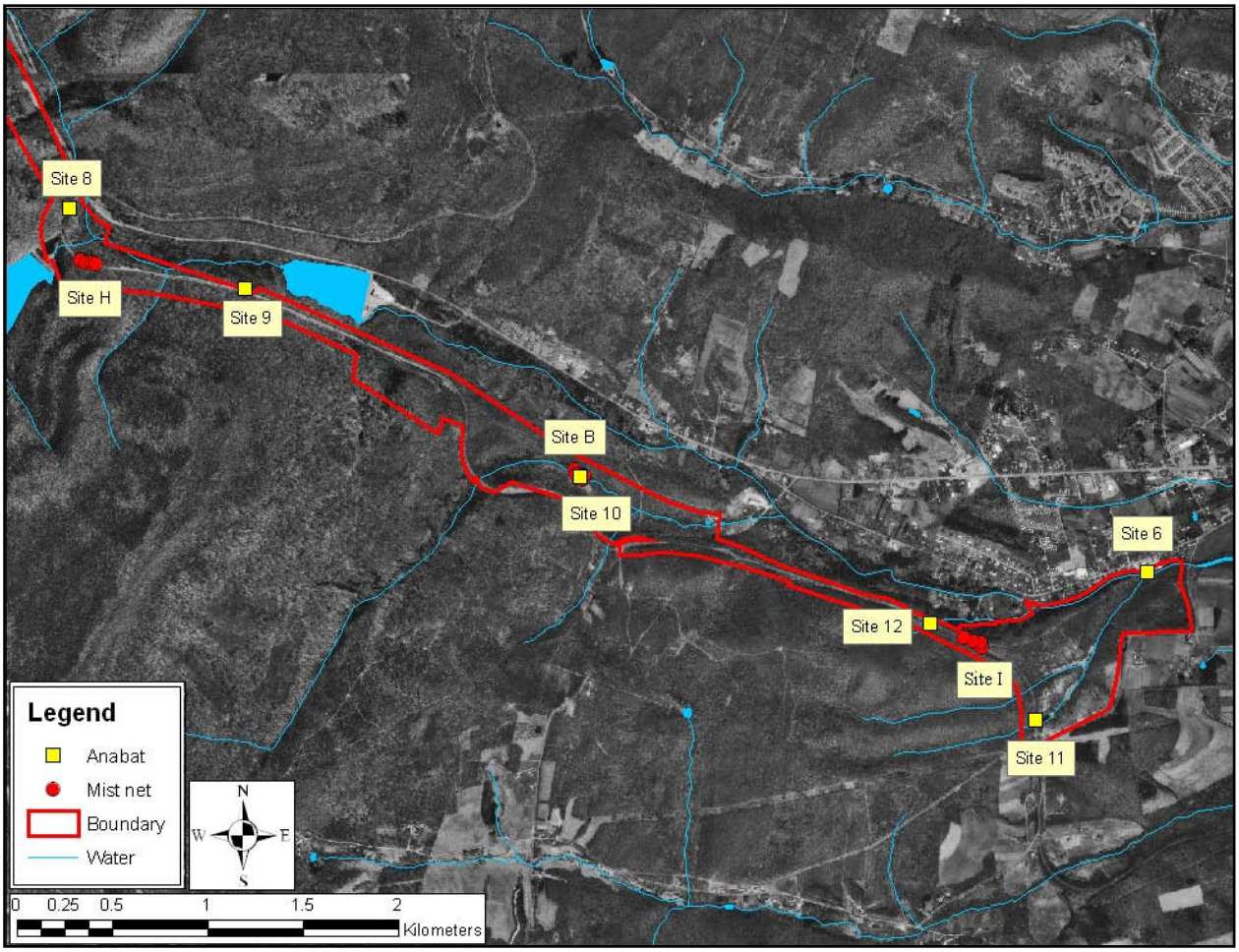

Figure 12. Mist net and acoustic monitoring (Anabat) sites where eastern red bats (*Lasiurus borealis*) were recorded at the eastern portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

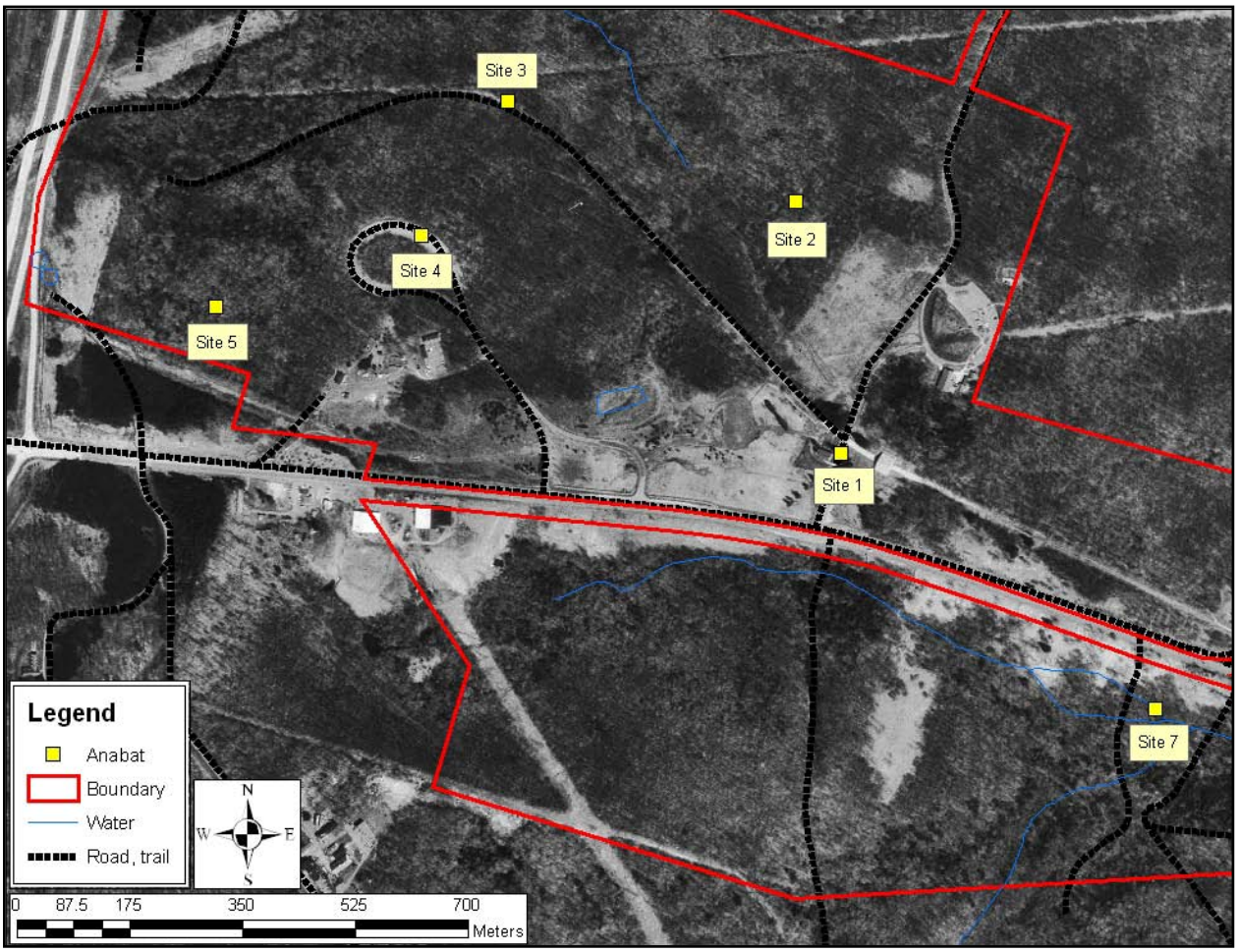

Figure 13. Mist net and acoustic monitoring (Anabat) sites where eastern red bats (*Lasiurus borealis*) were recorded at western portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

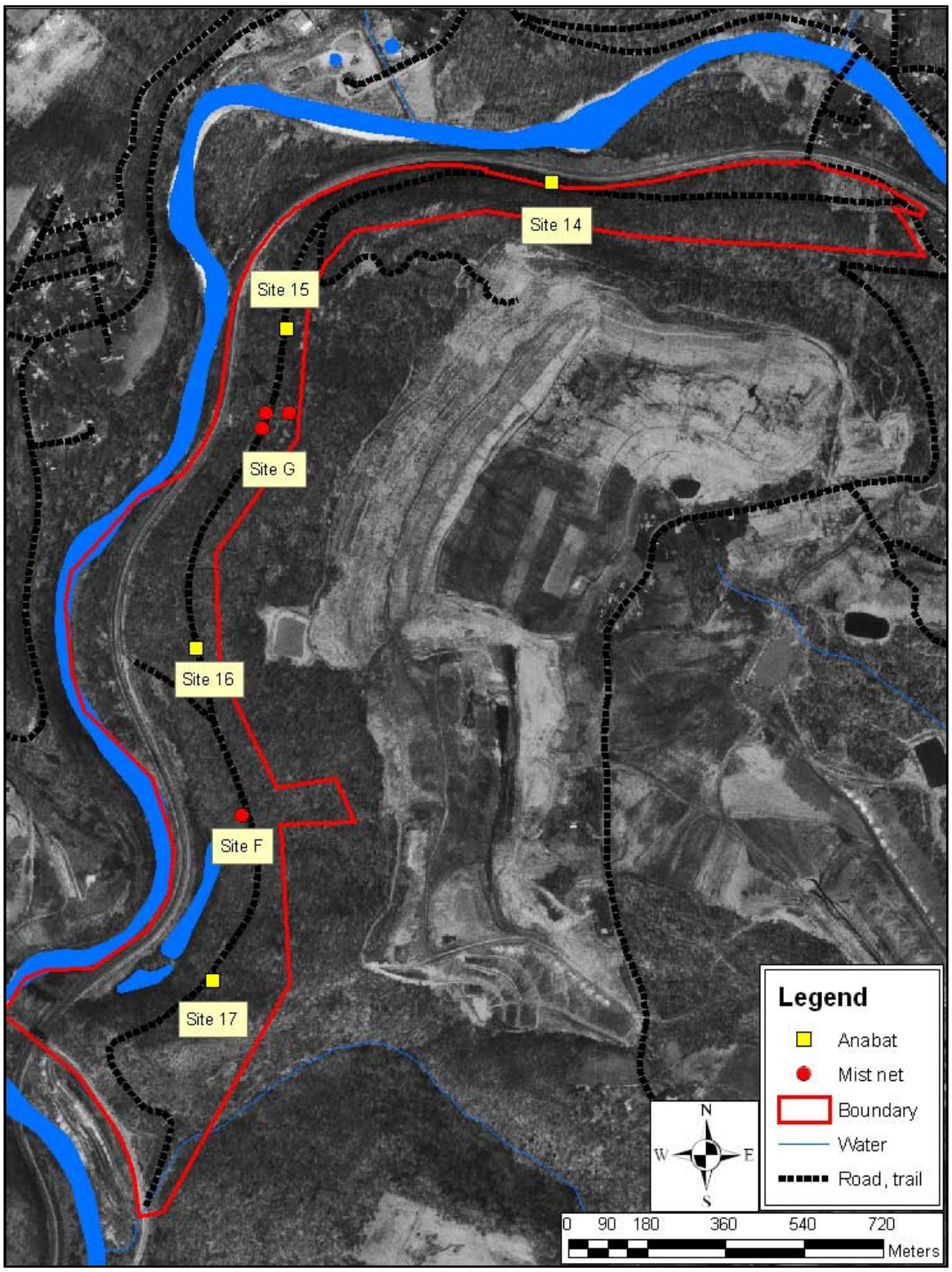

Figure 14. Mist net and acoustic monitoring (Anabat) sites where eastern red bats (*Lasiurus borealis*) were recorded at Allegheny Portage Railroad National Historic Site, Staple Bend Tunnel unit, 2005–2006.

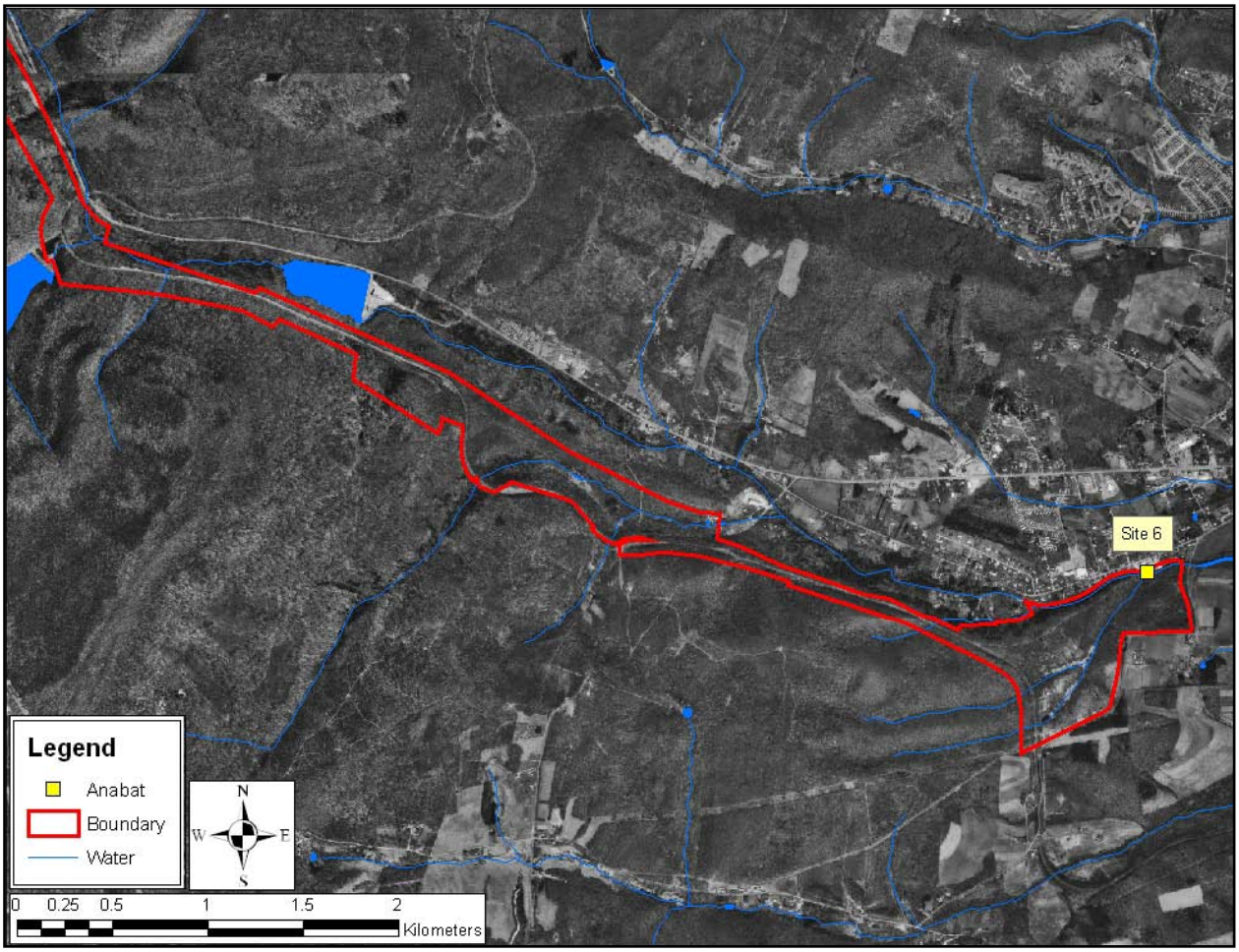

Figure 15. Mist net and acoustic monitoring (Anabat) sites where hoary bats (*Lasiurus cinereus*) were recorded at the eastern portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

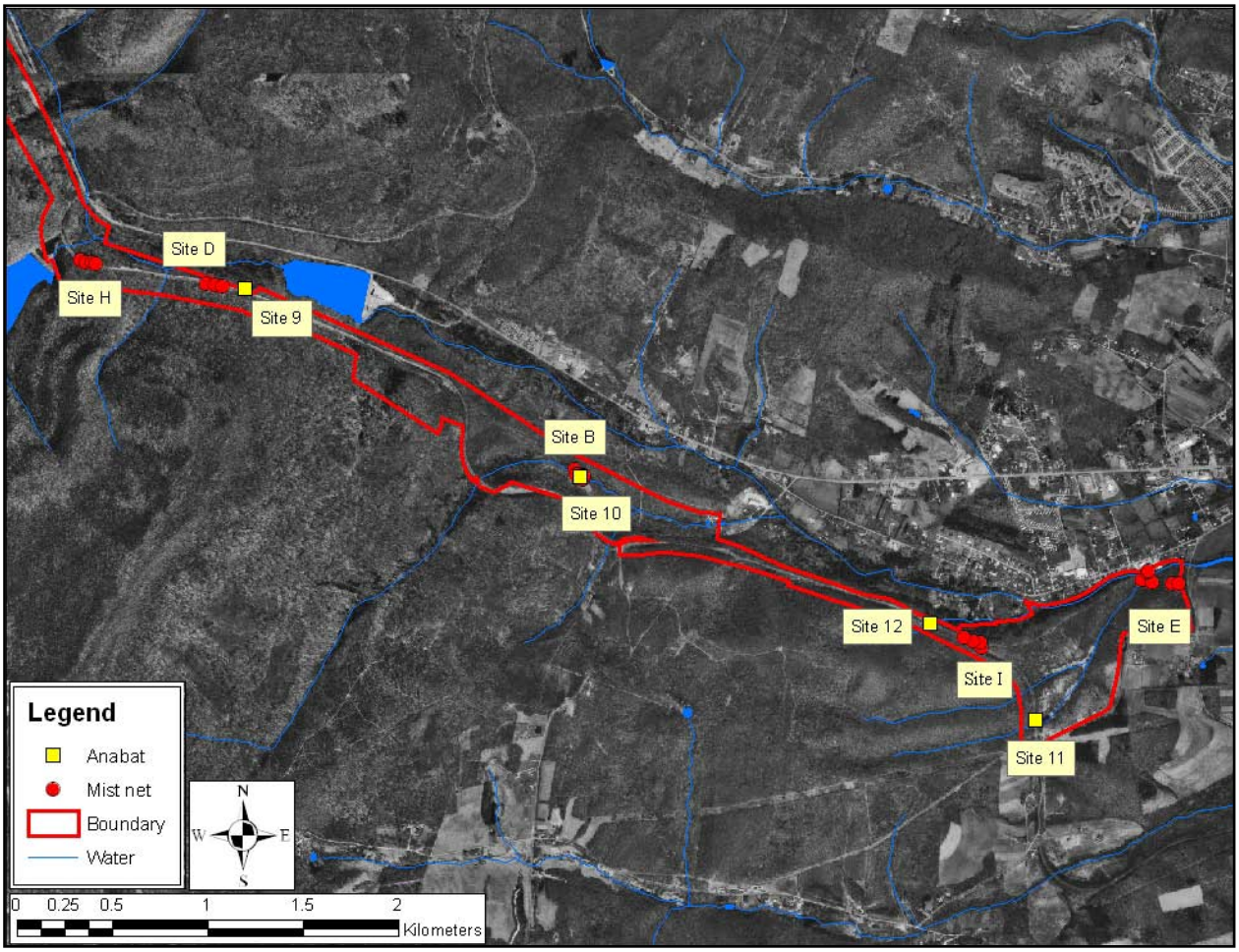

Figure 16. Mist net and acoustic monitoring (Anabat) sites where little brown myotis (*Myotis lucifugus*) were recorded at the eastern portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

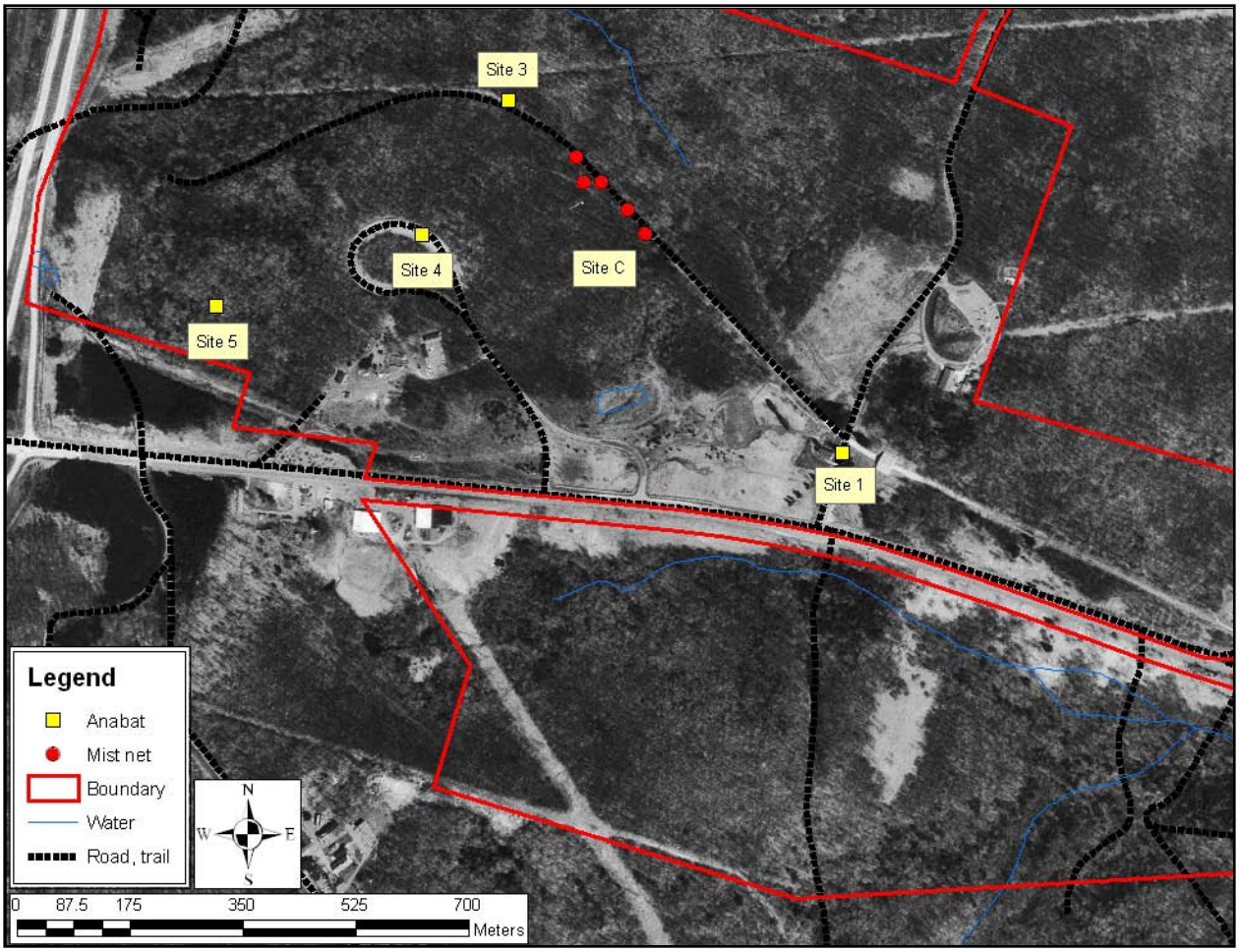

Figure 17. Mist net and acoustic monitoring (Anabat) sites where little brown myotis (*Myotis lucifugus*) were recorded at western portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

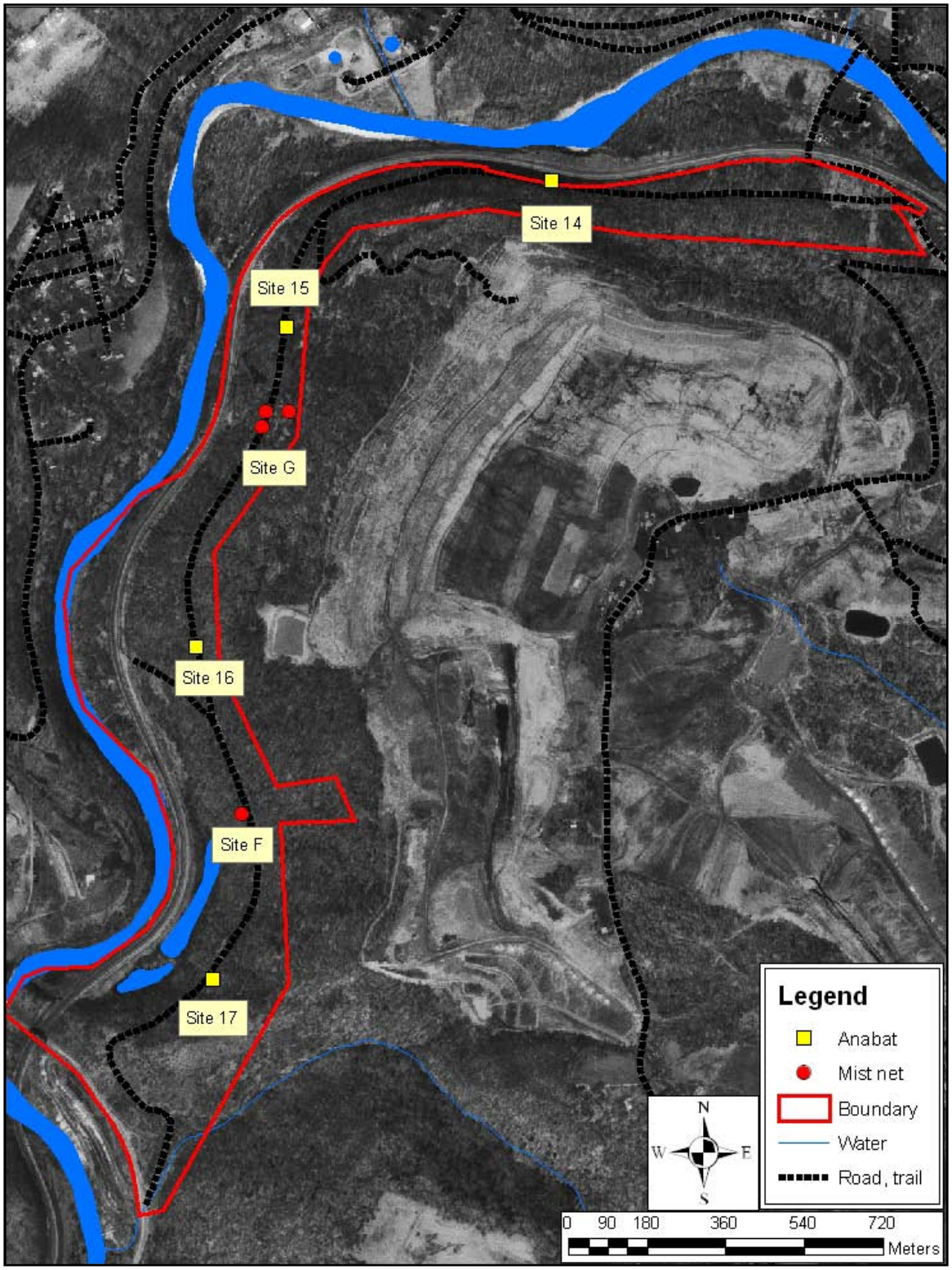

Figure 18. Mist net and acoustic monitoring (Anabat) sites where little brown myotis (*Myotis lucifugus*) were recorded at Allegheny Portage Railroad National Historic Site, Staple Bend Tunnel unit, 2005–2006.

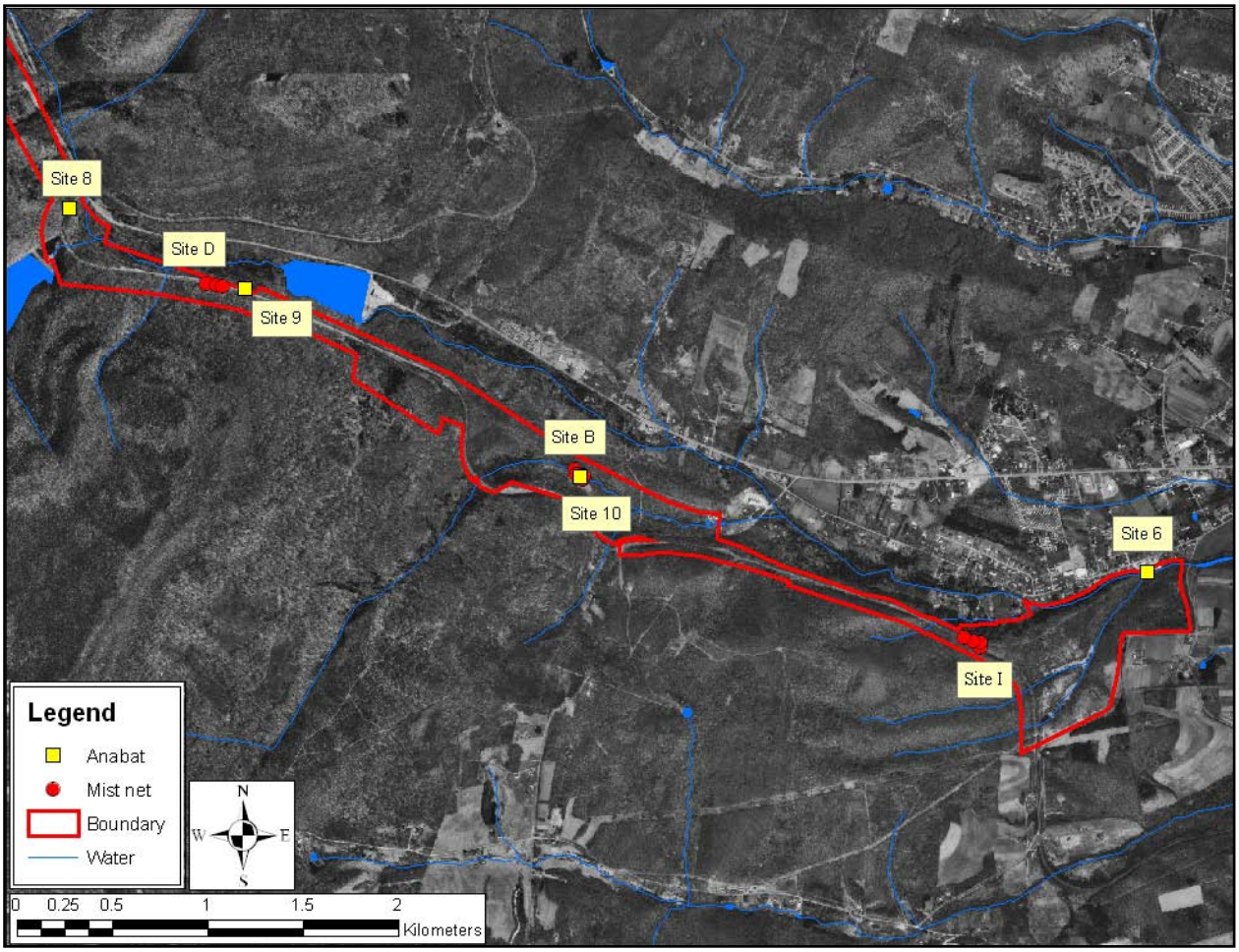

Figure 19. Mist net and acoustic monitoring (Anabat) sites where northern myotis (*Myotis septentrionalis*) were recorded at the eastern portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

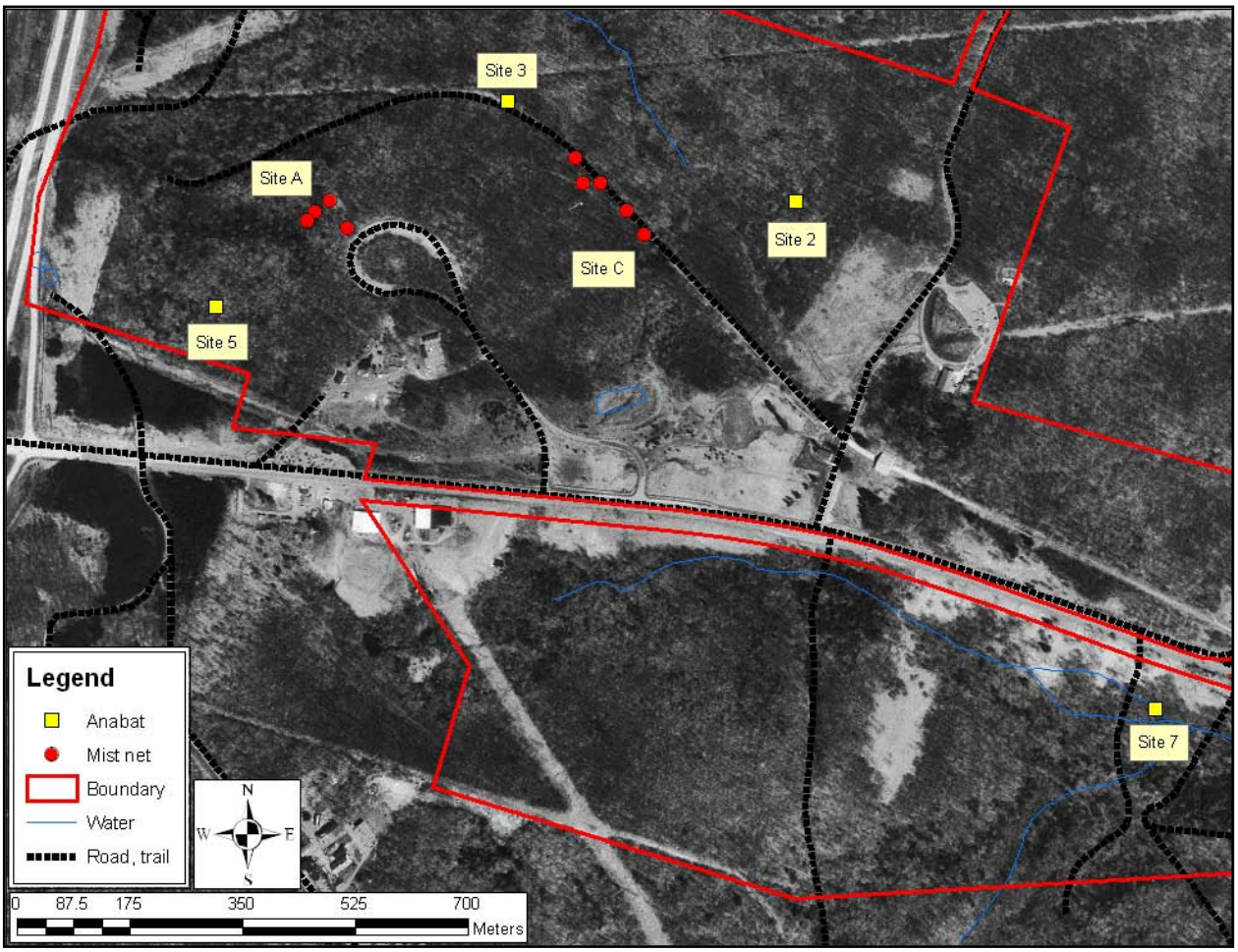

Figure 20. Mist net and acoustic monitoring (Anabat) sites where northern myotis (*Myotis septentrionalis*) were recorded at western portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

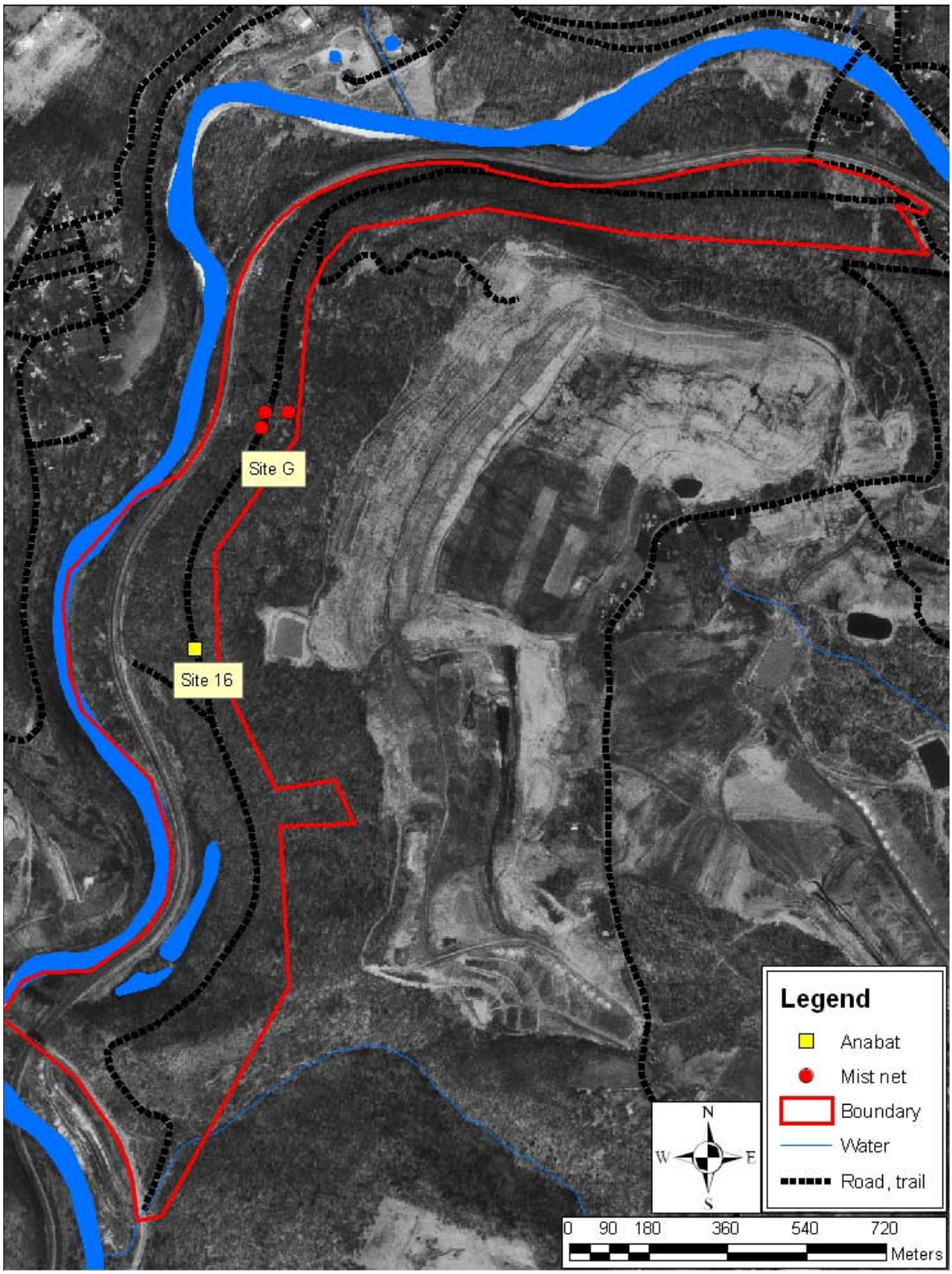

Figure 21. Mist net and acoustic monitoring (Anabat) sites where northern myotis (*Myotis septentrionalis*) were recorded at Allegheny Portage Railroad National Historic Site, Staple Bend Tunnel unit, 2005–2006.

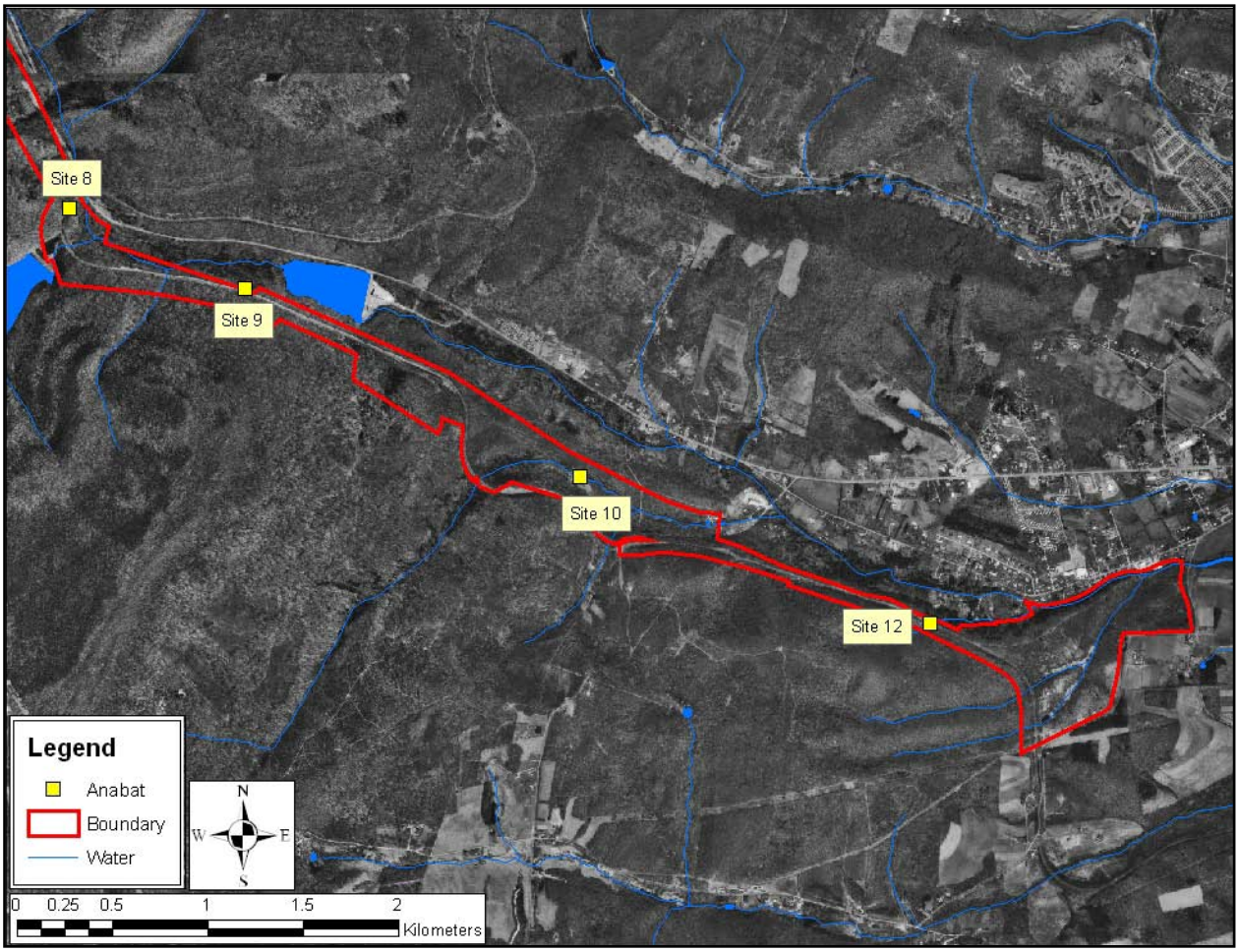

Figure 22. Mist net and acoustic monitoring (Anabat) sites where eastern pipistrelles (*Pipistrellus subflavus*) were recorded at the eastern portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

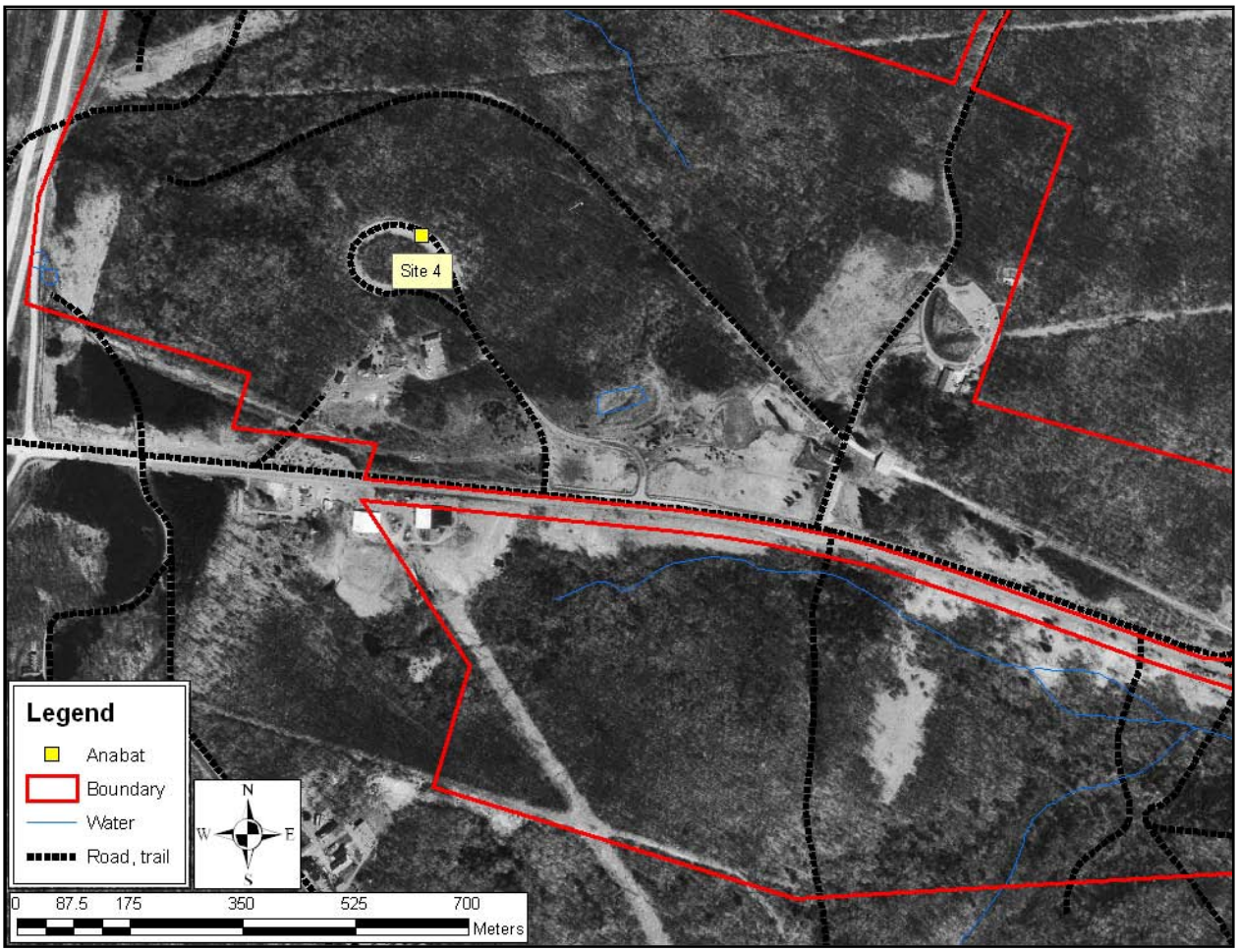

Figure 23. Mist net and acoustic monitoring (Anabat) sites where eastern pipistrelles (*Pipistrellus subflavus*) were recorded at western portion of Allegheny Portage Railroad National Historic Site, main unit, 2005–2006.

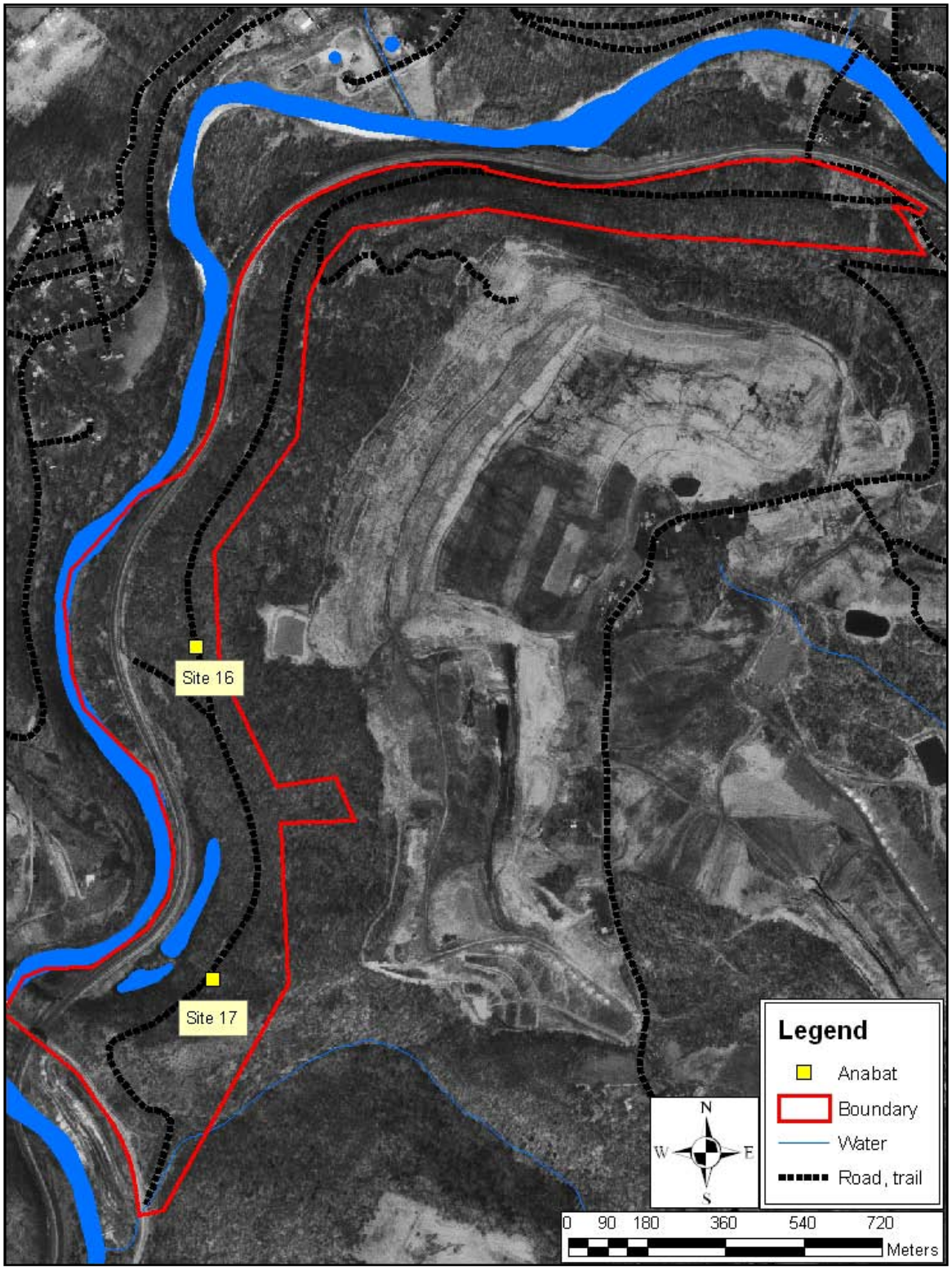

Figure 24. Mist net and acoustic monitoring (Anabat) sites where eastern pipistrelles (*Pipistrellus subflavus*) were recorded at Allegheny Portage Railroad National Historic Site, Staple Bend Tunnel unit, 2005–2006.

On 18 April 2005, we examined the Lemon House attic for signs of bat use. A broken exterior window in the eastern gable provided possible access for bats, but we observed no roosting bats or definitive evidence of bat use at the time. The window was repaired sometime between our April visit and bat inventories in June. On the evening of 20 June 2005, we observed three big brown bats (species determined via analysis of echolocation passes recorded on site) emerging from around the eastern-most chimney, possibly from under the flashing. On the evening of 7 July 2006, we observed four big brown bats emerging from the same area. We examined Staple Bend Tunnel for roosting bats on 30 June 2005 and 13 July 2006. We observed no bats roosting in the tunnel. We observed a little brown myotis roosting behind the shutter nearest the front door of the seasonal quarters in which we were housed. A bat was observed roosting there on almost a daily basis during our inventory work at ALPO in 2005 and 2006. We checked two bat houses in trees adjacent to the summit picnic area, once each in 2005 and 2006. No roosting bats or signs of bat use were observed in the bat houses.

Fort Necessity National Battlefield

We mist netted at 13 sites totaling 124 mist net nights at FONE (Figures 25–27). We captured 105 bats, including: 61 northern myotis, 23 little brown myotis, 10 eastern red bats, nine big brown bats, and two eastern pipistrelles (Table 3; Figures 28–42). We captured reproductively active female big brown bats, eastern red bats, little brown myotis, and northern myotis. We captured juvenile eastern red bats, little brown myotis, and northern myotis.

We conducted acoustic monitoring at 14 sites at FONE and collected 602 echolocation passes from six species (Table 6, Figures 25–27). We recorded big brown bats at more sites than any other species, but we recorded the most echolocation passes from eastern red bats (Tables 6–7). We acoustically detected, but did not capture, hoary bats at FONE (Figures 28–42). We did not examine any buildings at FONE for bat use.

Friendship Hill National Historic Site

We mist netted at eight sites totaling 111 mist net nights at FRHI (Figure 43). We captured 118 bats, including: 35 big brown bats, 30 little brown myotis, 14 northern myotis, six eastern pipistrelles, two eastern red bats, and one unidentified *Myotis* sp. (Table 3; Figures 44–49). We captured reproductively active female big brown bats, eastern red bats, little brown myotis, northern myotis, and eastern pipistrelles. We captured juvenile big brown bats and little brown myotis.

We conducted acoustic monitoring at 12 sites at FRHI and collected 729 echolocation passes from six species (Table 6, Figure 43). Big brown bats were the most commonly recorded species, representing 50.2% of identifiable passes at 83.3% of acoustic monitoring sites (Tables 6–7). We acoustically detected, but did not capture, hoary bats at FRHI (Figures 44–49).

On 4 October 2004, we examined Gallatin House and the adjacent Carriage House for roosting bats and evidence of bat use (Appendix E). We located five big brown bats roosting singly behind window shutters. During our summer inventories, we observed one to five big brown bats roosting singly behind second story shutters on four occasions in 2005 and 2006.

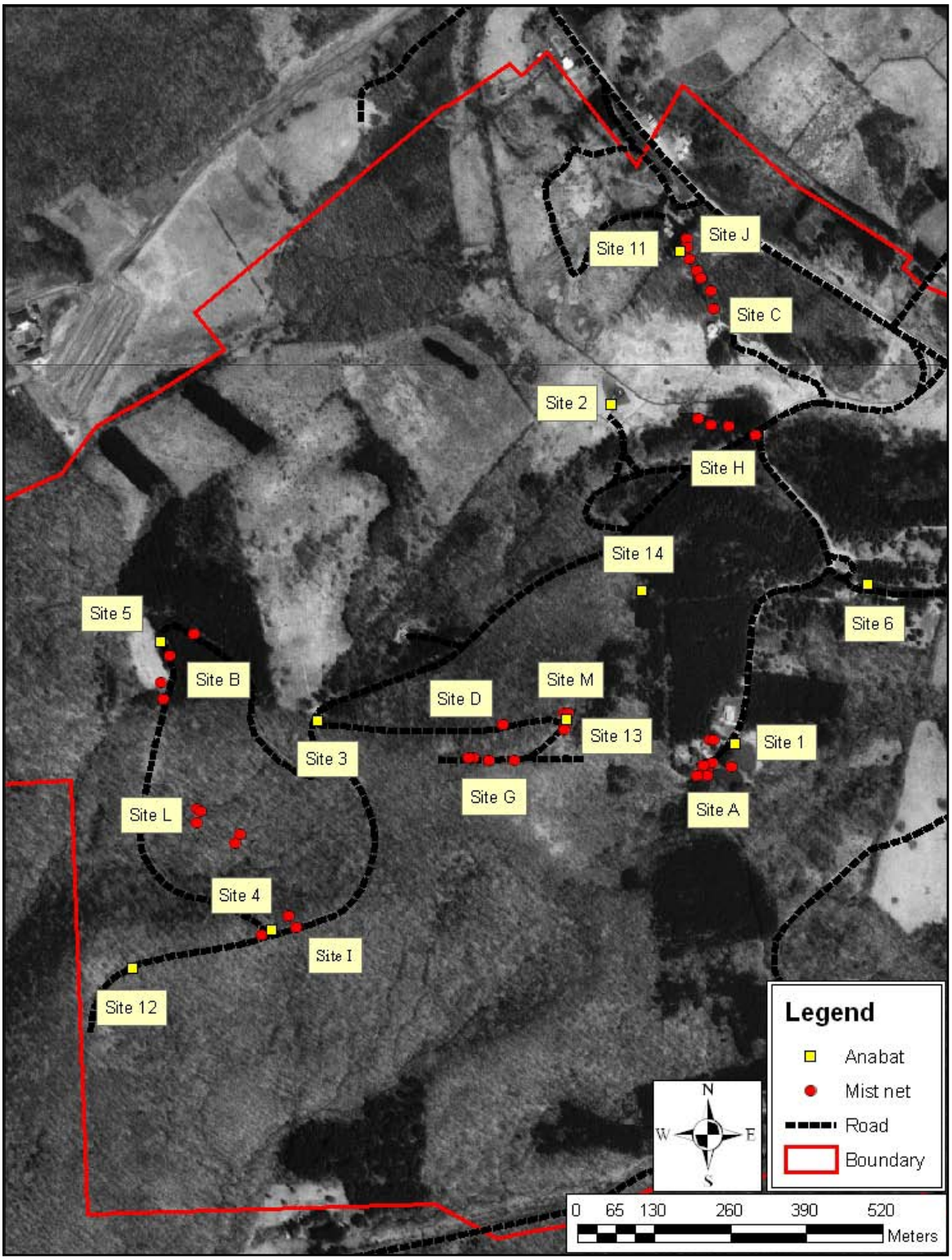

Figure 25. Mist net and acoustic monitoring (Anabat) sites at Fort Necessity National Battlefield, main unit, 2005–2006.

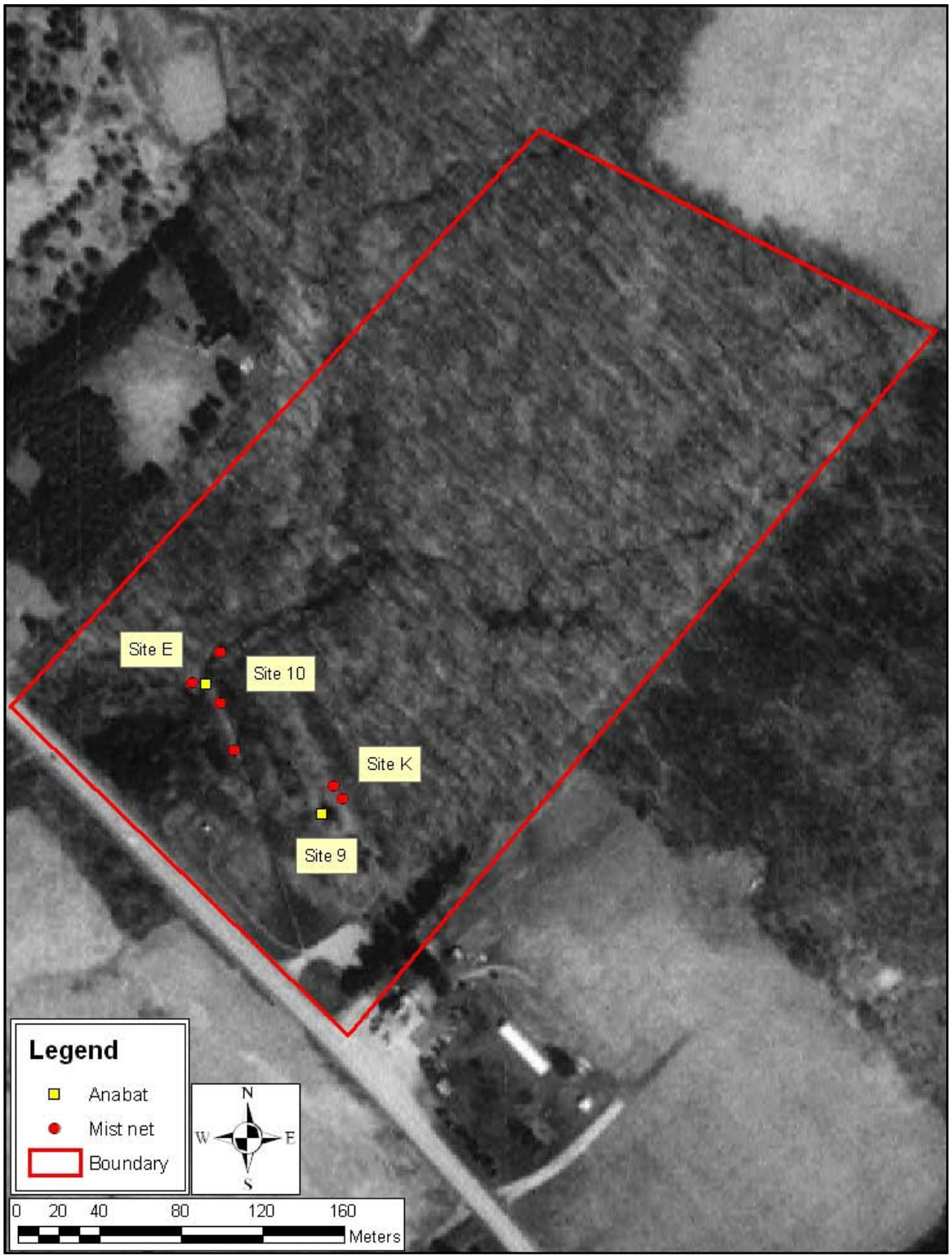

Figure 26. Mist net and acoustic monitoring (Anabat) sites at Fort Necessity National Battlefield, Braddock's Grave unit, 2005–2006.

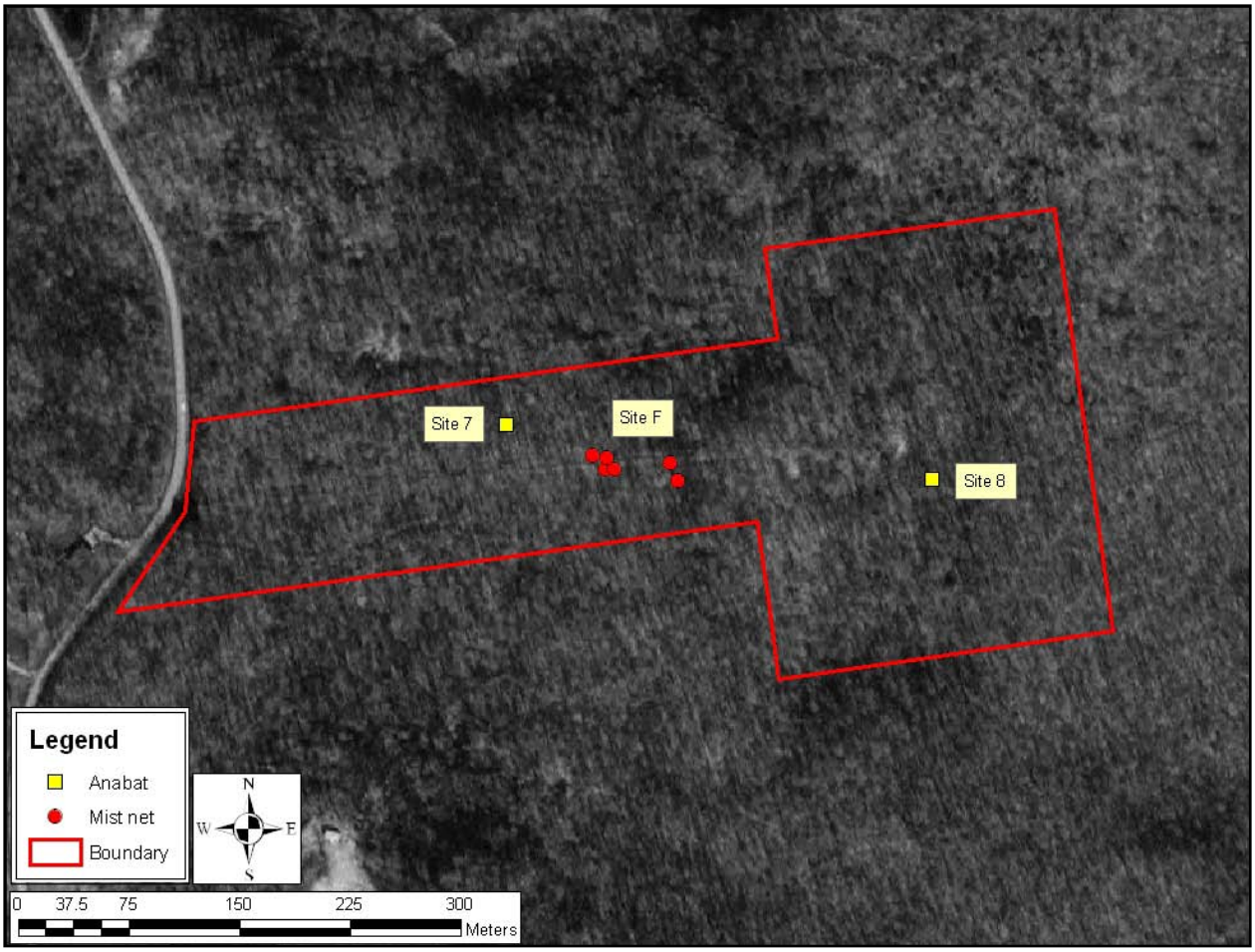

Figure 27. Mist net and acoustic monitoring (Anabat) sites at Fort Necessity National Battlefield, Jumonville Glen unit, 2005–2006.

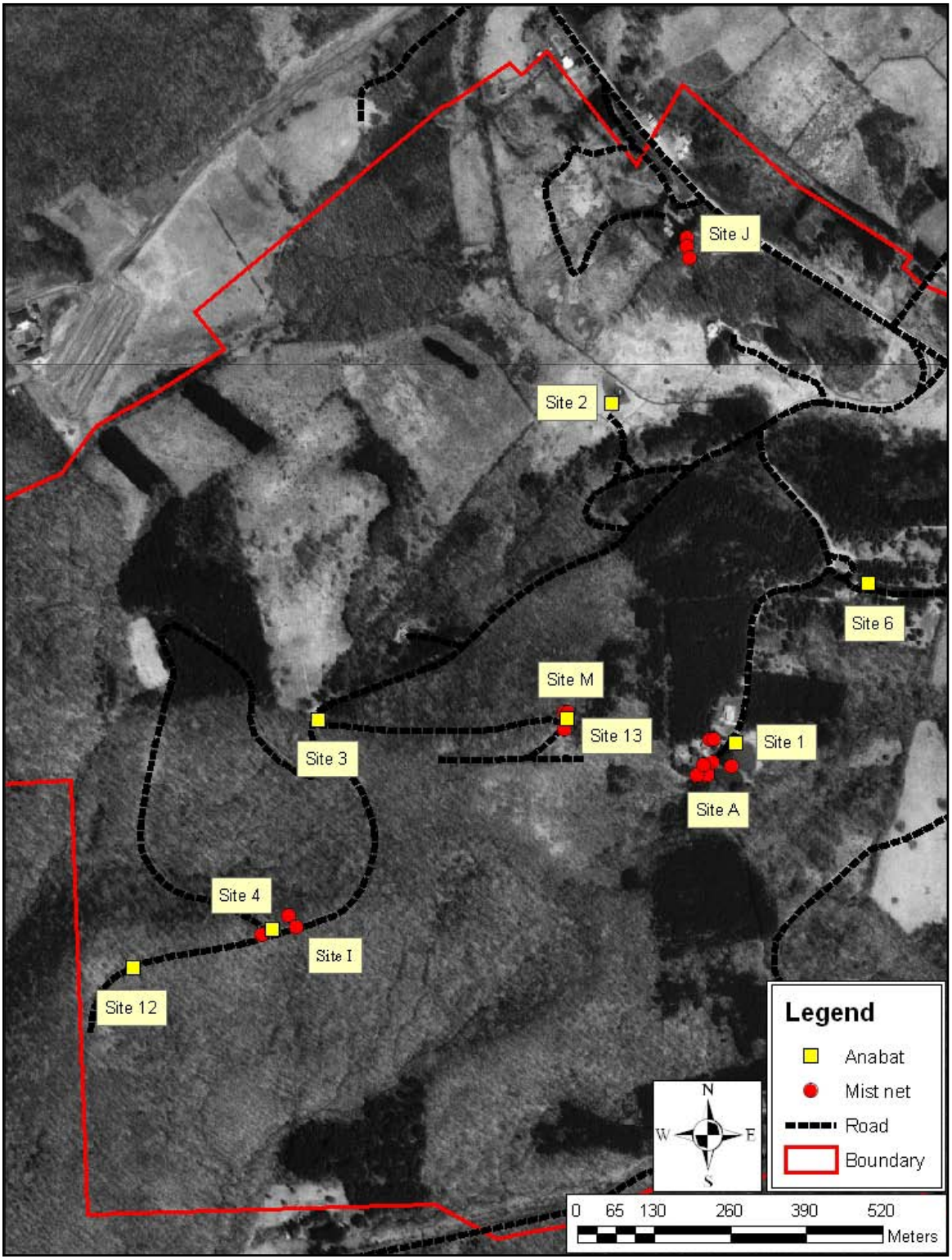

Figure 28. Mist net and acoustic monitoring (Anabat) sites where big brown bats (*Eptesicus fuscus*) were recorded at Fort Necessity National Battlefield, main unit, 2005–2006.

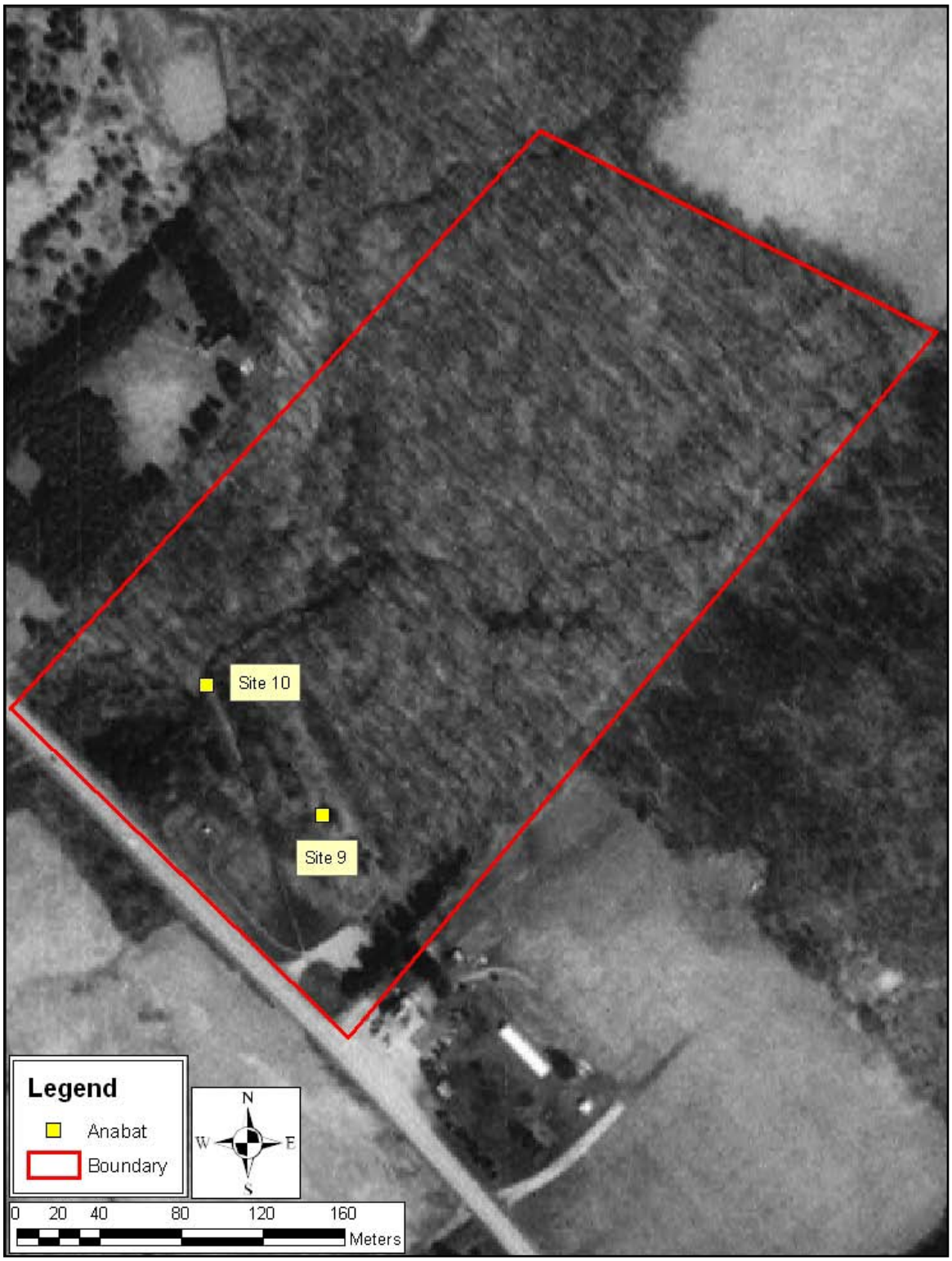

Figure 29. Mist net and acoustic monitoring (Anabat) sites where big brown bats (*Eptesicus fuscus*) were recorded at Fort Necessity National Battlefield, Braddock's Grave unit, 2005–2006.

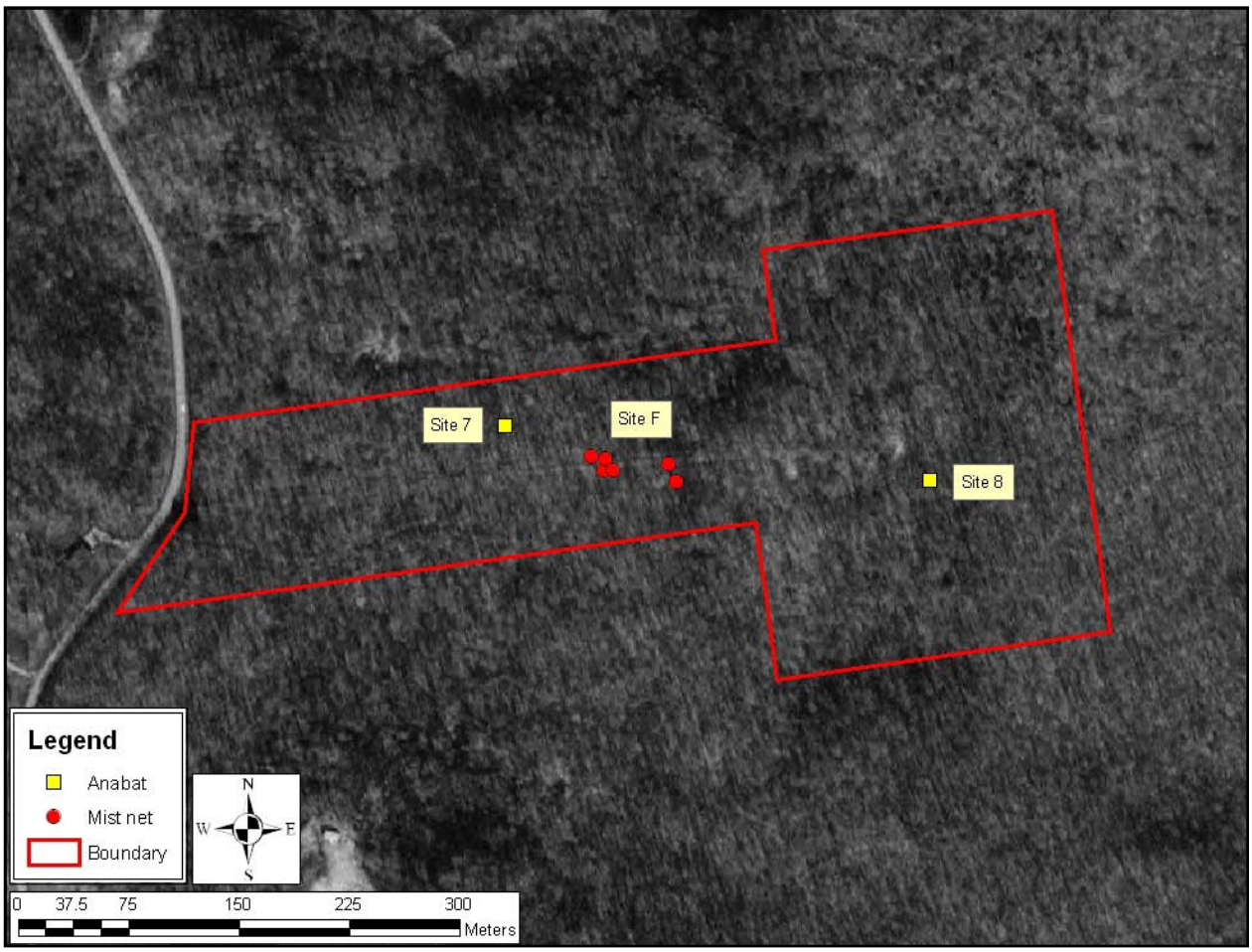

Figure 30. Mist net and acoustic monitoring (Anabat) sites where big brown bats (*Eptesicus fuscus*) were recorded at Fort Necessity National Battlefield, Jumonville Glen unit, 2005–2006.

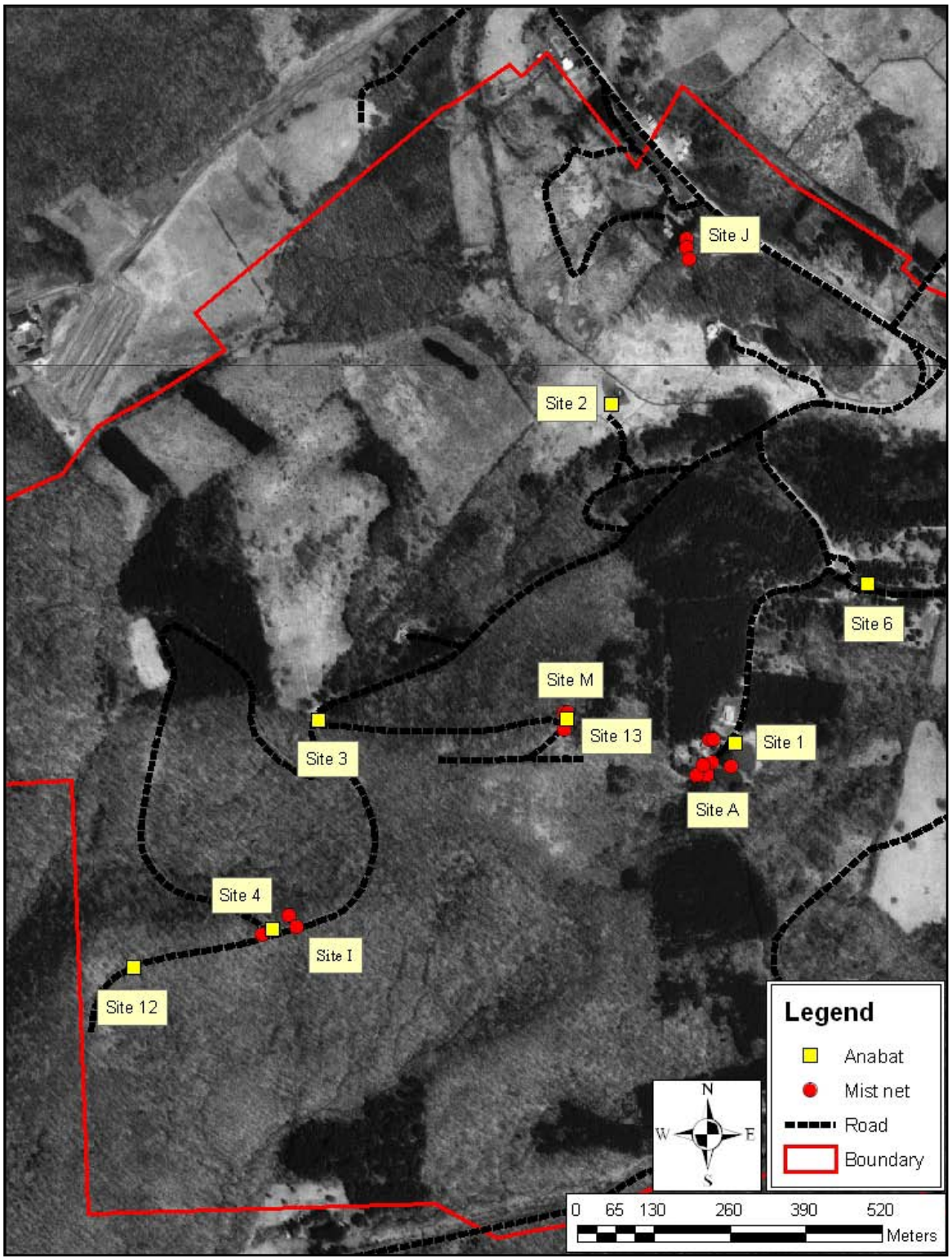

Figure 31. Mist net and acoustic monitoring (Anabat) sites where eastern red bats (*Lasiurus borealis*) were recorded at Fort Necessity National Battlefield, main unit, 2005–2006.

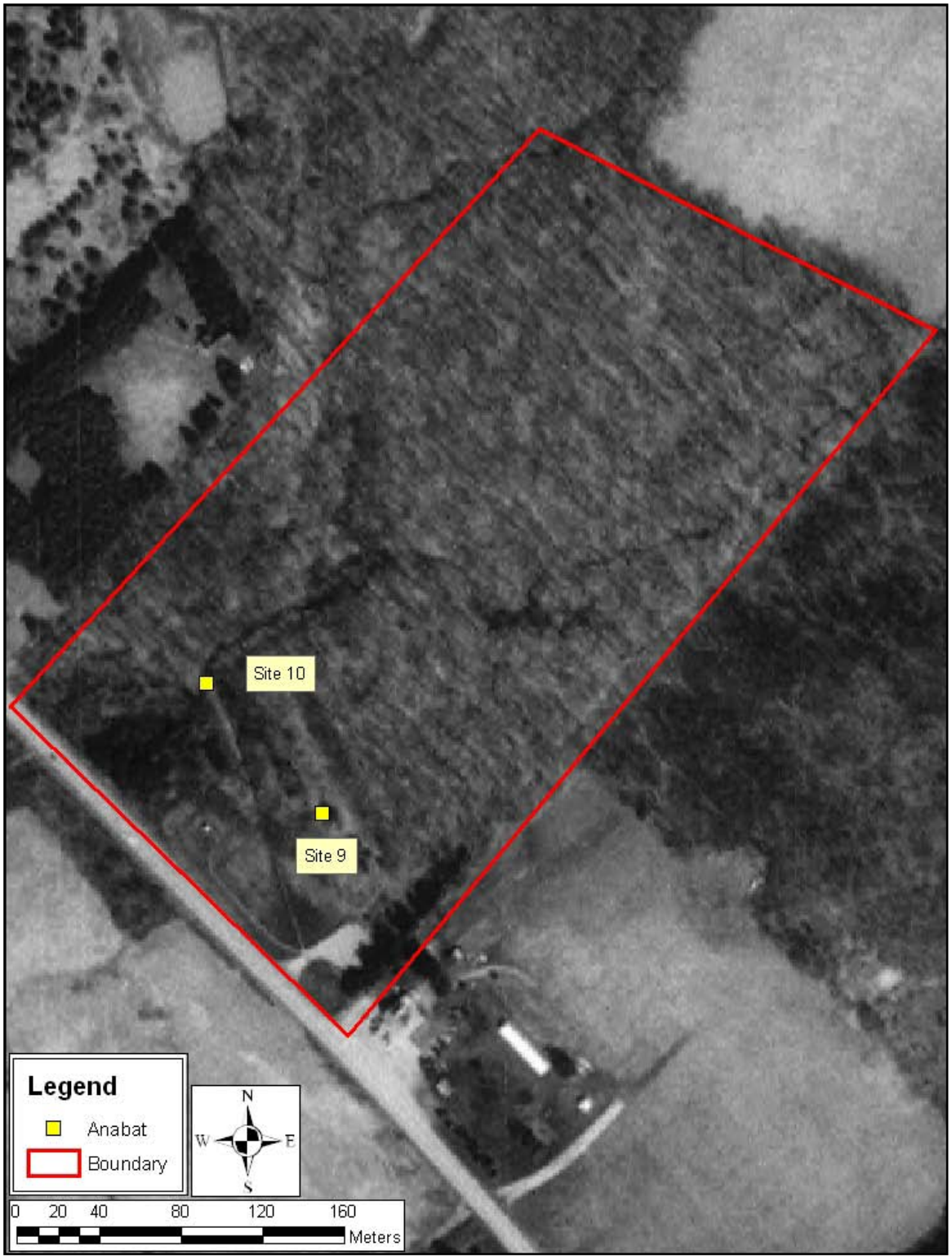

Figure 32. Mist net and acoustic monitoring (Anabat) sites where eastern red bats (*Lasiurus borealis*) were recorded at Fort Necessity National Battlefield, Braddock's Grave unit, 2005–2006.

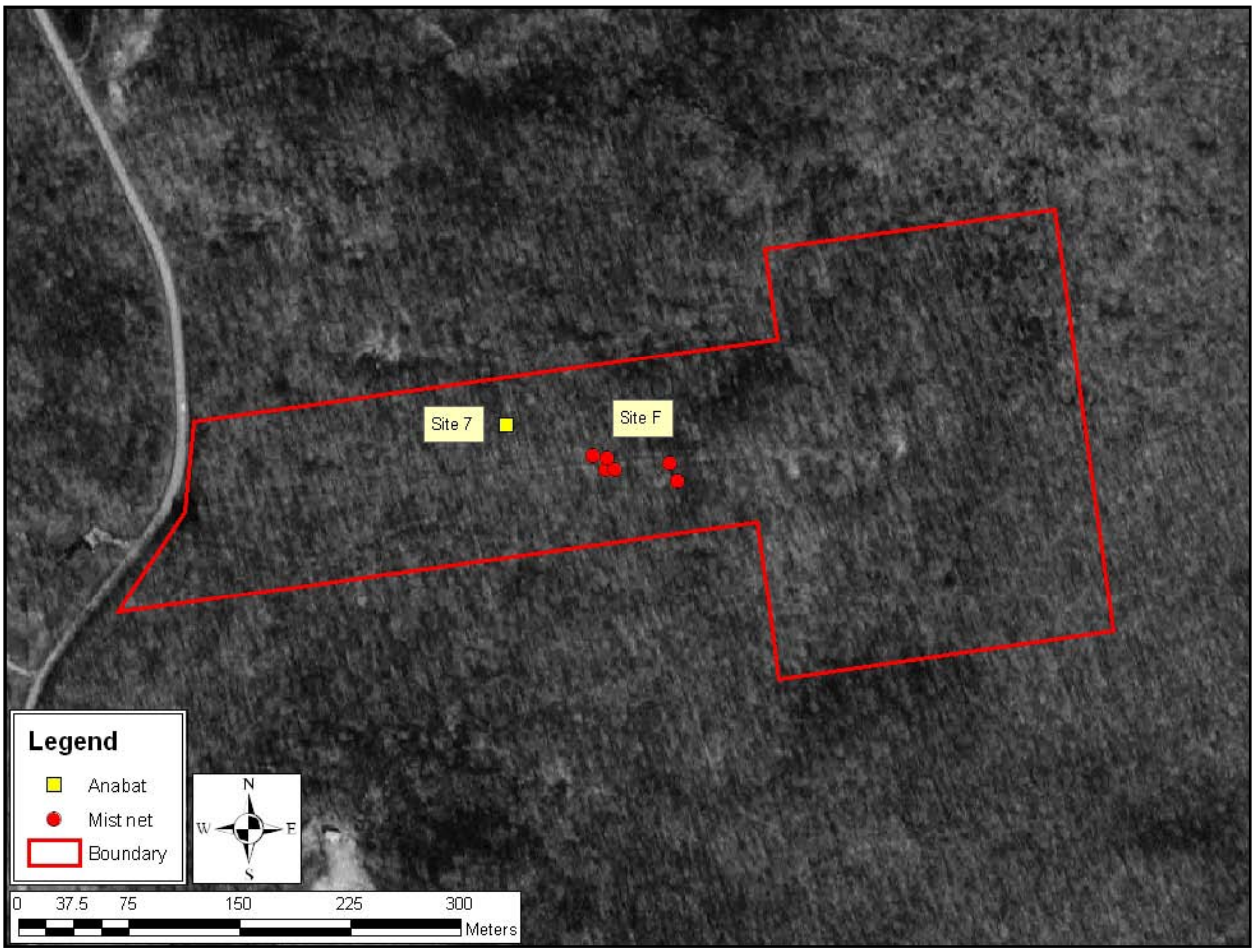

Figure 33. Mist net and acoustic monitoring (Anabat) sites where eastern red bats (*Lasiurus borealis*) were recorded at Fort Necessity National Battlefield, Jumonville Glen unit, 2005–2006.

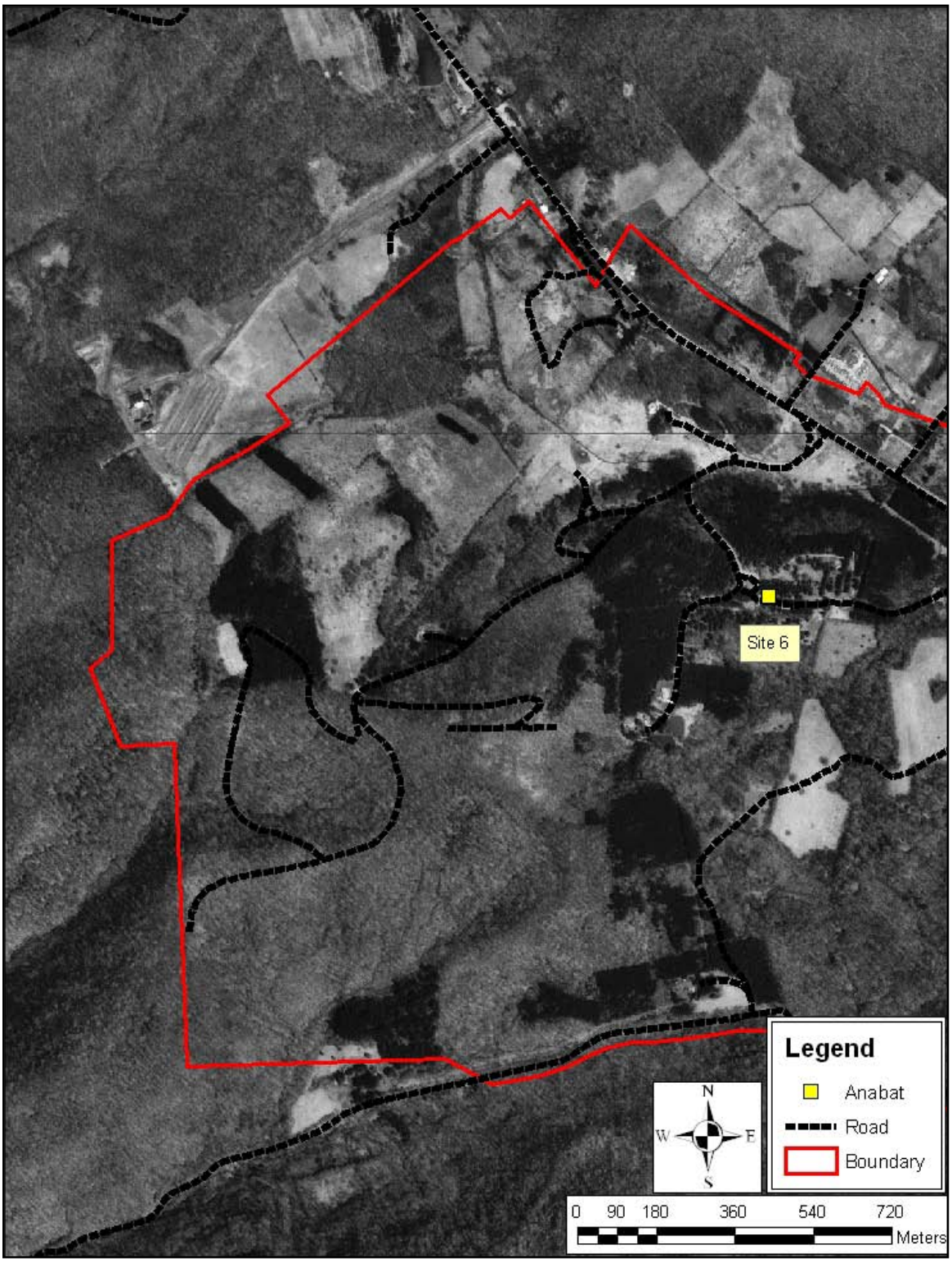

Figure 34. Mist net and acoustic monitoring (Anabat) sites where hoary bats (*Lasiurus cinereus*) were recorded at Fort Necessity National Battlefield, main unit, 2005–2006.

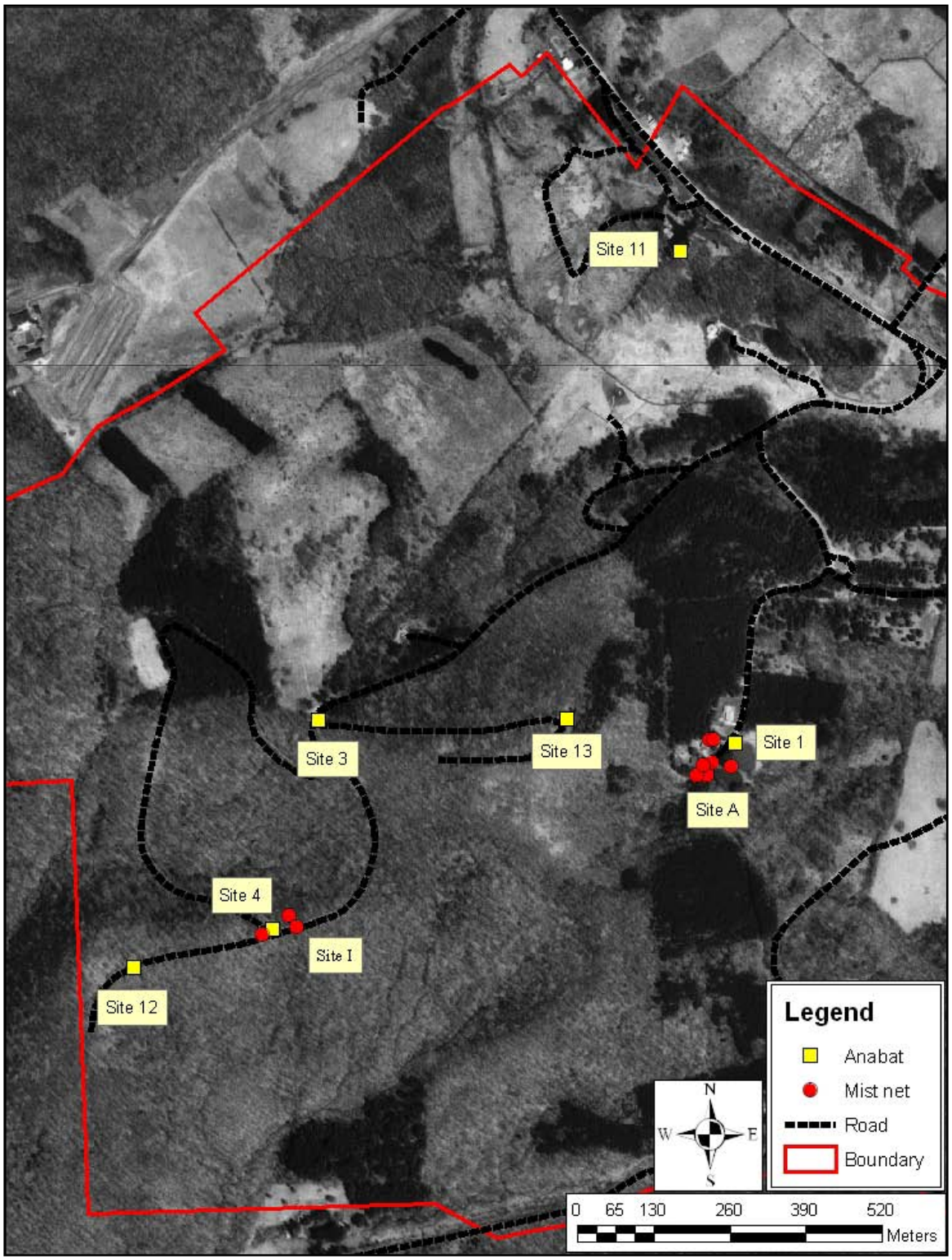

Figure 35. Mist net and acoustic monitoring (Anabat) sites where little brown myotis (*Myotis lucifugus*) were recorded at Fort Necessity National Battlefield, main unit, 2005–2006.

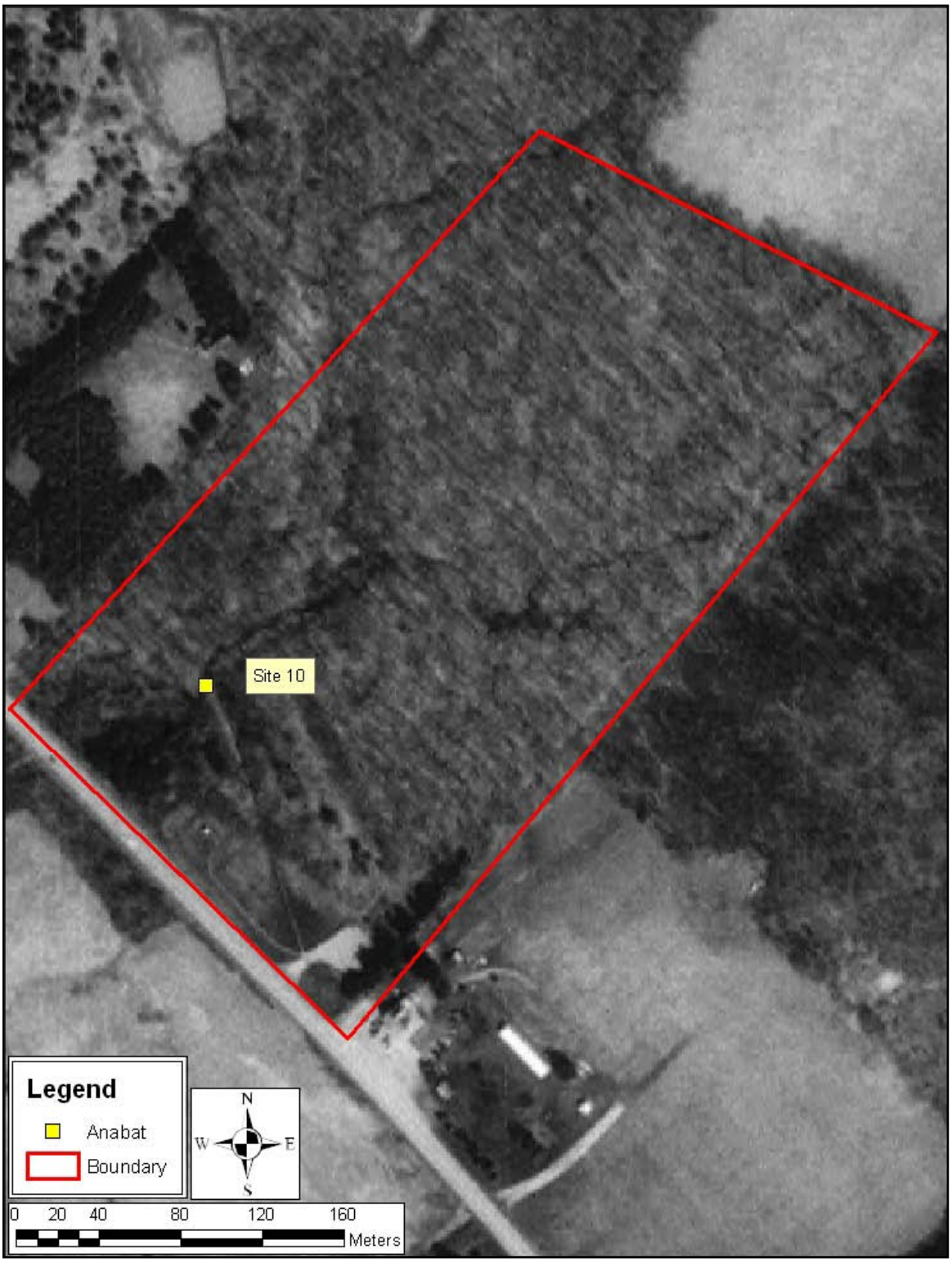

Figure 36. Mist net and acoustic monitoring (Anabat) sites where little brown myotis (*Myotis lucifugus*) were recorded at Fort Necessity National Battlefield, Braddock's Grave unit, 2005–2006.

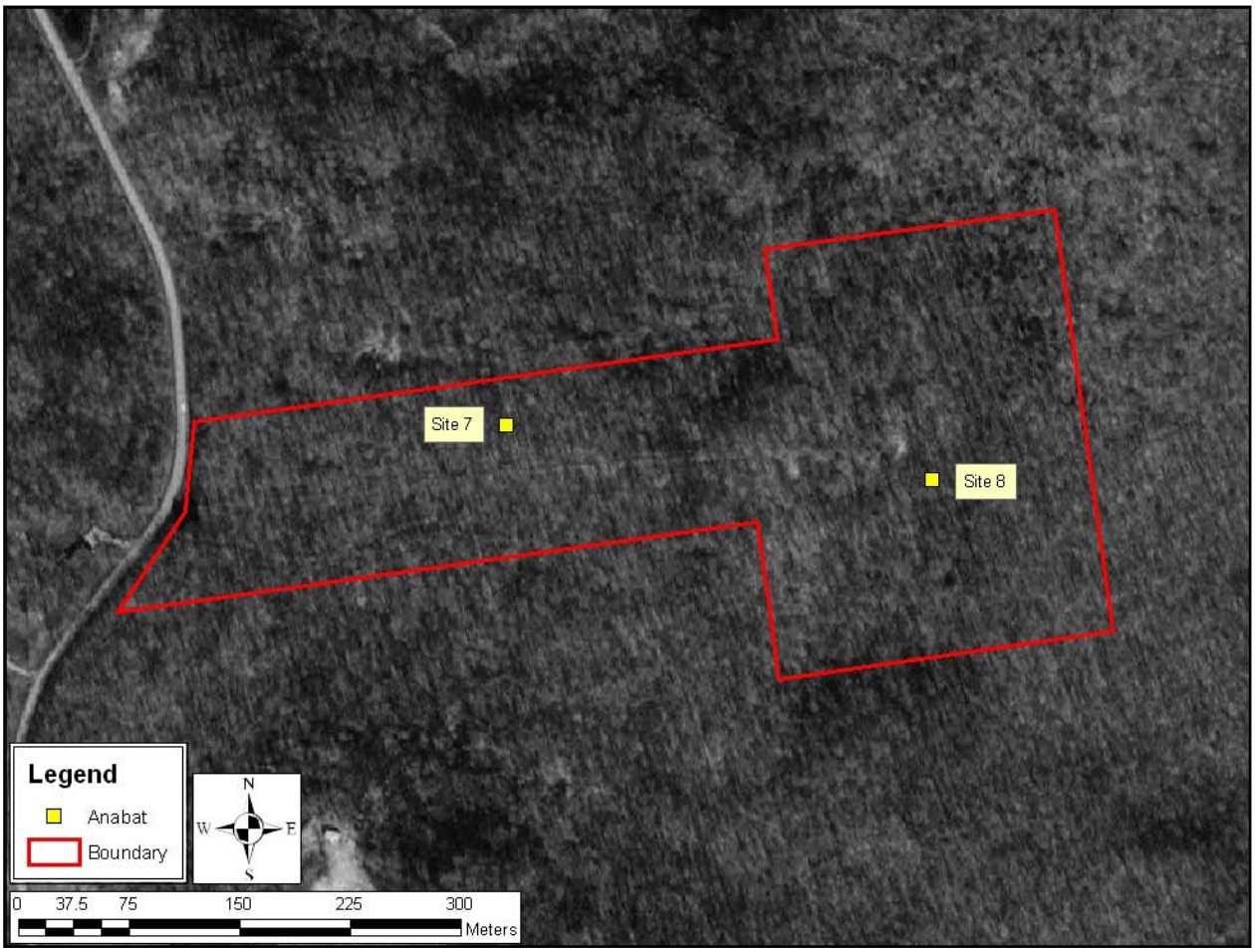

Figure 37. Mist net and acoustic monitoring (Anabat) sites where little brown myotis (*Myotis lucifugus*) were recorded at Fort Necessity National Battlefield, Jumonville Glen unit, 2005–2006.

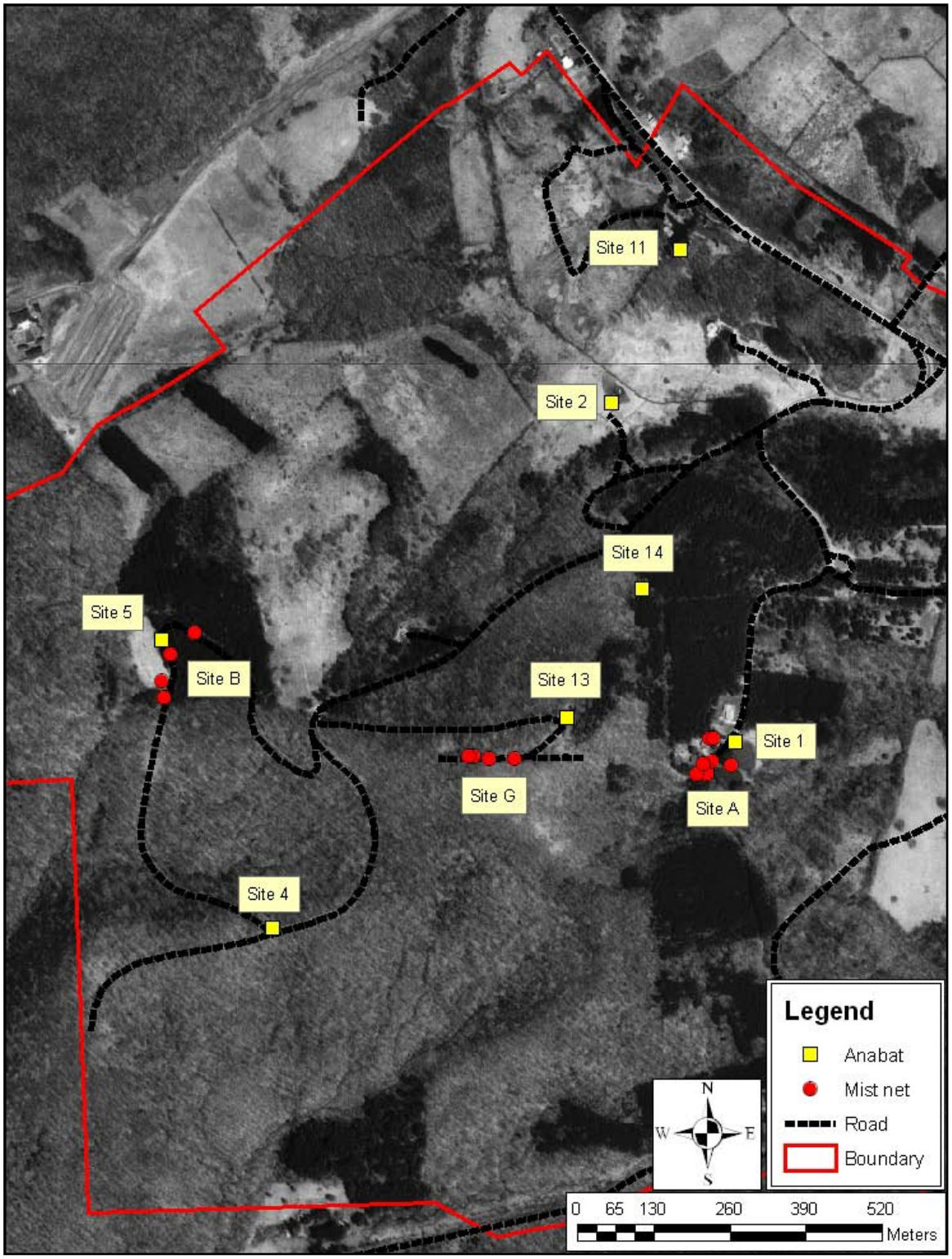

Figure 38. Mist net and acoustic monitoring (Anabat) sites where northern myotis (*Myotis septentrionalis*) were recorded at Fort Necessity National Battlefield, main unit, 2005–2006.

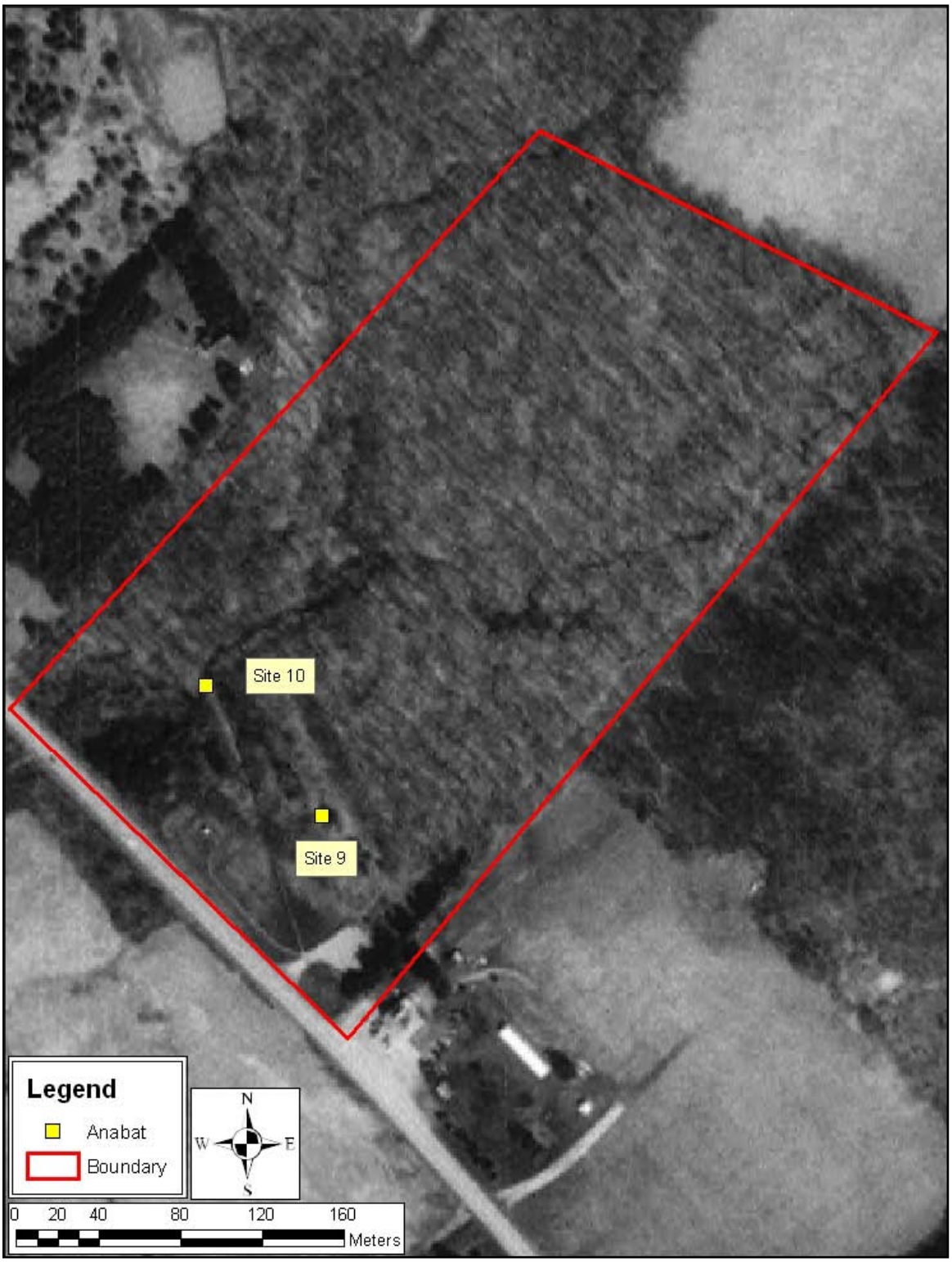

Figure 39. Mist net and acoustic monitoring (Anabat) sites where northern myotis (*Myotis septentrionalis*) were recorded at Fort Necessity National Battlefield, Braddock's Grave unit, 2005–2006.

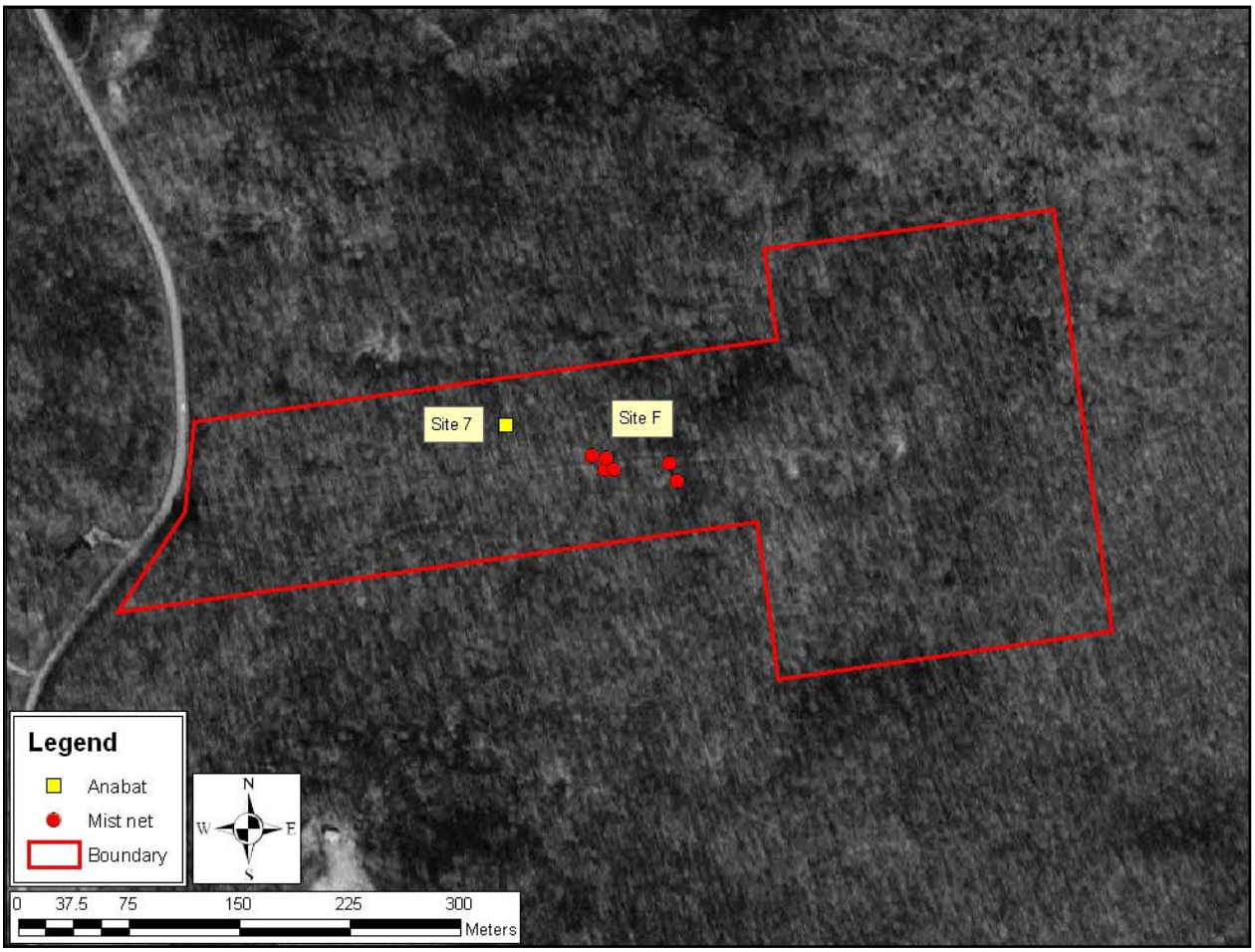

Figure 40. Mist net and acoustic monitoring (Anabat) sites where northern myotis (*Myotis septentrionalis*) were recorded at Fort Necessity National Battlefield, Jumonville Glen unit, 2005–2006.

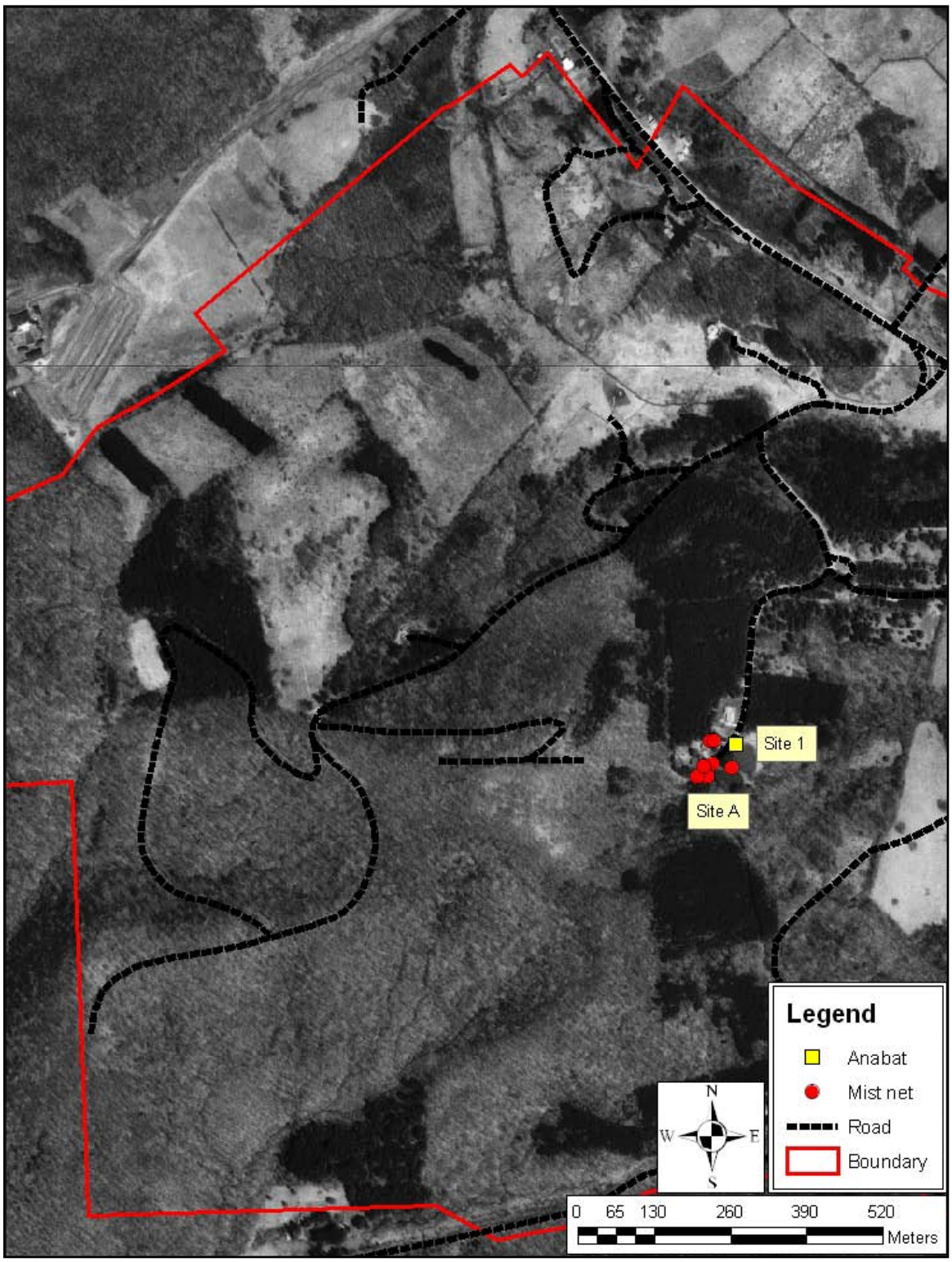

Figure 41. Mist net and acoustic monitoring (Anabat) sites where eastern pipistrelles (*Pipistrellus subflavus*) were recorded at Fort Necessity National Battlefield, main unit, 2005–2006.

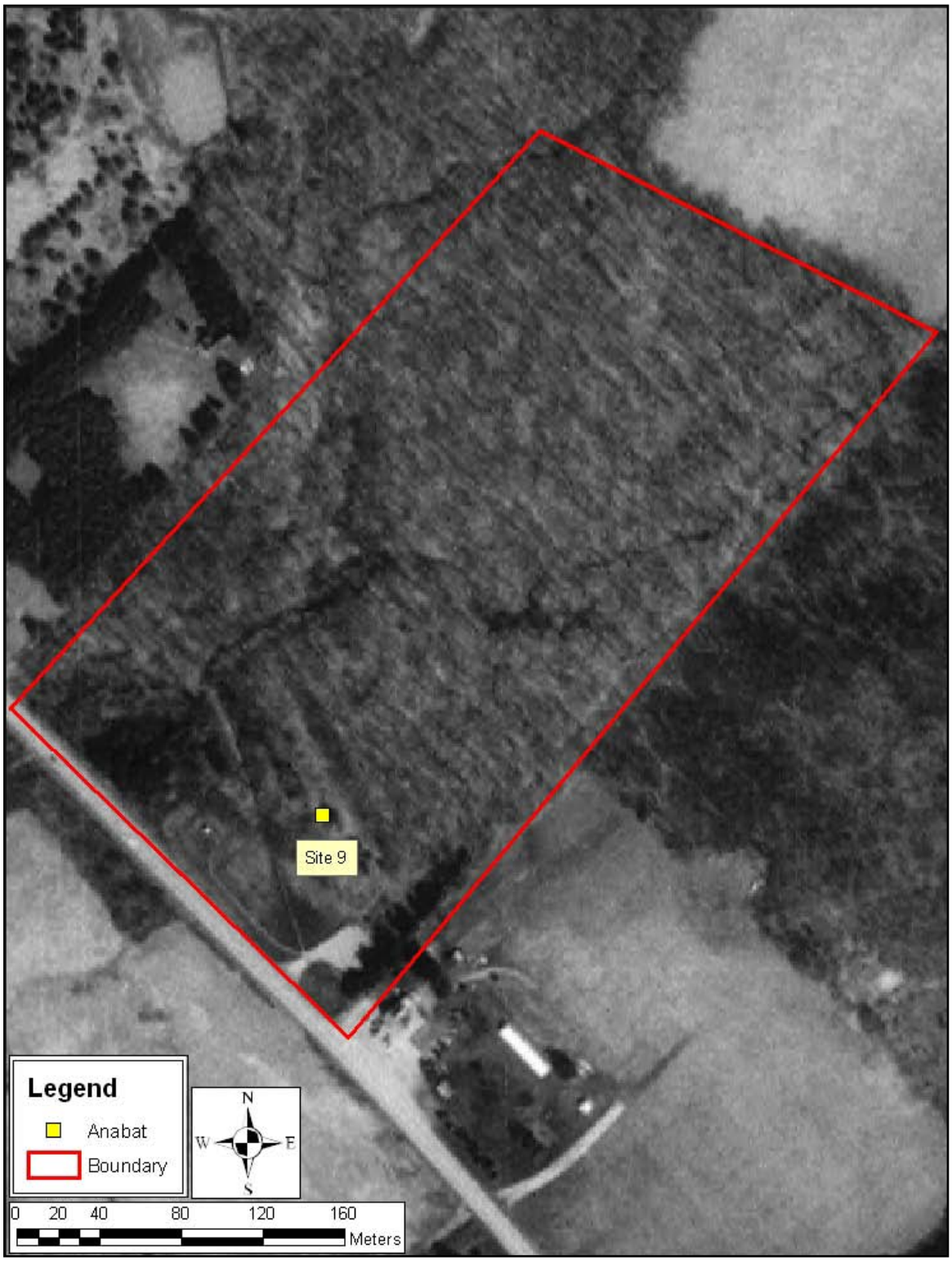

Figure 42. Mist net and acoustic monitoring (Anabat) sites where eastern pipistrelles (*Pipistrellus subflavus*) were recorded at Fort Necessity National Battlefield, Braddock's Grave unit, 2005–2006.

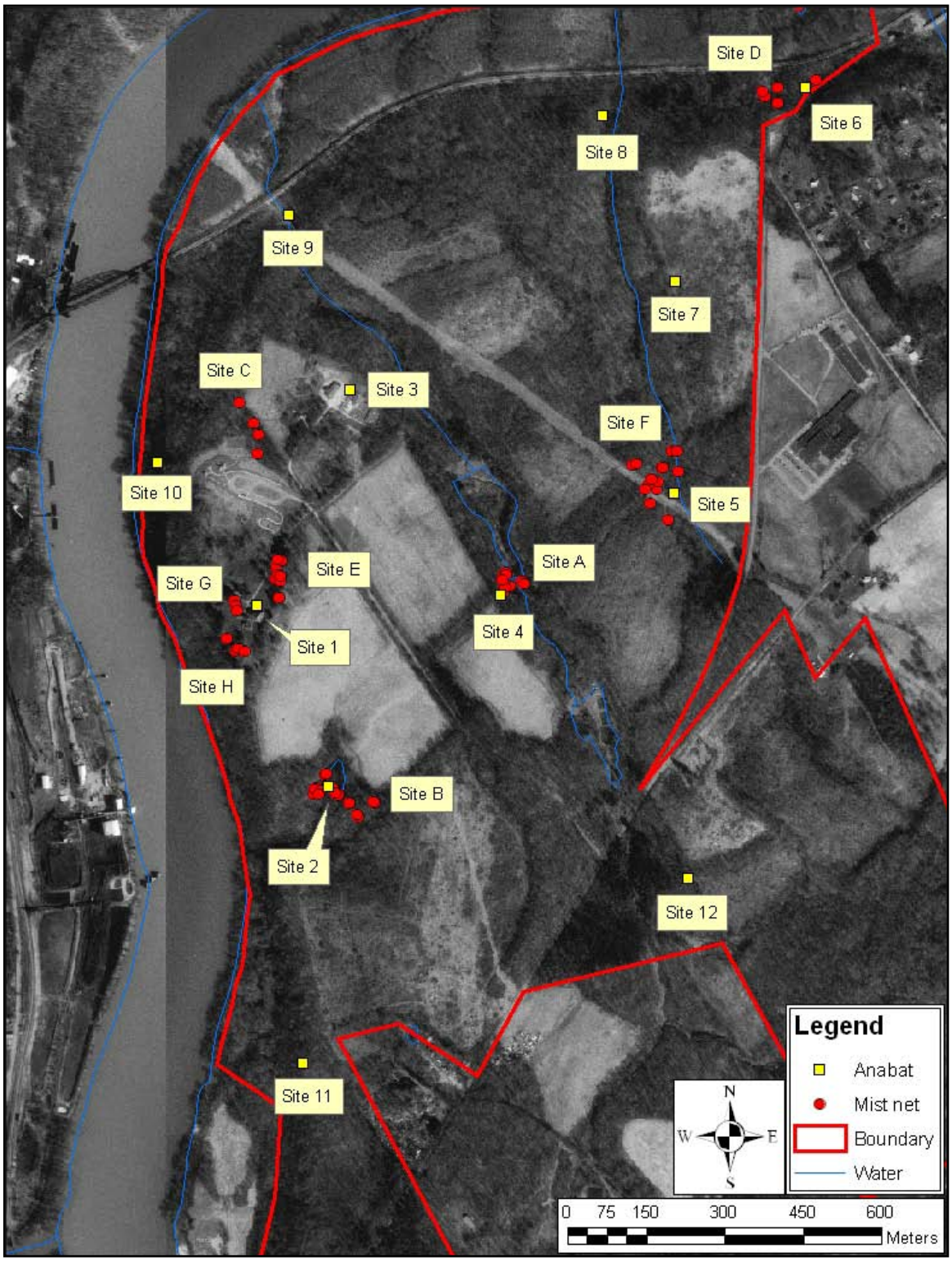

Figure 43. Mist net and acoustic monitoring (Anabat) sites at Friendship Hill National Historic Site, 2005–2006.

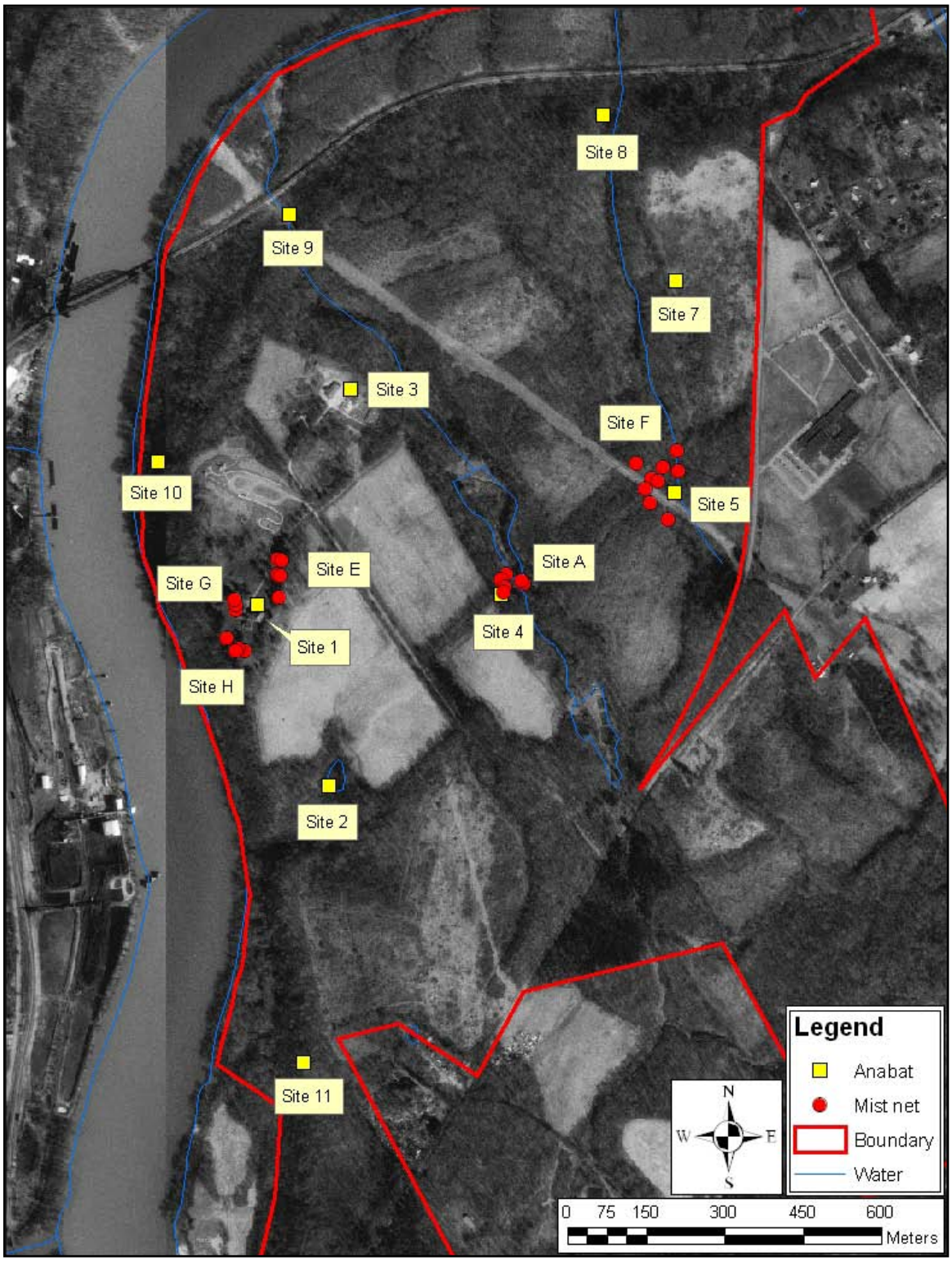

Figure 44. Mist net and acoustic monitoring (Anabat) sites where big brown bats (*Eptesicus fuscus*) were recorded at Friendship Hill National Historic Site, 2005–2006.

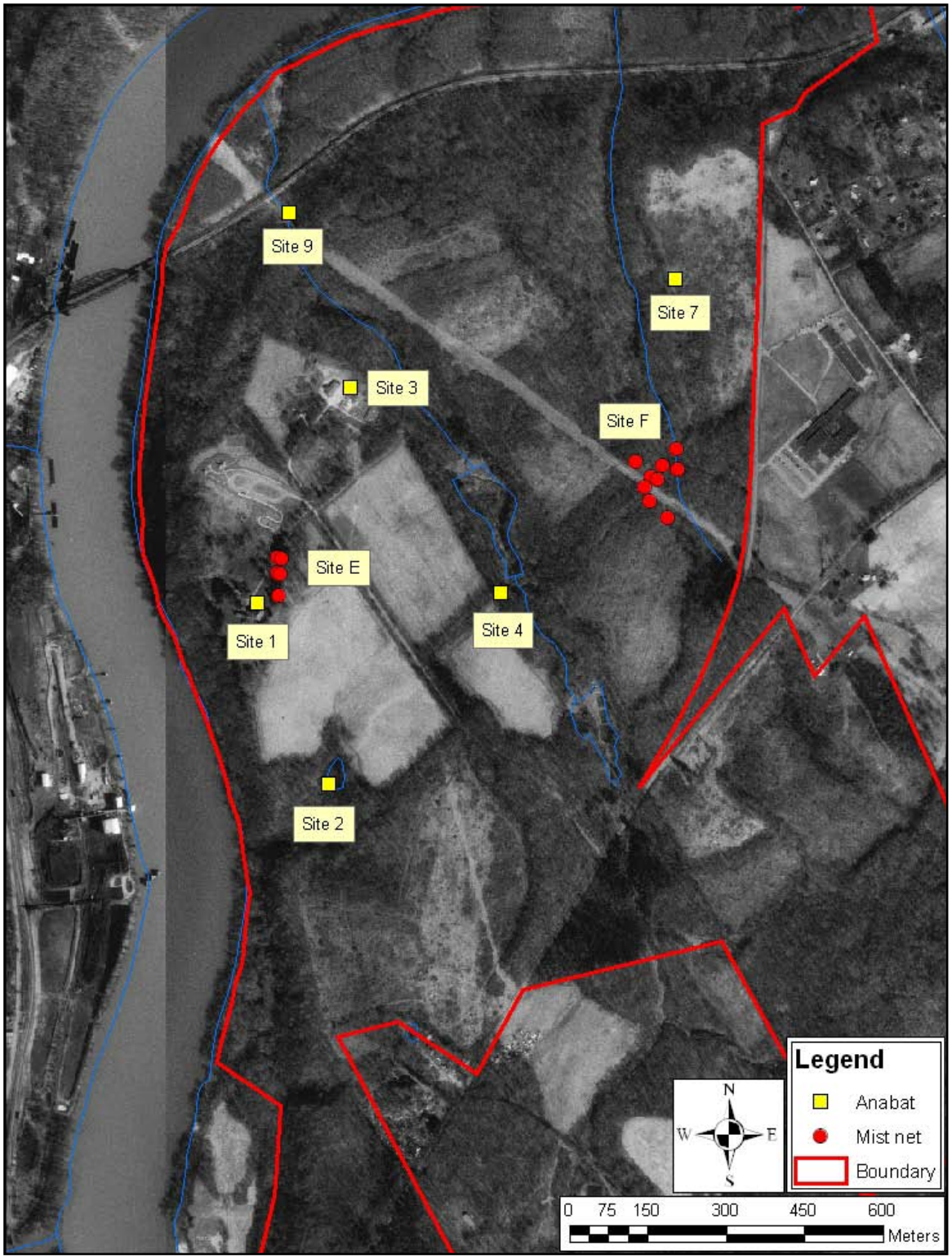

Figure 45. Mist net and acoustic monitoring (Anabat) sites where eastern red bats (*Lasiurus borealis*) were recorded at Friendship Hill National Historic Site, 2005–2006.

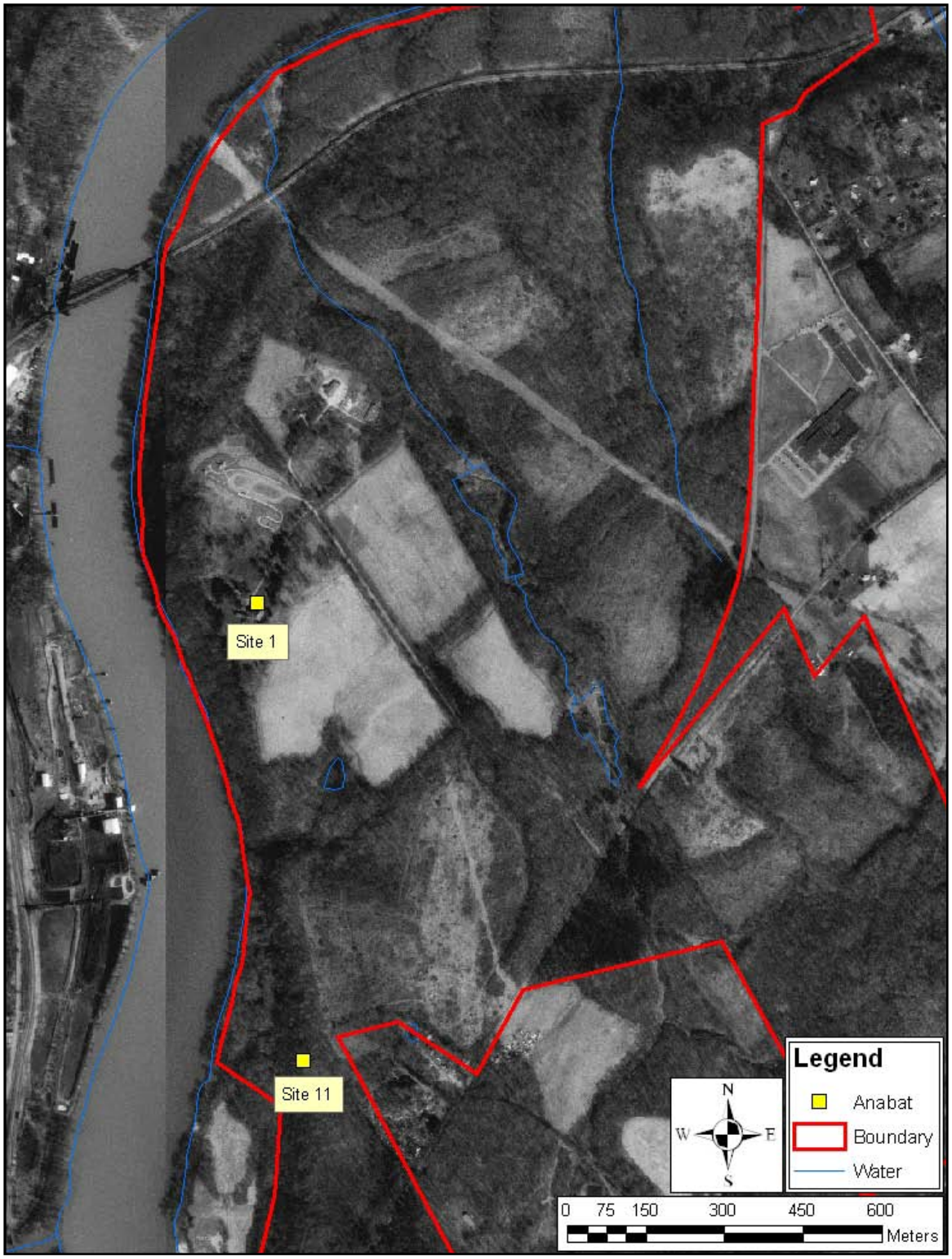

Figure 46. Mist net and acoustic monitoring (Anabat) sites where hoary bats (*Lasiurus cinereus*) were recorded at Friendship Hill National Historic Site, 2005–2006.

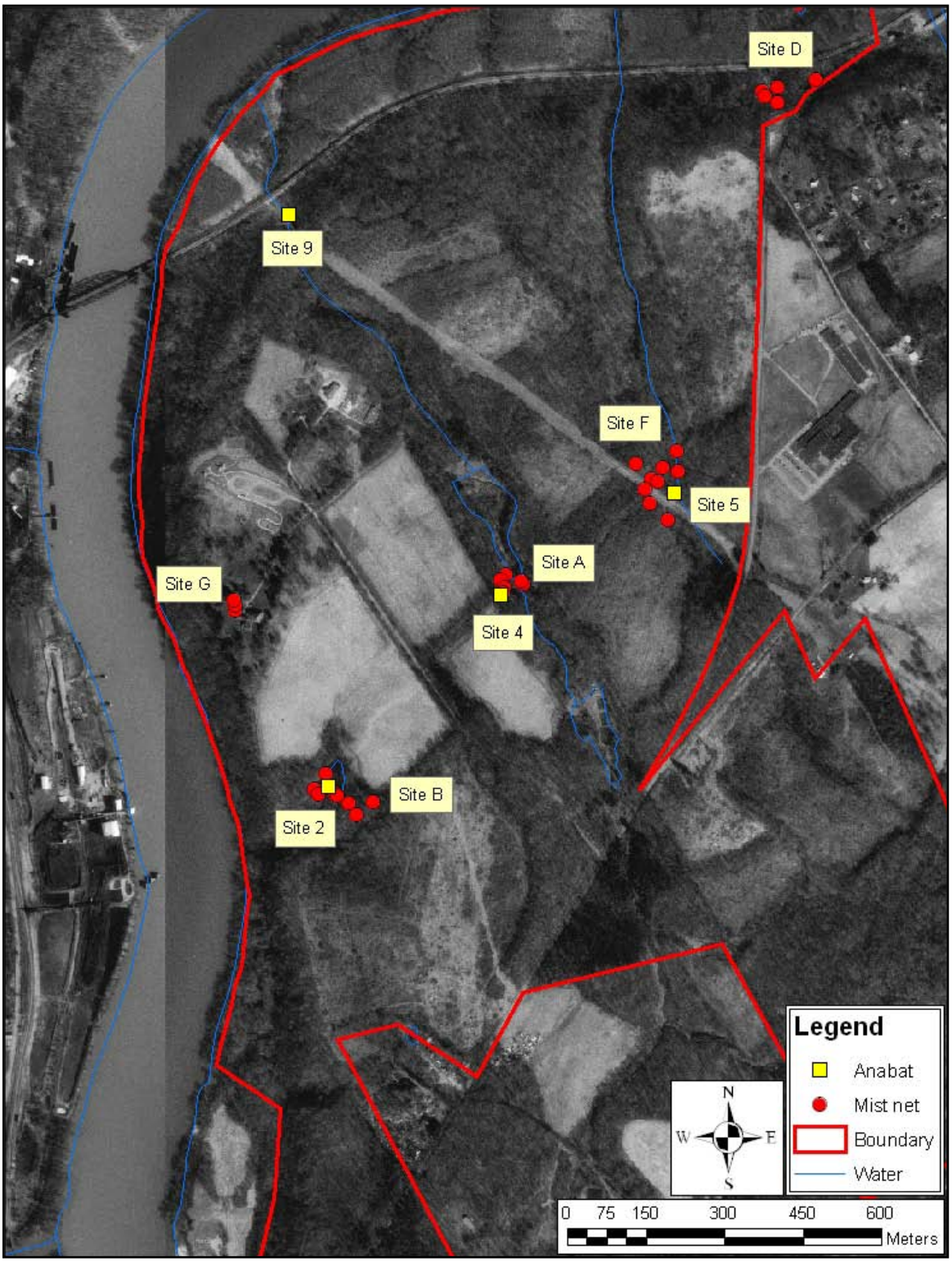

Figure 47. Mist net and acoustic monitoring (Anabat) sites where little brown myotis (*Myotis lucifugus*) were recorded at Friendship Hill National Historic Site, 2005–2006.

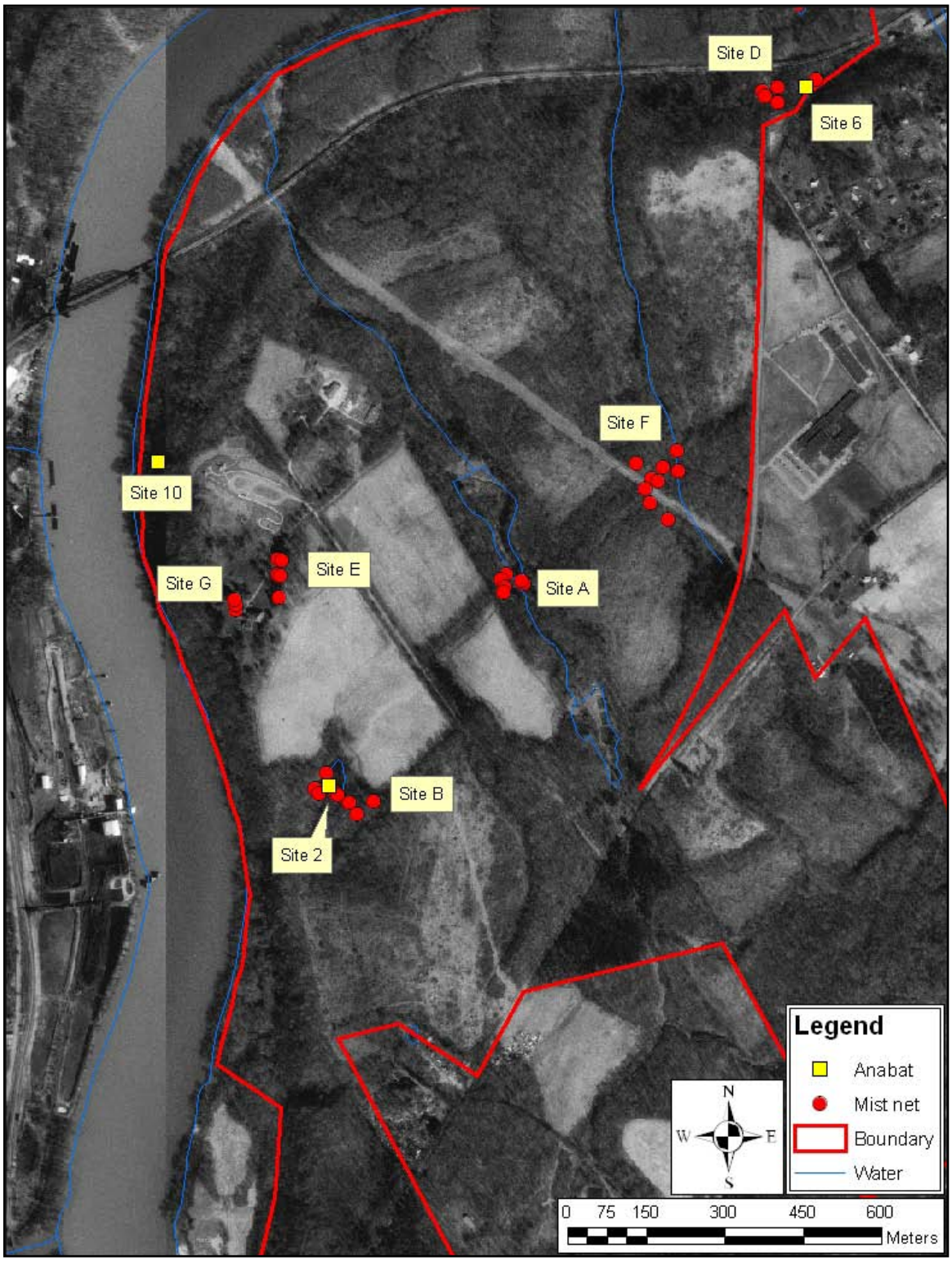

Figure 48. Mist net and acoustic monitoring (Anabat) sites where northern myotis (*Myotis septentrionalis*) were recorded at Friendship Hill National Historic Site, 2005–2006.

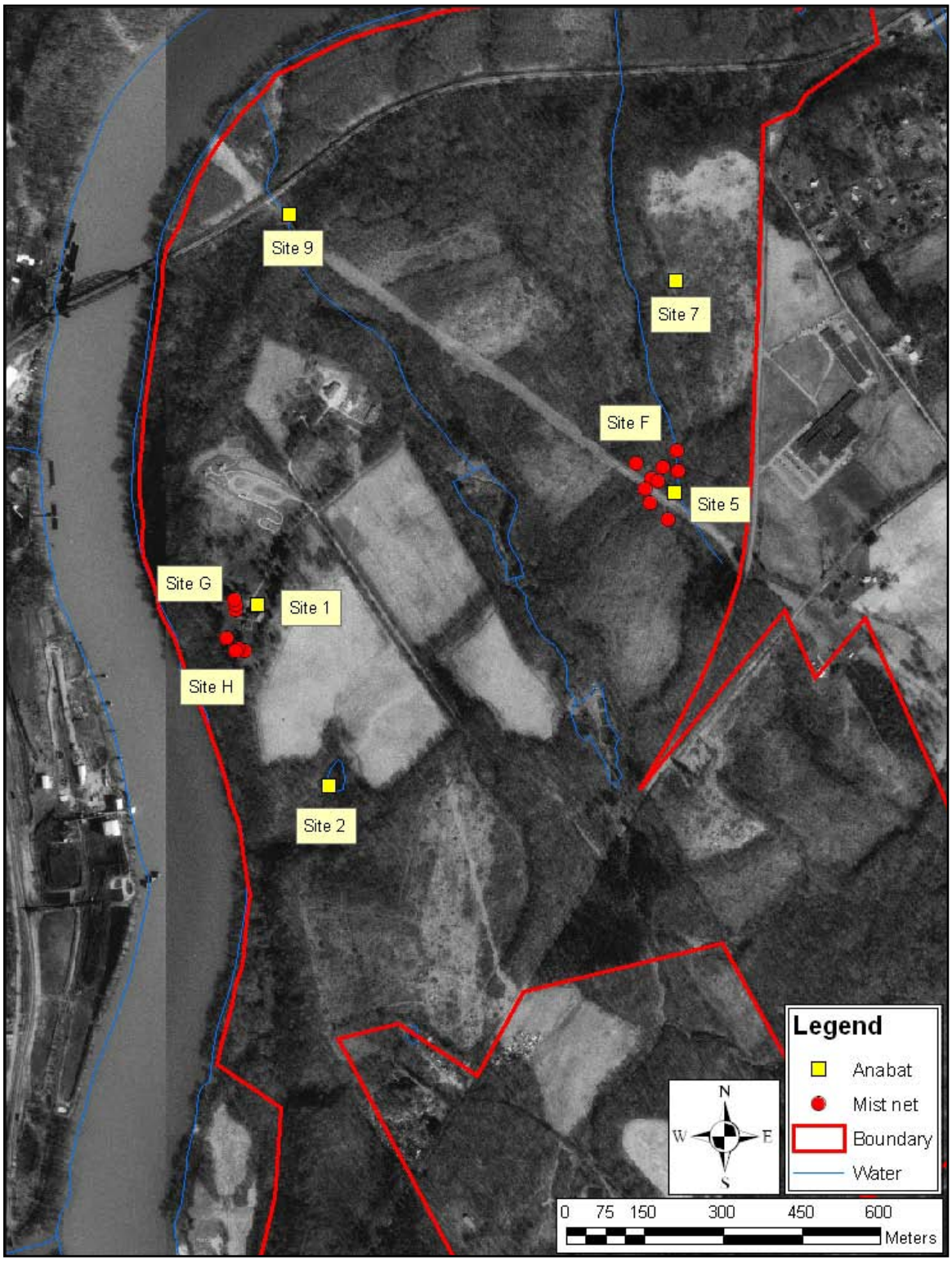

Figure 49. Mist net and acoustic monitoring (Anabat) sites where eastern pipistrelles (*Pipistrellus subflavus*) were recorded at Friendship Hill National Historic Site, 2005–2006.

Johnstown Flood National Memorial

We mist netted at two sites totaling 26 mist net nights at JOFL (Figure 50). We captured 24 bats, including: 13 big brown bats, nine little brown myotis, and two northern myotis (Table 3; Figures 51–56). We documented reproductively active females of all captured species. We captured juvenile big brown bats and little brown myotis.

We conducted acoustic monitoring at six sites at JOFL and collected 473 echolocation passes from six species (Table 6, Figure 50). Eastern red bats were recorded at more sites than any other recorded species, but we recorded the most echolocation passes from big brown bats (Tables 6–7). We acoustically detected, but did not capture, eastern red bats, hoary bats, and eastern pipistrelles at JOFL (Figures 51–56). We did not examine any buildings at JOFL for bat use.

Species Diversity, Evenness, and Richness

Simpson's diversity index (1-*D*) was 0.711 in the four inventoried ERMN park units as a whole. Species evenness ($E_{1/D}$) was 0.687 overall. A higher number indicates higher species diversity and evenness. Species diversity ranged from 0.583 at JOFL to 0.696 at FRHI (Table 8). Species evenness ranged from 0.497 at FONE to 0.756 at JOFL. Species richness ranged from three at JOFL to five at FONE and FRHI when examining capture data only. When acoustic data were examined, species richness was six at all parks (Table 8).

Rarefaction

The minimum number of captured bats needed to assess species richness varied among the four inventoried ERMN park units (Table 9). It was necessary to capture three to four bats to document two species in the parks. To capture three species, it was necessary to capture six to 22 bats, depending on the park.

The number of mist net sites and number of sample nights needed to assess species richness also varied among parks. On average, we mist netted at nine locations for nine nights to capture five species, which only occurred at FONE and FRHI (Table 9).

Acoustic monitoring efforts were comparatively less than mist net efforts to document the same species richness (Table 9). At FRHI and JOFL, we documented three species in the first 20-minute acoustic monitoring sample. On average, 14 acoustic monitoring samples were necessary to document six species. Fourteen acoustic monitoring samples typically were completed in two to three nights.

Horn's Index of Similarity (HIS)

There were no clear or outstanding differences among parks in terms of bat species compositions and relative frequencies. Mist net data indicated that FONE and JOFL were the most dissimilar pair of parks (HIS = 0.69), but acoustic data indicated they were the most similar pair of parks (HIS = 0.95) in terms of bat species compositions and relative frequencies (Table 10). Overall, mist netting and acoustic monitoring were complementary (HIS = 0.85). HIS values were 0.65, 0.67, 0.87, and 0.92 at FONE, FRHI, ALPO, and JOFL, respectively.

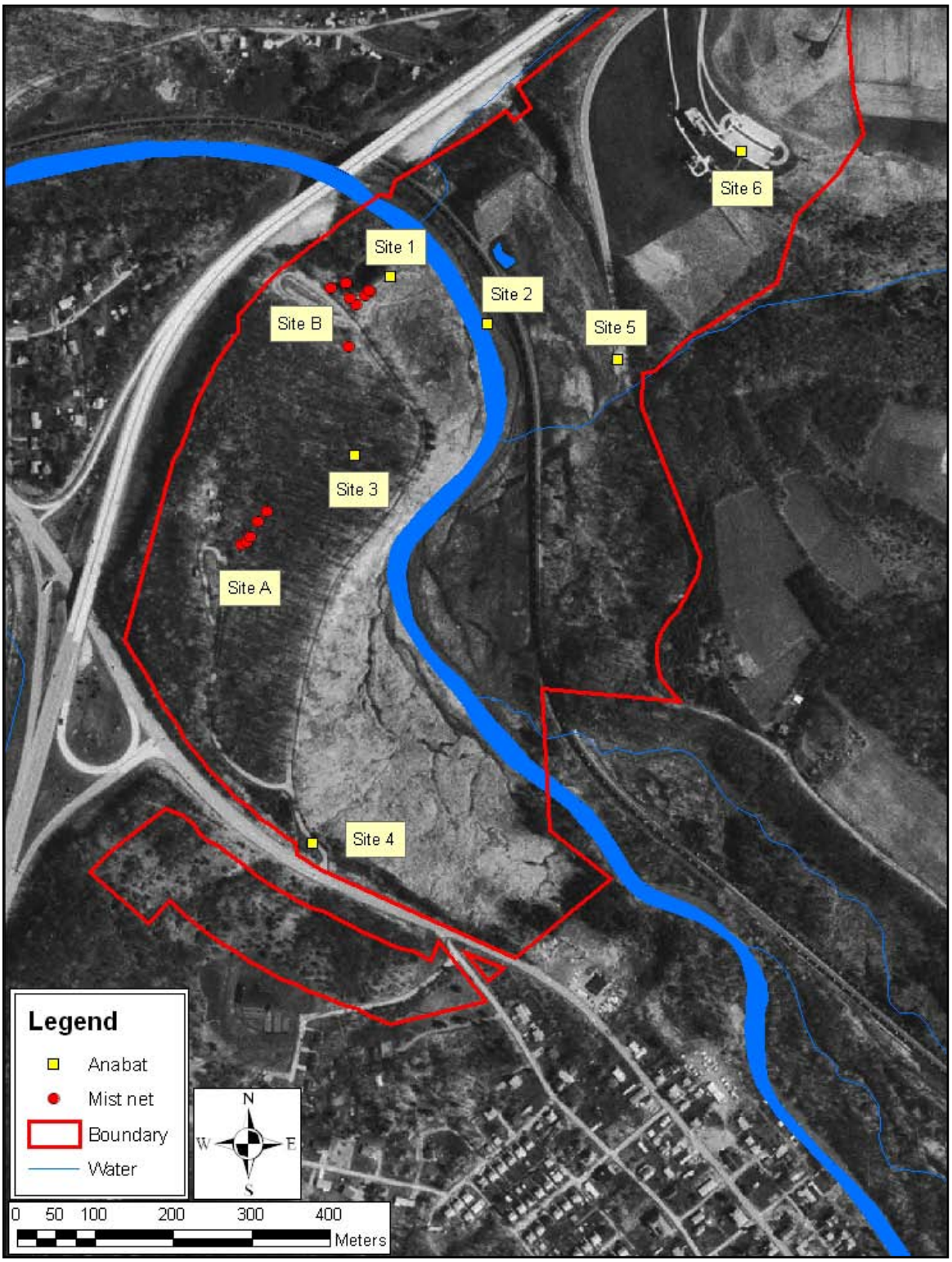

Figure 50. Mist net and acoustic monitoring (Anabat) sites at Johnstown Flood National Memorial, 2005–2006.

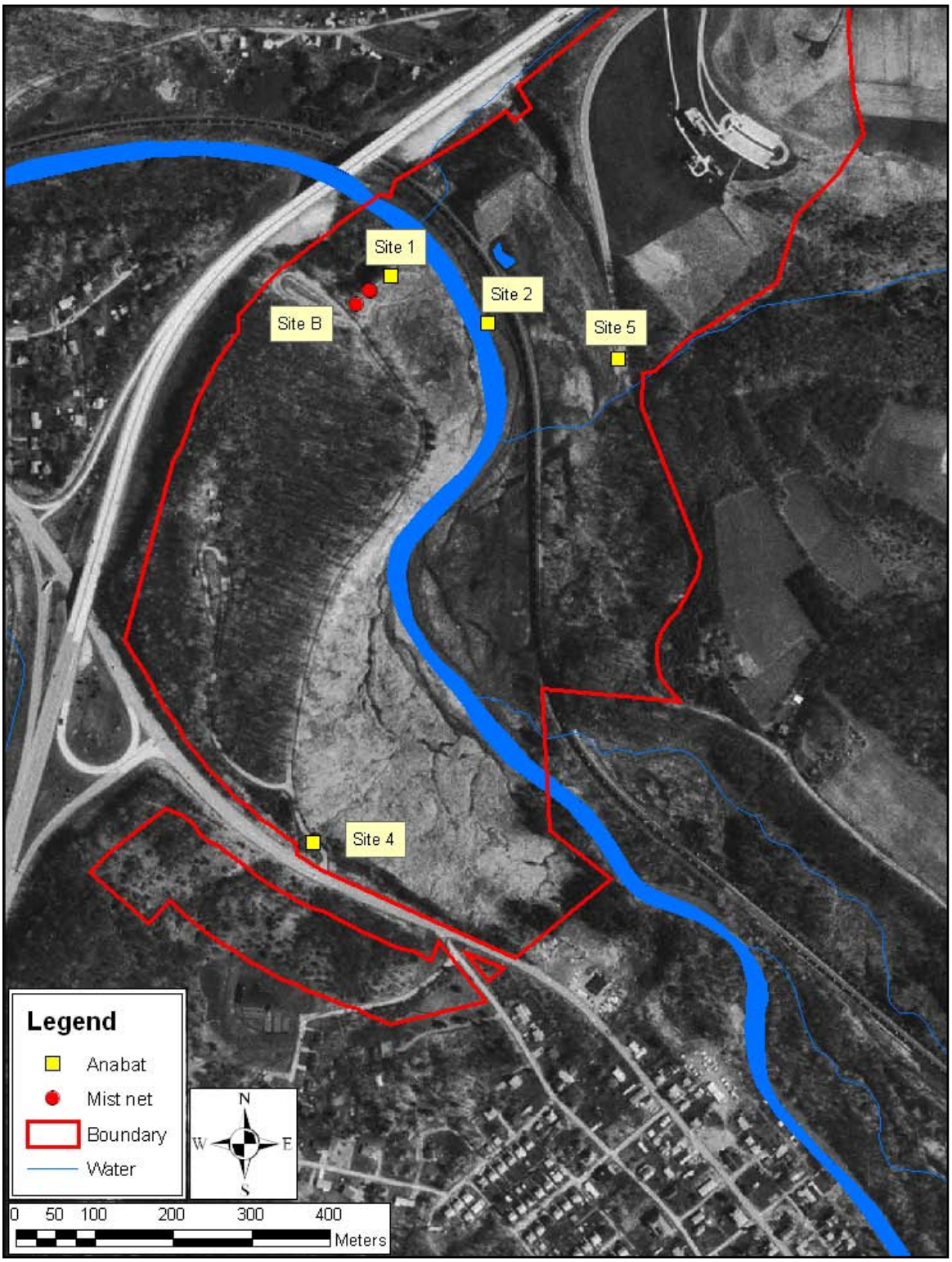

Figure 51. Mist net and acoustic monitoring (Anabat) sites where big brown bats (*Eptesicus fuscus*) were recorded at Johnstown Flood National Memorial, 2005–2006.

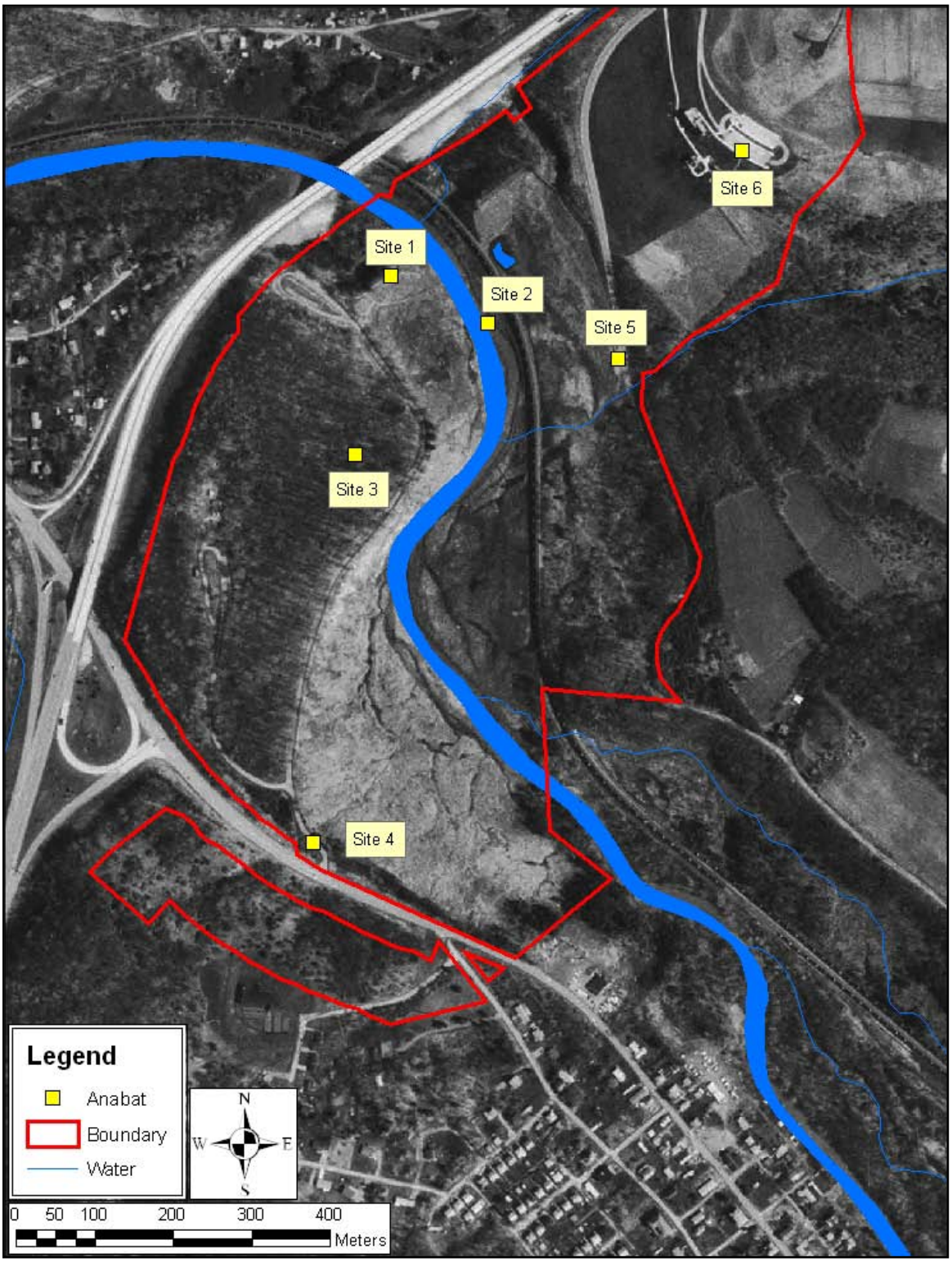

Figure 52. Mist net and acoustic monitoring (Anabat) sites where eastern red bats (*Lasiurus borealis*) were recorded at Johnstown Flood National Memorial, 2005–2006.

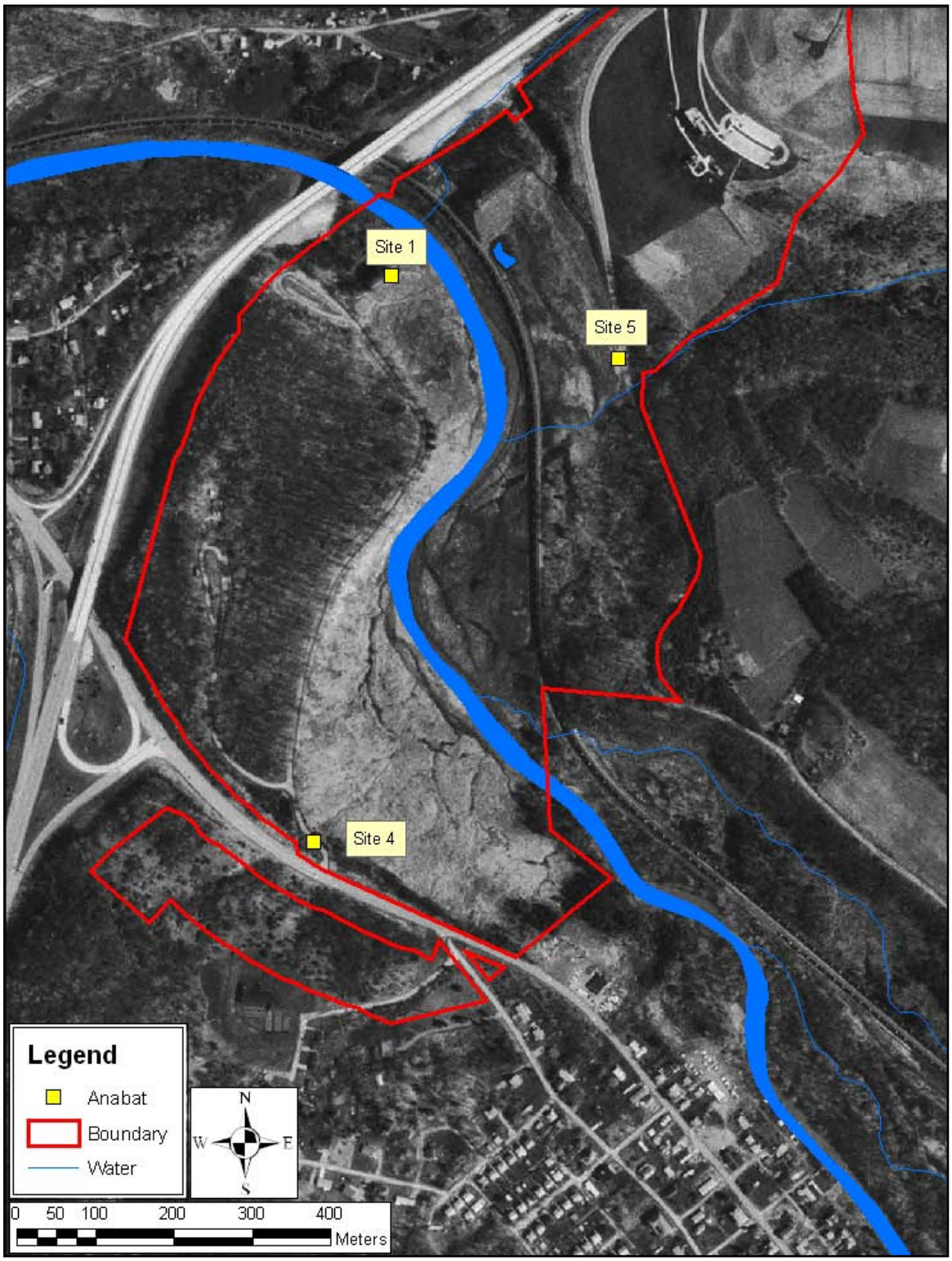

Figure 53. Mist net and acoustic monitoring (Anabat) sites where hoary bats (*Lasiurus cinereus*) were recorded at Johnstown Flood National Memorial, 2005–2006.

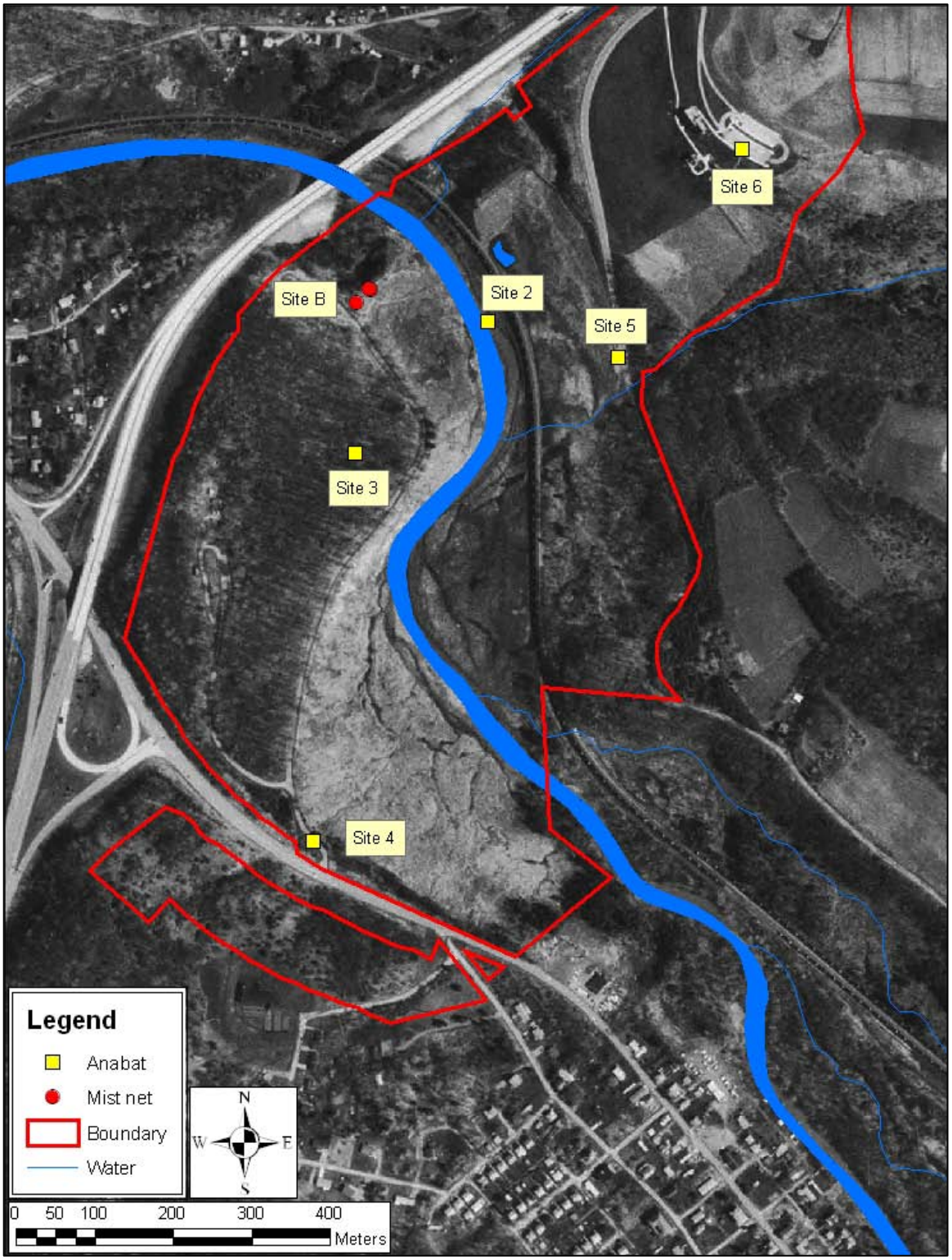

Figure 54. Mist net and acoustic monitoring (Anabat) sites where little brown myotis (*Myotis lucifugus*) were recorded at Johnstown Flood National Memorial, 2005–2006.

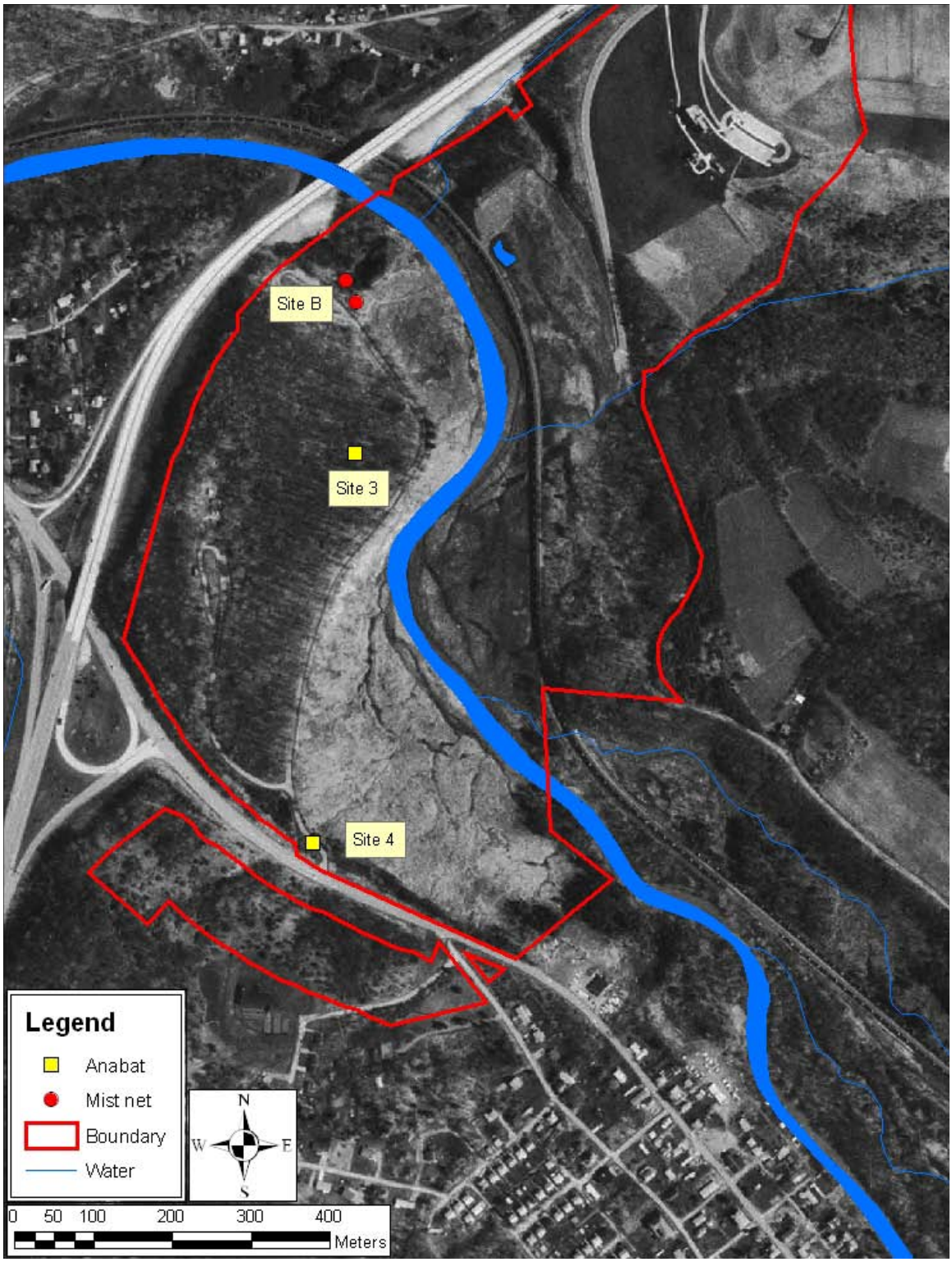

Figure 55. Mist net and acoustic monitoring (Anabat) sites where northern myotis (*Myotis septentrionalis*) were recorded at Johnstown Flood National Memorial, 2005–2006.

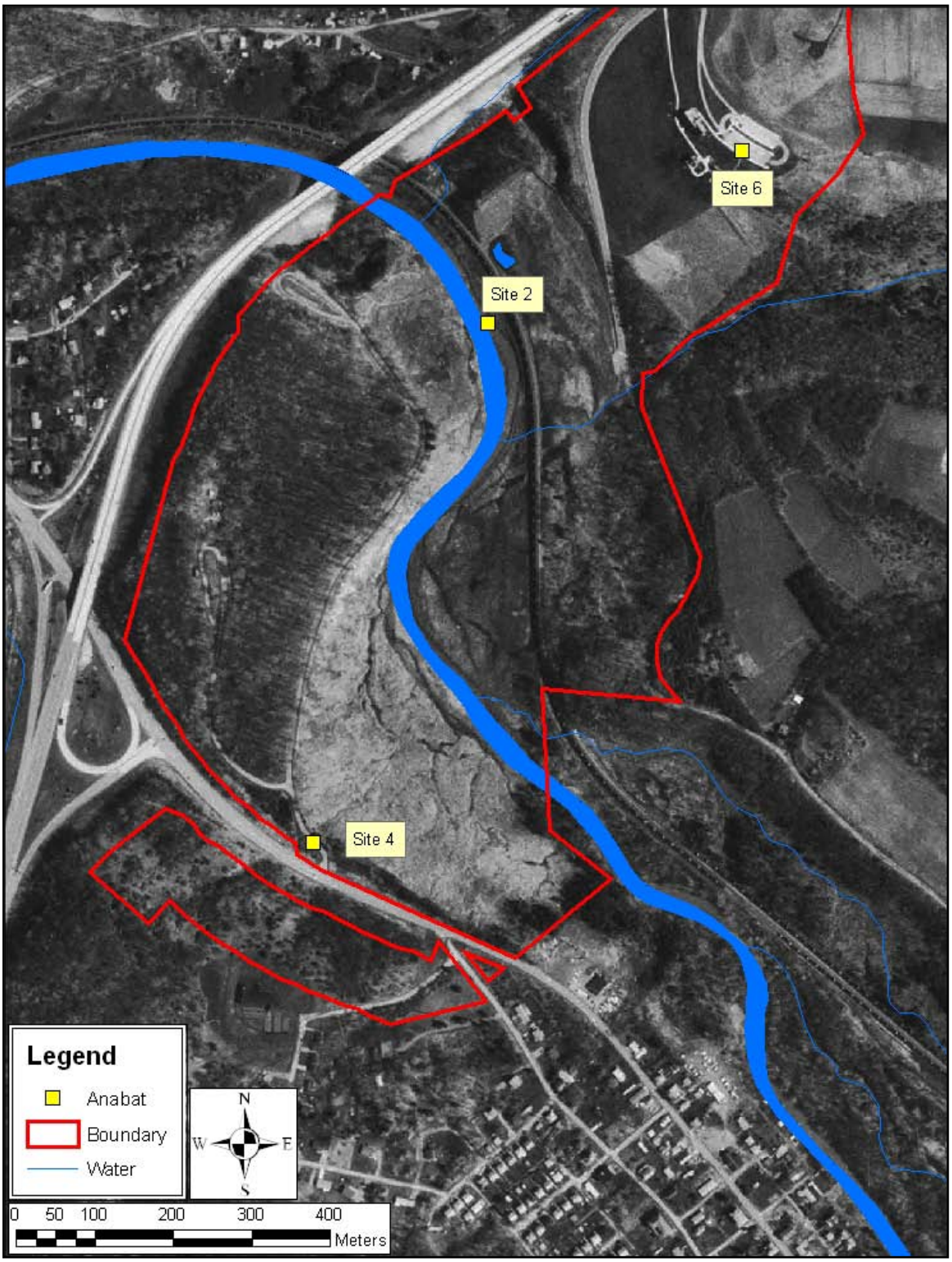

Figure 56. Mist net and acoustic monitoring (Anabat) sites where eastern pipistrelles (*Pipistrellus subflavus*) were recorded at Johnstown Flood National Memorial, 2005–2006.

Table 8. Simpson's diversity index (*1-D*), measure of evenness ($E_{1/D}$), and species richness at four Eastern Rivers and Mountains Network park units, 2005–2006.

	Park unit[a]				
Variable	All	ALPO	FONE	FRHI	JOFL
Simpson's diversity index[b]	0.711	0.640	0.603	0.696	0.583
Simpson's measure of evenness[c]	0.687	0.683	0.497	0.641	0.756
Capture species richness[d]	5.000	4.000	5.000	5.000	3.000
Acoustic species richness[e]	6.000	6.000	6.000	6.000	6.000
Combined species richness[f]	6.000	6.000	6.000	6.000	6.000

[a]ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.
[b]Higher number indicates higher species diversity.
[c]Higher number indicates higher species evenness.
[d]Number of bat species captured in mist nets.
[e]Number of bat species detected during acoustic monitoring.
[f]Number of bat species captured in mist nets or detected during acoustic monitoring.

Table 9. Number of mist net locations, captured individuals, and acoustic survey locations needed to assess bat species communities at four Eastern Rivers and Mountains Network park units, 2005–2006.

				No. species[e]					
Park[a]	Method[b]	Type[c]	*n*[d]	1	2	3	4	5	6
All[f]	Capture	Locations	32	1	3	5	8	9	–
		Nights	60	1	3	5	7	9	–
		Individuals	329[g]	1	3	6	18	232	–
	Acoustic	Locations	196	1	2	3	8	10	14
ALPO	Capture	Locations	9	1	1	2	6	–	–
		Nights	18	1	1	2	7	–	–
		Individuals	113	1	3	8	84	–	–
	Acoustic	Locations	68	1	1	5	9	9	13
FONE	Capture	Locations	13	1	6	7	7	7	–
		Nights	18	1	7	10	10	10	–
		Individuals	105	1	3	8	19	104	–
	Acoustic	Locations	56	1	3	4	15	22	29
FRHI	Capture	Locations	8	1	2	5	5	6	–
		Nights	17	1	2	5	5	8	–
		Individuals	87[g]	1	3	6	16	85	–
	Acoustic	Locations	48	1	1	1	6	6	10
JOFL	Capture	Locations	2	2	2	2	–	–	–
		Nights	4	2	2	3	–	–	–
		Individuals	24	1	4	22	–	–	–
	Acoustic	Locations	24	1	1	1	2	2	4

[a]ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.
[b]Capture = mist net survey; Acoustic = Anabat acoustic survey.
[c]Locations = mist net or acoustic survey locations; Individuals = individual bat captures.
[d]Number of mist net locations, captured individuals, and acoustic survey locations at each park.
[e]Number of bat species recorded.
[f]Average of all park data, with exception of captured individuals, which were estimated using rarefaction analysis of combined park data.
[g]Does not include one unidentified *Myotis* sp.

Table 10. Horn's index of similarity among four Eastern Rivers and Mountains Network park units, 2005–2006. A higher number indicates that the parks' species relative frequencies and compositions are more similar.

		Park			
Method	Park [a]	ALPO	FONE	FRHI	JOFL
Anabat	ALPO	1.00			
	FONE	0.86	1.00		
	FRHI	0.87	0.72	1.00	
	JOFL	0.92	0.95	0.73	1.00
Mist net	ALPO	1.00			
	FONE	0.83	1.00		
	FRHI	0.93	0.79	1.00	
	JOFL	0.92	0.69	0.95	1.00

[a]ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.

Incidental Captures and Observations

Allegheny Portage Railroad National Historic Site

We observed a northern ring-necked snake (*Diadophis punctatus*) on the railroad trace east of Muleshoe curve on 29 June 2005. We observed a porcupine (*Erethizon dorsatum*) on the railroad trace at the Staple Bend Tunnel on 1 July 2005. On 6 July 2006, a field sparrow (*Spizella pusilla*) was captured and released from a mist net near Blair Gap Run and Mill Road; and we observed a raccoon (*Procyon lotor*) near Blair Gap Run and Mill Road. We observed a porcupine at the railroad trace access gate at Muleshoe Curve on 18 July 2006. We captured and released a southern flying squirrel (*Glaucomys volans*) from a mist net over the railroad trace near the Ranger Lane access on 20 July 2006 (voucher photo provided).

Fort Necessity National Battlefield

We observed a road-killed eastern milksnake (*Lampropeltis triangulum*) near a small culvert approximately 50 m (164 ft) in from the park's main gate on 17 May 2005. We observed a gray fox (*Urocyon cinereoargenteus*) at the Jumonville Glen parking area on 23 May 2005. We observed a long-tailed salamander (*Eurycea longicauda*) under a woodpile next to Great Meadows Center garage on 24 May 2005. We captured and released, unharmed, from a mist net over the walkway below Mount Washington Tavern, a southern flying squirrel on 25 May 2005. On 26 May 2005, we observed a northern ring-necked snake and a woodland jumping mouse (*Napaeozapus insignis*) on Reservoir Road. We observed three slimy salamanders (*Plethodon glutinosus*), one long-tailed salamander, and six red efts (*Notophthalmus viridescens*) on Reservoir Road on 2 June 2005. We observed a southern flying squirrel and gray fox near the walkway below Mount Washington Tavern on 1 August 2006. We captured and released, unharmed, a southern flying squirrel from a mist net over Reservoir Road on 4 August 2006 (voucher photos provided).

Friendship Hill National Historic Site

On 13 June 2005, we captured and released, unharmed, an eastern screech owl (*Otus asio*) from a mist net at New Geneva Spur. From 15–18 August 2006, we captured and released, unharmed, a southern flying squirrel (voucher photo provided) each night from mist nets at or near Ice Pond Run, Sophia's Pond, Dublin Run, and the Gallatin House. On 24 August 2006, we captured and released, unharmed, a northern cardinal (*Cardinalis cardinalis*) from a mist net near the Gallatin House.

Johnstown Flood National Memorial

We observed a meadow jumping mouse (*Zapus hudsonius)* on the banks of the South Fork on 6 July 2005. On 8 July 2005, a striped skunk (*Mephitis mephitis*) was observed at the Visitor Center parking lot and a southern flying squirrel was captured and released, unharmed, (voucher photos provided) from a mist net at the south abutment. On 14 July 2006, we captured and released, unharmed, a southern flying squirrel from a mist net at the south abutment.

Discussion

Of the 11 bat species that have been documented in Pennsylvania, nine potentially occur at the four inventoried ERMN park units (Harvey et al. 1999). Only two records of Seminole bats (*Lasiurus seminolus*) are known from Pennsylvania; one from Berks County and one from Lancaster County (Poole 1932, 1949). Evening bats are more restricted to southeastern Pennsylvania (NAUS 2006). We identified six of the nine bat species that potentially occur at the four inventoried ERMN park units. All inventoried bats are considered common species in the mid-Atlantic region (Harvey et al. 1999). Of the remaining three species, silver-haired bats are considered common and probably occur at all the inventoried ERMN park units during spring and autumn migration, with few individuals occurring in the parks during summer (Cryan 2003). Eastern small-footed myotis are a threatened species and the four inventoried ERMN park units do not contain the unique habitat, e.g., extensive rock outcrops, required by this species. Indiana myotis are endangered and, although habitat conditions exist that are suitable for this species, it probably either does not occur in the parks, or occurs in such low numbers as to have gone undetected by our inventory. At FRHI, we captured an unidentified *Myotis* sp. that escaped from the mist net before it could be handled and positively identified. It is unlikely that this bat was an eastern small-footed myotis or Indiana myotis, but rather a little brown myotis or northern myotis, which were commonly captured at that particular mist net site. Similarly, we recorded unidentifiable *Myotis* sp. echolocation passes at all four inventoried ERMN park units, but were not confident to categorize any of these passes to species, particularly eastern small-footed myotis or Indiana myotis. These species have unique echolocation call characteristics that permit identification under ideal circumstances (e.g., high call quality, ≥5 consistent call pulses; Britzke et al. 2002; Mukhida et al. 2004). However, all myotine bats potentially occurring in Pennsylvania emit echolocation calls that are similar enough in frequency and structure that differentiating among the species can be difficult unless high quality passes with ≥5 call pulses are recorded.

The intensity level of our mist netting inventory fell short of minimum Indiana myotis sampling effort guidelines established by the United States Fish and Wildlife Service for all park units except FRHI (USFWS 1999). Recommendations include one mist net set consisting of ≥2 mist net sites established for ≥2 nights per km of stream corridor, and two mist net sets per km^2 of forested habitat (USFWS 1999). Applying these minimum guidelines to the parks, 32, 22, 14, and six nights respectively, would be needed to satisfactorily assess ALPO, FONE, FRHI, and JOFL for presence of Indiana myotis. We mist netted for 17, 19, 17, and four nights at ALPO, FONE, FRHI, and JOFL, respectively. The USFWS guidelines do not state how wide or what minimum stream order a stream corridor must be for consideration when mist netting. We included first order streams, even those at high elevations, which may have resulted in overestimating the minimum effort required at each park, because most foraging data for Indiana myotis indicate that they more commonly forage in valleys, floodplains, and associated riparian corridors (Carter 2006). We augmented our mist netting efforts with acoustic monitoring, which frequently revealed areas of high bat activity that were mist netted on subsequent nights.

Allegheny Portage Railroad National Historic Site

Of the four ERMN park units we inventoried, ALPO had the second highest species diversity and evenness. The mosaic of forests, open areas, and waterways, and its location on the Allegheny Front, likely contribute to the diversity of species at ALPO (Owen et al. 2004; Ford et al. 2005). Of the six bat species we documented at ALPO, big brown bats and little brown myotis likely are the most abundant. We captured and acoustically detected them more frequently than other species. The majority of activity we detected was at the Level 10 homesite and on the railroad trace between Muleshoe Curve and Ranger Lane. Moreover, nearly half (48.6%) of bats captured at the Level 10 homesite and on the railroad trace between Muleshoe Curve and Ranger Lane were reproductively active females, indicating that this section of the park likely contains maternity colonies, or, at the very least, provides foraging habitat for female bats during this important phase of their life cycle. Activity at the Summit area was lower than the rest of the park, possibly because it is at a higher elevation. During summer, female bats are more prevalent at lower elevations because of warmer temperatures and associated riparian areas (Grindal et al. 1999; Cryan et al. 2000; Brack et al. 2002).

Several big brown bats roosted near the eastern-most chimney of the Lemon House. They may have been roosting under the flashing or some other crevice between the chimney and roof. Although it is unlikely that the bats were causing harm, any attempts to exclude them from the house should be mitigated by placing a bat house nearby (Appendix A and E).

At the four inventoried ERMN park units, only one potential hibernaculum is present: Staple Bend Tunnel at ALPO. Historically, Staple Bend Tunnel was a hibernaculum for a small community (i.e., a few dozen) of big brown bats, little brown myotis, northern myotis, and eastern pipistrelles (C. Butchkoski, Wildlife Biologist, Pennsylvania Game Commission, unpublished data, February 1997). At that time (February 1997), the tunnel entrances had been mostly closed off for decades by a steel company that formerly owned the tunnel (K. Penrod, Natural Resource Manager, National Park Service, pers. comm., April 2005). The tunnel entrances were opened sometime between 1997 and 2005. In winter 2005, a hibernaculum survey was conducted and no bats were observed. We did not observe any bats roosting in the tunnel during summer months (Hall and Brenner 1968). It is possible that bats use the tunnel as an autumn swarming site, although this remains to be investigated. Although bats swarming at entrances may not necessarily use the tunnel as a day roost or hibernaculum, swarming sites provide a valuable location for genetic exchange (Veith et al. 2004). Staple Bend Tunnel is very accessible to park visitors. Placement of gates or other structures to eliminate human disturbance and improve internal climate for bats may attract hibernating bats to the tunnel, but probably would be in conflict with historical and cultural resource values, as well as visitor use (Appendix A).

Fort Necessity National Battlefield

Of the six bat species we documented at FONE, northern myotis was probably the most abundant. The northern myotis capture rate at FONE was more than at all other ERMN park units we inventoried, combined. This result is likely attributable to the large, intact forest tracts that occur at FONE. Northern myotis are known to roost and forage in forest interiors (Menzel et al. 2002c; Owen et al. 2004). We documented reproductively active females of all captured

species except eastern pipistrelle, indicating that FONE likely contains maternity colonies, or, at the very least, provides foraging habitat for female bats during the maternity period. Bat activity was high around the ponds at the Great Meadows Center, according to acoustic and mist net data. These ponds probably attract insects as well as provide a water source for foraging bats. Mist netting in other areas of the park were much less productive than at the ponds and were more effectively inventoried via acoustic monitoring.

Species diversity and evenness were relatively low compared to other ERMN park units in our inventory. This result is attributable to the majority (58.1%) of our captures being northern myotis and only two being eastern pipistrelles.

Friendship Hill National Historic Site

Of the four ERMN park units in our inventory, FRHI had the highest species diversity, but ranked third in species evenness. Relatively low species evenness was attributable to high capture rates of two species; big brown bats and little brown myotis. However, relatively high species richness captured at FRHI produced a relatively high species diversity index. Big brown bats, little brown myotis, and, to a lesser extent, northern myotis are the most abundant bats species at FRHI. Eastern pipistrelle activity at FRHI was the highest among the parks, but was low compared to other species.

Bat activity was highest at Sophia's Pond according to acoustic data. We were unable to situate mist nets in an arrangement that efficiently captured bats at Sophia's Pond; primarily because of a lack of defined foraging or travel corridors to the pond. Bat activity was high around the Gallatin House and at Ice Pond Run near the railroad tracks and utility corridor; a likely junction of travel and foraging corridors. Although we did not monitor bat activity directly over the Monongahela River, it is probable that bats roosting at FRHI use the river as a water source and foraging area.

Big brown bats regularly use the Gallatin House as a roost. Although we were unable to determine how bats were accessing the building's interior, we observed bats roosting singly behind exterior second story shutters during all five inspections. We observed no bat colonies emerging from the Gallatin House at dusk on any of several occasions in summer 2005 or 2006. The bats roosting behind the shutters probably do not pose a threat to visitor safety, unless they fall to the ground where they can be reached. If the bats are regarded as a nuisance, then closing the shutters so that they are several inches away from the wall may encourage the bats to move because they would be more exposed to the elements and possible predation (Appendix E).

Johnstown Flood National Memorial

Although JOFL had the highest species evenness among the four inventoried ERMN park units, it had the lowest species diversity because we captured only three species there. Mist netting opportunities were difficult to locate at JOFL. There was no forested corridor in which to mist net at the South Fork of the Little Conemaugh River, which is affected by acid mine drainage (K. Penrod, Natural Resource Manager, National Park Service, pers. comm., April 2005). Riparian corridors typically are excellent areas to mist net for bats because they provide water sources and protected foraging areas (Grindal et al. 1999; Owen et al. 2004). Acoustic monitoring indicated

that there was high bat activity over the early succession habitat that was at one time Lake Conemaugh.

Big brown bats, little brown myotis, northern myotis, and eastern red bats are probably the most abundant bats at JOFL. Although we did not capture any eastern red bats, they were commonly detected during acoustic monitoring. We documented reproductively active females of all captured species at JOFL, indicating that maternity colonies may exist within the park, probably in the forest tract at the picnic area. Similar to other ERMN park units in our inventory, hoary bats and eastern pipistrelles were infrequently detected at JOFL.

Species Diversity, Evenness, and Richness

Simpson's diversity index for the bat community in the four inventoried ERMN park units (0.711), overall, was similar, but slightly lower than, bat communities inventoried at National Capital Region Network (NCRN) national parks (0.730; Gates and Johnson 2005), New River Gorge National River (0.731; Castleberry et al. 2006), the MeadWestvaco Wildlife and Ecosystem Research Forest and Monongahela National Forest in West Virginia (0.782, Edwards et al. 2001), and Savannah River Site, South Carolina (0.727; Menzel et al. 2003b). Simpson's diversity index for a bat community in eastern Mississippi was 0.640 (Miller 2003) and 0.638 at the Chickamauga and Chattanooga National Military Park in Georgia (Ford et al. 2004). In all cases except Mississippi and NCR national parks, bat species richness was higher (seven to 10 species) compared to the four inventoried ERMN park units. This fact indicates that species evenness at the inventoried ERMN park units is comparable, if not higher, than some other areas in the southeastern United States. Indeed, the inventoried ERMN park units had a species evenness of 0.687, which was higher than any of the aforementioned studies (≤0.614). The broad range of habitats (i.e., roosting and foraging opportunities) within the inventoried ERMN park units likely contributed to the relatively high bat species diversity (Humphrey 1975).

Rarefaction

The minimum number of captured bats, mist net sites, and acoustic monitoring sites needed to record all bat species within each park probably depends on species evenness, abundance, and distribution. Rarefaction presented unrealistic minimum sampling effort recommendations for four inventoried ERMN park units. Theoretically, we would need to capture 232 bats before recording a sixth species, likely the eastern pipistrelle. This requirement of such a large number of captured bats is due to no eastern pipistrelle captures at ALPO and JOFL. Eastern pipistrelles were the 36th and 50th bat captured at FRHI and FONE, respectively. Theoretically, we would need to capture 18 bats to document the fourth species, the eastern red bat, which was captured at all parks except JOFL. Rarefaction was unable to estimate how much sampling effort would be required to document additional species at the parks (e.g., Indiana myotis) because the method requires at least one capture of each species to calculate an estimate (Krebs 1999).

Mist net sites are established within home ranges of an unknown number of bats and bat species. Potentially, few of the bats with home ranges encompassing the mist net sites may be captured. Moreover, we may "miss" bats due to temporal aspects of bat ecology (e.g., migration). Identical mist-net sets may capture different species and numbers nightly at the same site (this study; Edwards et al. 2001). In West Virginia, a small pool of water was mist netted for 14

nights over two summers before an Indiana myotis was captured (Edwards et al. 2001). However, seven species commonly detected throughout their inventory were captured by the fifth night of mist netting various streams, pools, and corridors.

Minimum acoustic monitoring effort needed to detect all species varied from park to park, but typically was less than minimum mist net effort. Additionally, multiple sites could be acoustically monitored each night compared to a single site with mist nets. Differences in bat species detection when using acoustic or capture methods are well documented (Kunz and Brock 1975; Murray et al. 1999; O'Farrell and Gannon 1999). In Missouri, significantly more species were detected with acoustic surveys than with mist nets (Murray et al. 1999). O'Farrell and Gannon (1999) found that a combination of acoustic and capture methods was most effective in completely evaluating species compositions in the western United States. Hoary bats are infrequently documented during mist netting in the mid-Atlantic region, but commonly are recorded during acoustic monitoring, possibly because they forage over the forest canopy and thus over mist nets (Shump and Shump 1982b; Gates and Johnson 2005). Northern myotis are difficult to record acoustically because of their low-intensity echolocation call, but are commonly captured in the central Appalachian Mountains (Faure et al. 1993; Gates and Johnson 2005). These behaviors held true in the ERMN park units in our inventory. Some species were detected more frequently with acoustic monitoring than with capture methods, and vice versa. During our bat inventories, acoustic monitoring consistently detected more species per park than mist nets. Acoustic monitoring was much more effective at collecting species data where mist nets were likely inefficient. At JOFL, there were limited mist net opportunities because the park lacks defined, riparian corridors and small pools where mist nets are most effective. We were able to identify all six bat species at the park in one night of acoustic surveys; whereas, it is difficult to say how much mist net effort would have to be expended to identify the same species. This outcome is not to say that acoustic surveys can totally replace mist net surveys. There is a debate over the efficacy of bat detectors to monitor bats low-intensity echolocation calls (e.g., *Myotis* spp.) and over the effect of interspecific overlap of echolocation call characteristics on species identification accuracy (Fenton 1997; Barclay 1999; O'Farrell et al. 1999). Additionally, no techniques currently exist that allow us to reliably obtain age, sex, or reproductive information from echolocation call characteristics.

Horn's Index of Similarity

Throughout the ERMN park units in our inventory, mist netting complemented acoustic monitoring in documenting species occurrence and the relative frequency of those species according to Horn's Index of Similarity. In other words, the proportion of the total number of captured bats comprised by each species was similar to their contributed proportion of the total number of echolocation passes recorded. For example, big brown bats comprised 25.7% of the total capture and 32.2% of echolocation passes recorded, overall. The noticeable difference in the proportion of northern myotis captured (29.1%) and proportion of northern myotis echolocation passes recorded (2.4%) is likely due to its low-amplitude echolocation call, which makes it more difficult to detect acoustically (Faure et al. 1993).

Differences in local scale habitat among parks may influence bat species relative frequencies, although parks were similar, overall. The largest difference in species relative frequencies was between FONE and JOFL, due to the large difference in proportions of big brown bats and

northern myotis captured at each park. Our mist net sets at JOFL were on forest edges, which is the type of habitat in which big brown bats often forage (Ford et al. 2005). At FONE, we were able to situate mist net sets in forested surroundings, which is the type of habitat in which northern myotis often forage (Owen et al. 2003; Ford et al. 2005). There was a smaller difference between the parks when examining acoustic data, as we were able to sample in open and forested areas in both parks.

Conclusions

Through acoustic and capture methods, we were able to positively identify six of the nine bat species that potentially occur at the four inventoried ERMN park units. Although they are all common species, they are, nevertheless, important components of the ecosystem at ERMN park units. The parks provide maternal and foraging habitat for bats during summer. The parks probably also serve as stopover sites for migrant bats; although this remains to be determined. From an inventory standpoint, the silver-haired bat probably would be the only species to be gained from bat inventories conducted during spring and autumn. The only rare or endangered species that potentially could be documented in additional surveys in summer would be the Pennsylvania state-threatened eastern small-footed myotis and the federally endangered Indiana myotis. The park most likely to provide habitat for these species is ALPO. Historic and recent records of both species are within 20 km (12.4 mi) of ALPO. The intensity level of our inventory fell short of minimum Indiana myotis sampling effort guidelines established by the United States Fish and Wildlife Service except for FRHI (USFWS 1999). However, our inventory efforts should have documented either species if they were at least locally abundant and, therefore, a management concern at ALPO. Although they may only occur in low numbers in this park, if at all, habitat should be preserved to promote the presence of these species.

Bat activity at most parks was concentrated at water sources, particularly small ponds. Creation of additional ponds would enhance habitat, not only for bats, but for other wildlife as well, especially at higher elevations where water resources are scarce. Also, water quality improvements to existing water sources, i.e., acid mine drainage remediation, will improve habitat for bats by providing a clean drinking water source and improving emerging aquatic insect abundances, as well.

Although it is unknown if roosting habitat is a limiting resource to bats at the four inventoried ERMN park units, establishing bat houses, particularly if excluding bats from structures, can improve roosting conditions at the parks. Retention of snags, particularly those with exfoliating bark, and live trees with exfoliating bark (e.g., shagbark hickory [*Carya ovata*]), when possible, will improve potential roosting habitat for several bat species, including Indiana myotis.

Additional bat species may be documented at Staple Bend Tunnel during autumn swarming when bats congregate at potential hibernacula and mating sites. At the C&O Canal National Historical Park in Maryland, three bat species, including eastern small-footed myotis and Indiana myotis, were captured at an abandoned railroad tunnel during autumn swarming, that were not captured during summer inventories.

Additional inventory and monitoring of bats at the four ERMN park units that we inventoried should be highly focused on unique habitats, e.g., Staple Bend Tunnel, or certain times of year, e.g., spring and autumn; thus, targeting potential rare and endangered species, and common species not documented in our inventory, as well.

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Appendix A. Bat roosting ecology and management at four Eastern Rivers and Mountains Network park units.

Bats potentially occurring at Eastern Rivers and Mountains Network (ERMN) park units are known to roost in tree canopies and tree cavities, under exfoliating tree bark and deciduous leaf litter, behind shutters and shingles, in buildings, bridges, caves, mines, tunnels, and storm sewers throughout their range (Barbour and Davis 1969). Typically, bats use caves, mines, and tunnels for hibernacula during winter. Bats have been documented using buildings for hibernacula, but it probably is uncommon in the four ERMN park units we inventoried. Big brown bats (*Eptesicus fuscus*) are the most likely of the species potentially occurring at the inventoried ERMN park units to use buildings as hibernacula (Whelden 1941; Barbour and Davis 1969; Whitaker and Gummer 2000).

Potential conflicts exist between bat roosting behavior and park maintenance and visitor safety. Bats roosting in or on buildings potentially can come in contact with park visitors, creating health hazards. The most humane technique for limiting the conflict is to exclude the bats from within the structure. Excluding bats from buildings can be difficult, because bats can gain access though very small holes and cracks (<1.5 cm [0.6 in]). Building access locations can be determined by observing bat emergence at dusk. Buildings should be sealed when bat occupancy is at a minimum (i.e., winter). The majority of bats in a colony disperse by September, but a few individuals may remain into November. Bats typically will return to summer roosts in April (Cagle and Cockrum 1943; Davis and Hitchcock 1965). Lost roosts should be mitigated by placement of bat houses nearby. Bat houses are most successful in attracting bat colonies when placed near lost roosts (Brittingham and Williams 2000; White 2004). Occupancy rates of >60% have been reported for bat houses placed near lost roosts (White 2004). Bat houses placed on trees or distant from existing colonies commonly have low occupancy rates. Mounting dark-colored (e.g., National Park Service brown) bat houses with large landing areas on buildings with solar exposure and existing colonies have high potential for occupancy (White 2004). Bat colonies typically will not voluntarily relocate to a bat house from a building that has not been sealed (Brittingham and Williams 2000). Bat houses are available in a wide variety of shapes and sizes. Small bat houses can be erected when a small number of bats (<100) is displaced. Large bat houses and even bat condos can be used when hundreds or even thousands of bats are displaced. Bat species most likely to occupy bat houses at the four inventoried ERMN park units are the big brown bat and little brown myotis (*Myotis lucifugus*). Other species have been known to use bat houses, including Indiana myotis (*M. sodalis*), northern myotis (*M. septentrionalis*), and silver-haired bats (*Lasionycteris noctivagans*) (Kiser and Kiser 2001; Whitaker et al. 2006). Bats typically show roost fidelity to anthropogenic structures, possibly because of the relative permanency of such roosts. In contrast, roosts that are more ephemeral in nature (e.g., decaying trees) are used for shorter time periods (Lewis 1995).

Dead and dying trees probably are used by several bat species at the four inventoried ERMN park units, but may pose a hazard to visitor safety. Bat species that use cavities, crevices, and sloughing bark of dead and dying trees include big brown bats, silver-haired bats, little brown myotis, northern myotis, and Indiana myotis (Barbour and Davis 1969). Bats using dead and dying trees sometimes switch roost trees as frequently as every few days (Brigham 1991; Lewis 1995). Dead and dying roost trees may be as small as 8.0 cm (3.15 in) diameter at breast height (DBH), but more commonly are about 30 cm (11.8 in) DBH and larger (Menzel et al. 2001b).

Dead and dying trees should be retained, as they are potential roosts for bats and other wildlife species (Morrison et al. 1998). To limit direct impact to roosting bats, dead and dying trees may be felled in winter. Bats likely have evolved to adapt to the ephemeral nature of dead and dying tree roosts.

Foliage-roosting bats commonly switch roosts more often than bats that roost in buildings or dead and dying trees (Lewis 1995). Eastern red bats (*Lasiurus borealis*) and eastern pipistrelles (*Pipistrellus subflavus*) are known to switch roost trees every 1–3 days (Menzel et al. 1998; Hutchinson and Lacki 1999; Mager and Nelson 2001; Veilleux et al. 2003). Eastern red bats and eastern pipistrelles typically roost under live- and dead-leaf clusters in tree canopies. Although little is know about the roosting habits of hoary bats (*Lasiurus cinereus*), they likely exhibit similar roosting behavior (Constantine 1966; Tenaza 1966; Barclay 1989). Similar to dead and dying roost trees, trees that foliage-roosting bats use typically are large diameter, co-dominant and dominant mature trees (Menzel et al. 1998; Hutchinson and Lacki 1999; Mager and Nelson 2001). Assessing individual trees for foliage-roosting bats is difficult because of frequent roost switching and the bats' cryptic coloration (Limpert 2003). It is unlikely that tree trimming as part of routine park maintenance has significant effects on foliage-roosting bat populations at the four inventoried ERMN park units. The probability of encountering foliage-roosting bats probably is low.

Bats are known to primarily hibernate in caves, mines, and tunnels in Pennsylvania (Mohr 1942). At the four inventoried ERMN park units, only one such hibernaculum is present: Staple Bend Tunnel in Allegheny Railroad National Historic Site. Historically, Staple Bend Tunnel was a hibernaculum for a small community (i.e., a few dozen) of big brown bats, little brown myotis, northern myotis, and eastern pipistrelles (C. Butchkoski, Wildlife Biologist, Pennsylvania Game Commission, unpublished data, February 1997). At the time (February 1997), the tunnel entrances had been mostly closed off for decades by a steel company that formerly owned the tunnel (K. Penrod, Natural Resource Manager, National Park Service, pers. comm., 23 January 2007). As a result, the tunnel was a more suitable hibernaculum because the decreased airflow allowed for more stable temperature and humidity regimes. The tunnel was subsequently reopened, which increased airflow through the tunnel and allowed human disturbance also. In winter 2005, a hibernaculum survey was conducted and no bats were observed. The tunnel may have provided a hibernaculum for bats that were summer residents in the park. Few male bats are known to roost in caves, mines, and tunnels during summer. Although we did not observe any bats using Staple Bend Tunnel during our inventory, some may still use it (Hall and Brenner 1968). It is very unlikely that Staple Bend Tunnel has ever been used as a summer maternity roost (Barbour and Davis 1969). However, it is possible that bats use the tunnel as an autumn swarming site, although this remains to be investigated. In late summer and early autumn, bats arrive at cave, mine, and tunnel entrances and exhibit a swarming behavior that is thought to fulfill life history aspects, such as mate selection, breeding, and hibernacula selection (Fenton 1969; Cope and Humphrey 1977; Schowalter 1980). Although bats swarming at entrances may not necessarily use the tunnel as a day roost or hibernaculum, swarming sites provide a valuable location for genetic exchange (Veith et al. 2004). In Canada, Fenton (1969) found that little brown myotis captured at a cave during autumn swarm hibernated at a cave >800 km (497 mi) away, although many hibernated within 160 km (99 mi).

Staple Bend Tunnel is very accessible to park visitors. Human disturbance of hibernacula has been partly responsible for population declines of some endangered bats including Indiana myotis, gray myotis (*Myotis grisescens*), and Virginia big-eared bats (*Corynorhinus townsendii virginianus*) (Harvey et al. 1999; Clawson 2002). Although bats occasionally arouse from hibernation naturally, human disturbance can cause bats to use fat reserves vital for survival through winter (Daan 1973). Gates on hibernacula entrances have been beneficial in protecting endangered bats by reducing or eliminating human disturbance of roosting bats (Tuttle and Taylor 1998). However, improperly designed gates can hinder bat access and movements through a hibernaculum entrance, resulting in abandonment in some cases (White and Seginak 1987; Ludlow and Gore 2000). Improperly designed gates also can make hibernacula unsuitable as roosts by altering airflow, which affects temperature and humidity regimes within (Tuttle 1977; Humphrey 1978; Richter et al. 1993; Tuttle and Kennedy 1999). Some bat species prefer a narrow range of internal temperature and humidity conditions (Tuttle 1979; Raesly and Gates 1987), which are influenced by airflow and physical characteristics of hibernacula including entrance, passage, and room dimensions (Tuttle and Stevenson 1978; Raesly and Gates 1987; Hurst and Lacki 1997). Although small populations of common bat species used Staple Bend Tunnel, the conservation of these marginal roost sites is important nonetheless (Gates et al. 1984). Placement of gates or other structures to eliminate human disturbance and improve the internal climate for bats may attract hibernating bats to the tunnel, but probably this action would be in conflict with historical and cultural resource values, as well as visitor use.

Appendix B. Accounts of bat species potentially occurring at Eastern Rivers and Mountains Network park units, Pennsylvania.

Family Vespertilionidae

All bat species inhabiting or potentially inhabiting the four inventoried Eastern Rivers and Mountains Network (ERMN) park units belong to the Vespertilionidae family. This family contains 42 genera and 355 species on six continents (Nowak 1994). Within the United States, 10 genera and 45 species occur (Harvey et al. 1999). Potentially, up to five genera and nine species occur within the four inventoried ERMN park units.

Big brown bat (*Eptesicus fuscus*)

Morphology—Of the 11 subspecies of big brown bat, one (*E. f. fuscus*) occurs at the four inventoried ERMN park units. Big brown bats are one of the largest bat species that occur in the region. They are dark brown in color, similar to little brown myotis (*Myotis lucifugus*), but are a much larger bat. Weights typically range from 13–25 g, and head to tail lengths range from 10–13 cm (4–5 in) (Kurta and Baker 1990). Longevity records of up to 19 years have been reported (Paradiso and Greenhall 1967).

Range and Migration—The big brown bat is common throughout its range, which includes southern Canada, the continental United States, Central America, and northern South America (Kurta and Baker 1990). Migratory distances typically are <80 km (50 mi) between hibernacula and summer roosts (Griffin 1940; Beer 1955; Mills et al. 1975).

Roosting—Big brown bats typically hibernate in mines (Pearson 1962), caves (Hall and Brenner 1968; Gates et al. 1984), storm sewers (Goehring 1954), tunnels (Gates et al. 1984), and sometimes buildings (Whelden 1941; Whitaker and Gummer 2000). In summer, big brown bats roost in snags, buildings, and caves (Hall and Brenner 1968; Barbour and Davis 1969; Betts 1996). Females form maternity colonies that commonly are located in snags and buildings (Davis et al. 1968; Barbour and Davis 1969), and occasionally in rock crevices (Lausen and Barclay 2002). Big brown bats commonly return to the same structure to form maternity colonies each year, typically in May (Davis et al. 1968; Mills et al. 1975).

Reproduction—Maternity colonies may consist of >100 individuals (Brigham 1991). After a 60-day gestation period, females give birth to 1−2 young each in June. Young become volant at 3−5 weeks of age (Barbour and Davis 1969, Kurta and Baker 1990). Some female young return to their natal roost the next year (Mills et al. 1975).

Foraging—Big brown bats are among the first bats observed at dusk (Kunz 1973). They often are observed foraging around street lights (Furlonger et al. 1987), but they also forage in open areas, forest stands, forested riparian areas, and over waterways (Kurta 1982; Owen et al. 2004).

Big brown bats consume a variety of insects, including: coleopterans (beetles, weevils), dipterans (flies, mosquitoes), hemipterans (true bugs), hymenopterans (flying ants, wasps), lepidopterans (moths), orthopterans (locusts, katydids, crickets, grasshoppers), and tricopterans (caddisflies). The majority of the big brown bat's diet consists of coleopterans, including many agricultural

pests, e.g., spotted cucumber beetles (*Diabrotica undecimpunctata*) (Griffith and Gates 1985; Whitaker 1995; Agosta and Morton 2003; Carter et al. 2003).

Status in Inventoried ERMN Park Units—Big brown bats are common in all four inventoried ERMN park units. Reproductively active females were captured at all parks and juveniles were captured at most parks, indicating that maternity colonies likely exist within all the parks.

Silver-haired bat (*Lasionycteris noctivagans*)

Morphology—The silver-haired bat is the only species in Genus *Lasionycteris*, and it is monotypic. It is a relatively average-sized bat compared to other bat species potentially occurring at the four inventoried ERMN park units. The dorsal fur is mostly black with white or silver tips. Weights range from 8–11 g, and head to tail lengths range from 9–11 cm (3.5–4.3 in) (Kunz 1982).

Range and Migration—The silver-haired bat is considered common throughout the continental United States, southern Canada and Pacific coast to southern Alaska (Kunz 1982). The winter range of the silver-haired bat is the southern half of the continental United States, although some hibernate in the northern United States. In spring, they migrate to the northern United States and Canada (Izor 1979). No studies have focused on migratory distances of silver-haired bats. During migration, silver-haired bats are known to collide with tall structures, including lighthouses (Saunders 1930) and wind turbines (Johnson et al. 2003a).

Roosting—Silver-haired bats have been documented hibernating in caves (Beer 1956; Krutzsch 1966), house basements (Bartsch 1956; Gosling 1977), mines (Pearson 1962), hollow trees (Jackson 1961), and tunnels (Kennedy 2006). Summer and winter roosting colonies are small at <20 individuals (Barbour and Davis 1969). Little is known about specific summer roost characteristics of the silver-haired bat in the mid-Atlantic. The majority of research investigating silver-haired bat summer roosts has been conducted in coniferous forests of the Pacific Northwest and Canada. Silver-haired bats have been documented roosting in abandoned woodpecker holes in Ontario, Saskatchewan, and British Columbia (Vonhof and Barclay 1996; Parsons et al. 1986). Crampton and Barclay (1998) found silver-haired bats roosting in cavities of trees in early stages of decay. In Washington, silver-haired bats have been found roosting under loose bark and in tree cavities (Campbell et al. 1996). In Manitoba, migrating silver-haired bats roosted singly in heavily furrowed bark and splits in tree trunks (Barclay et al. 1988). In West Virginia, Menzel et al. (2000) found a silver-haired bat roosting beneath leaf litter, possibly during its autumn migration.

Reproduction—During summer, females form maternity colonies of 3−16 individuals (Betts 1996). Females give birth to 1−2 young in late June after a 50- to 60-day gestation (Easterla and Watkins 1970; Kunz 1982). The young become volant by late July (Kunz 1971). Males typically occur singly throughout their range during summer (Kunz 1982).

Foraging—Silver-haired bats commonly forage in riparian areas near coniferous and mixed deciduous forests (Jones 1966; Edwards et al. 2001; Owen et al. 2004). The echolocation call structure and wing morphology of silver-haired bats are suited for foraging in the open and in forests (Barclay 1985; Patriquin and Barclay 2003). Silver-haired bats consume a wide variety

of insects. In West Virginia, silver-haired bat diets consisted mainly of lepidopterans, but also dipterans and coleopterans (Carter et al. 2003). Black (1974) considered silver-haired bats a moth-specialist. Other insects that have been consumed by silver-haired bats include tricopterans, neuropterans (dobsonflies, lacewings), and hemipterans (Whitaker 1972; Brack 1983; Warner 1985).

Status in Inventoried ERMN Park Units —Silver-haired bats most likely occur at the four inventoried ERMN park units during spring and autumn migration, but few individuals may occur during summer. It is unlikely, but not impossible, that female silver-haired bats produce or raise offspring at the parks.

Eastern red bat (*Lasiurus borealis*)

Morphology—Of the five subspecies of eastern red bat, only one (*L. b. borealis*) occurs at the four inventoried ERMN park units. It is a medium-sized bat with weights ranging from 10–13 g, and head to tail lengths averaging 11 cm (4.3 in) (Shump and Shump 1982a). It is a rusty orange color with hairs tipped with white, which is particularly evident in females. The dorsal portion of the tail membrane is furred.

Range and Migration—The eastern red bat is considered common throughout its range, which includes the continental United States (except for the Rocky Mountain region), south through Central and South America into Argentina and Chile. Eastern red bats are migratory, traveling to northern latitudes in April−June for summer and to southern latitudes in August−October for winter (Shump and Shump 1982a). They migrate in groups during autumn and sometimes collide with tall structures, including buildings (Terres 1956), lighthouses (Saunders 1930), communications towers (Crawford and Baker 1981), and wind turbines (Johnson et al. 2003a). Eastern red bats have been documented <210 km (130 mi) from land over the Atlantic Ocean during migration (Norton 1930; Carter 1950; Mackiewicz and Backus 1956).

Roosting—During winter, eastern red bats roost under tree foliage, in woodpecker holes (Fassler 1975), or under leaf litter (Moorman et al. 1999). During summer, eastern red bats roost among the foliage of deciduous (McClure 1942; Mager and Nelson 2001) and coniferous trees (Menzel et al. 1998), behind shingles, under leaf litter (Mager and Nelson 2001), and, in rare instances, have been found in caves (Quay and Miller 1955). When roosting among tree foliage, eastern red bats may be 1.5−16.5 m (5−54 ft) above ground (McClure 1942; Menzel et al. 1998; Hutchinson and Lacki 1999; Mager and Nelson 2001). Roost tree switching occurs every 1–3 days (Menzel et al. 1998; Hutchinson and Lacki 1999; Mager and Nelson 2001). Eastern red bats roost in riparian and upland forests (Menzel et al. 1998; Hutchinson and Lacki 1999).

Reproduction—Females roost singly among tree foliage during the maternity season. In June, they give birth to as many as four young, but most commonly 2–3 (Gates and Wolcott 1946; Packard 1956; Stains 1965; LaVal and LaVal 1979). Young become volant in 3–6 weeks (Barbour and Davis 1969).

Foraging—Eastern red bats typically forage within the first two hours after sunset (Kunz 1973) over open areas and wooded streams (Hart et al. 1993; Owen et al. 2004). In Kentucky, eastern

red bats foraged 1.2−7.4 km (0.74−4.6 mi) from roosting sites and had home ranges encompassing 334.0 ha (825 ac) (± 82.1 SE) (Hutchinson and Lacki 1999).

Eastern red bats are considered a moth specialist (Dunning et al. 1992), but they have also been documented consuming coleopterans, dipterans, hemipterans, hymenopterans, orthopterans, and tricopterans (Ross 1961; Carter et al. 2003; Carter et al. 2004). Whitaker et al. (1997) reported red bats consuming lepidopterans and dipterans in winter months in Great Dismal Swamp, North Carolina and Virginia.

Status in Inventoried ERMN Park Units —Eastern red bats are a common bat species within the four inventoried ERMN park units. Reproductively active females were captured at some parks, indicating that the parks are used by this species to produce and raise their young. Eastern red bats probably migrate through ERMN park units in spring and autumn.

Hoary bat (*Lasiurus cinereus*)

Morphology—Of the three subspecies of hoary bat, one (*L. c. cinereus*) occurs at the four inventoried ERMN park units. It is the largest bat occurring in the region with weights ranging from 18–30 g, and head to tail lengths averaging 13 cm (5 in) (Shump and Shump 1982b). Its fur is mahogany brown and tipped with white over most of its body. It has a furred tail membrane.

Range and Migration—The range of the hoary bat includes Canada north to the tree line, the continental United States and Hawaii, south to Argentina and Chile (Shump and Shump 1982b). The hoary bat is considered common in the Pacific Northwest and prairie states, and uncommon in the eastern United States (Shump and Shump 1982b). Hoary bats have been documented in Iceland and far from land over the Atlantic Ocean during migration (Hayman 1959). The hoary bat occurs in the southern United States during winter and throughout the United States during summer. Autumn migration occurs in concentrations of individuals in August−October. Spring migration is less organized in April−June (Findley and Jones 1964). During migration, hoary bats are known to collide with tall structures, including lighthouses (Saunders 1930), communications towers (Crawford and Baker 1981), and wind turbines (Johnson et al. 2003a).

Roosting—Few studies have investigated the roosting habits of hoary bats. Hoary bats have primarily been observed roosting singly in tree foliage 3−5 m (10−16 ft) from the ground (Constantine 1966; Tenaza 1966). In Saskatchewan, hoary bats were observed roosting on white spruce (*Picea glauca*) branches that were facing southeast and about 13 m (42.5 ft) above the ground (Willis and Brigham 2005). Occasionally, hoary bat remains are found in caves (Mumford 1953; Beer 1954). In Georgia, a hoary bat was observed roosting in a squirrel's nest (Neill 1952).

Reproduction—In June, females roost singly under tree foliage and give birth to 1−4 young, averaging two (Bogan 1972; Shump and Shump 1982b). Young become volant at 4−5 weeks of age (Bogan 1972).

Foraging—Hoary bats emerge for foraging subsequent to sympatric bat species (Kunz 1973). Barclay (1989) observed female hoary bats emerging from their roosts 30−45 minutes after sunset. Hoary bat foraging activity is highest after sunset and just before sunrise (Kunz 1973).

Hoary bats forage in riparian areas, uncluttered areas (Owen et al. 2004), forest edges (Furlonger et al. 1987), and over waterways (Hart et al. 1993) and marshes (Barclay 1989). Hoary bats have been tracked foraging up to 20 km (12.4 mi) from their day roosts (Barclay 1989).

The diet of the hoary bat consists primarily of lepidopterans (Black 1972). In West Virginia, lepidopterans comprised 98% of hoary bat diets (Carter et al. 2003). Other insects that hoary bats consume include coleopterans, dipterans, neuropterans, and hymenopterans (Zinn and Baker 1979; Warner 1985).

Status in Inventoried ERMN Park Units —Hoary bats likely migrate through the four inventoried ERMN park units during spring and autumn. A few individuals probably use the parks during summer. It was the least commonly detected species at ERMN park units during our inventory.

Eastern small-footed myotis (*Myotis leibii*)

Morphology—The eastern small-footed myotis is monotypic and is the smallest bat potentially occurring at the four inventoried ERMN park units. Weights range from 3–6 g and head to tail lengths average about 8 cm (3 in) (Best and Jennings 1997). Longevity records of up to nine years have been reported (Cockrum 1956). It is yellowish brown in color and has a distinct black face mask and keeled calcars.

Range and Migration—Eastern small-footed myotis is considered globally rare (G3: either very rare and local throughout its range or distributed locally [even abundantly at some of its locations] in a restricted range [e.g., a single western state, a physiographic region in the East] or because of other factors making it vulnerable to extinction throughout its range; typically with 21 to 100 estimated occurrences). Its range includes northern Arkansas and southern Missouri, east to western South Carolina, north through the Appalachian Mountains and Ohio River basin, and into New England, southern Ontario, and Quebec (Best and Jennings 1997). The Pennsylvania Game Commission lists eastern small-footed myotis as a threatened species. Low over-winter survival rates may be the cause of its relative rarity (Hitchcock et al. 1984). It is ranked S1, S2, or S2S3 in all occupied states/provinces and has possibly been extirpated in Ohio (NatureServe 2006).

Roosting—During winter, eastern small-footed myotis hibernate solitarily in cold portions of mines and caves (Mohr 1932; Martin et al. 1966; Gates et al. 1984; Dalton 1987) where they sometimes may be found in crevices (Davis 1955) and under rock slabs (Davis and Lidicker 1955; Tuttle 1964). They typically are the last species to enter and first to exit hibernation (Barbour and Davis 1969). During summer, eastern small-footed myotis roost solitarily in mines and caves (Hall and Brenner 1968), although a small maternity colony in Ontario was located behind a barn door (Hitchcock 1955). In Maryland, a small maternity colony was located under a rock slab on a ridge top (Gates et al. 1981).

Reproduction—Little is known about maternity roosts or reproduction of eastern small-footed myotis, but they may form maternity colonies as other myotine bats do (Barbour and Davis 1969).

Foraging—Little documentation exists concerning the foraging ecology of eastern small-footed myotis. Individuals have been observed foraging <3 m (10 ft) from the forest floor (van Zyll de

Jong 1985). An analysis of four eastern small-footed myotis in western Maryland found their diets consisted of lepidopterans, coleopterans, dipterans, neuropterans, and hemipterans (McDowell-Griffith 1983). In West Virginia, Johnson and Gates (in review) found that eastern small-footed myotis consumed mostly lepidopterans, but also coleopterans, dipterans, hemipterans, neuropterans, psocopterans (psocids), and hymenopterans.

Status in Inventoried ERMN Park Units—Although we did not document eastern small-footed myotis at any park, there are numerous historical records near Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial (Dunn and Hall 1989). One eastern small-footed myotis hibernaculum is located at Canoe Creek State Park, about 20 km (12.5 mi) northeast of Allegheny Portage Railroad National Historic Site. Within the parks, there are no significant rock outcrops or hibernacula that would be suspected as eastern small-footed myotis roosts.

Little brown myotis (*Myotis lucifugus*)

Morphology—Of the six subspecies of little brown myotis, one (*M. l. lucifugus*) occurs at the four inventoried ERMN park units. Little brown myotis weights range from 4–8 g, and head to tail lengths average 9 cm (3.5 in) (Fenton and Barclay 1980). It is brown in color, and usually has a glossy sheen. Little brown myotis have been documented living ≤30 years (Griffin and Hitchcock 1965; Keen and Hitchkock 1980).

Range and Migration—The little brown myotis is considered common throughout its range, which includes Alaska, east through Canada, all the continental U.S. except for the plains states, and parts of Florida and coastal areas of the southeastern U.S. (Fenton and Barclay 1980). Little brown myotis migrate <272 km (170 mi) (Griffin 1940) between winter and summer ranges. They may form large groups that travel with cold fronts (Zimmerman 1937). There are no distinct latitudes occupied during summer and winter. Little brown myotis occupy northern and southern latitudes in the eastern U.S. year round (Barbour and Davis 1969).

Roosting—Little brown myotis hibernate in mines, road tunnels, and caves (Mohr 1942; Pearson 1962). They form loose aggregations within a hibernaculum, which may contain as many as 100,000 individuals (Barbour and Davis 1969)

In summer, males and females roost in separate locations. Males may occupy caves (Krutzsch 1961; Hall and Brenner 1968), trees, and houses during summer (Fenton and Barclay 1980). Maternity colonies of hundreds to over a thousand individuals are established in barns, attics, and buildings (Cagle and Cockrum 1943; Smith and Goodpaster 1956; Davis et al. 1965). Few studies have documented non-commensal little brown myotis maternity roosts. Barclay and Cash (1985) documented a maternity colony of <25 individuals in a hollow tree.

Reproduction—Gestation lasts 50−60 days before a single young is born in June (Wimsatt 1945; Kunz 1971). The young become volant at three weeks (Anthony and Kunz 1977).

Foraging—Little brown myotis emerge from their day roosts shortly after sunset to begin foraging along clearing edges (Patriquin and Barclay 2003), riparian areas (Owen et al. 2004), streams (Kurta 1982, Barclay 1991), and cluttered forest interiors (Adams 1996).

In Canada, little brown myotis had a mean home range size of 30.1 ± 15.0 ha (74.3 ± 37 ac) when pregnant and 17.6 ± 9.1 ha (43.5 ± 22.5 ac) when lactating (Henry et al. 2002).

The diet of little brown myotis is diverse and includes coleopterans, dipterans, ephemeropterans (mayflies), hemipterans, hymenopterans, lepidopterans, neuropterans, and tricopterans (Buchler 1976; LaVal and LaVal 1980; Warner 1985; Carter et al. 2003)

Status in Inventoried ERMN Park Units—The little brown myotis commonly occurs at all four inventoried ERMN park units. It was frequently encountered at all parks. Moreover, juveniles and reproductively active females were captured at all parks, indicating that little brown myotis produce and raise offspring at the parks.

Northern myotis (*Myotis septentrionalis*)

Morphology—The northern myotis is monotypic. Its weight ranges from 4–8 g, and head to tail length averages 9 cm (3.5 in) (Caceres and Barclay 2000). A longevity record of >18.5 years has been reported (Hall et al. 1957). Northern myotis resemble little brown myotis in size and color, but can be distinguished by their long ears and long, pointed tragus.

Range and Migration—The northern myotis is considered common throughout its range, which includes the eastern half of the continental U.S. and southern Canada (Caceres and Barclay 2000). Migrations of 56 km (35 mi) (Caire et al. 1979; Nagorsen and Brigham 1993) and 88 km (55 mi) have been documented (Griffin 1940).

Roosting—Northern myotis hibernate in caves (Dalton 1987), mines (Pearson 1962), and storm sewers (Goehring 1954), where they are difficult to observe because they roost in tight crevices (Caire et al. 1979; Gates et al. 1984). During summer, males typically roost singly in caves (Hall and Brenner 1968), mines (Johnson et al. 2003b), and tree cavities (Barbour and Davis 1969). Females form maternity colonies in tree cavities, crevices, and under loose bark (Sasse and Pekins 1996; Foster and Kurta 1999). In West Virginia, Menzel et al. (2002c) found that northern myotis maternity colonies preferred roosting in understory black locust (*Robinia pseudoacacia*) and wild black cherry (*Prunus serotina*) snags. In Kentucky, northern myotis maternity colonies roosted in cavities of hardwood trees and under bark of shortleaf pines (*Pinus echinata*) located on mid and upper slopes (Lacki and Schwierjohann 2001).

Reproduction—Females form maternity colonies of 11−65 individuals and give birth to 1−2 young in June (Barbour and Davis 1969; Menzel et al. 2002c). The young become volant at four weeks (Kunz 1971).

Foraging—Northern myotis are able to glean prey off foliage or other substrate and take prey on the wing (Ratcliffe and Dawson 2003). They forage in forested riparian areas (Owen et al. 2004), along forested trails (Broders et al. 2003), in the understory of non-riparian areas (Brack and Whitaker 2001), within diameter-limit harvests and forested road corridors (Owen et al. 2003), and in intact forest stands (Patriquin and Barclay 2003).

In West Virginia, the average home range size of pregnant or lactating females was 65 ha (160 ac) (Owen et al. 2003). Sasse and Pekins (1996) documented an average foraging distance of 602 m (± 66.6, range 60−1719) for northern myotis in New Hampshire.

Northern myotis consume a wide variety of insects. Northern myotis have been documented consuming lepidopterans, coleopterans, tricopterans, dipterans, hymenopterans, hemipterans, ephemeropterans, plecoptera (stoneflies), and neuropterans (LaVal and LaVal 1980; Griffith and Gates 1985; Brack and Whitaker 2001; Carter et al. 2003).

Status in Inventoried ERMN Park Units—The northern myotis commonly occurs at the four inventoried ERMN park units, especially FONE and ALPO, which have intact forests that northern myotis roost and forage in. Reproductively active females were captured at all parks, indicating that northern myotis produce and raise offspring at the parks.

Indiana myotis (*Myotis sodalis*)

Morphology—The Indiana myotis is monotypic. Its weight ranges from 5–11 g, and head to tail lengths range from 8–9 cm (3.1–3.5 in) (Whitaker and Hamilton 1998). It is similar in appearance to the little brown myotis, but can be distinguished by its keeled calcar and short toe hairs. Longevity records of >20 years have been reported (LaVal and LaVal 1980).

Range and Migration—The geographic range of Indiana myotis includes the Midwestern U.S., east to the Appalachian Mountains, through New England (Thomson 1982). Indiana myotis were listed as an endangered species in 1967 under the Endangered Species Act of 1966 because of significant population declines. Currently, Indiana myotis is considered globally rare (G2: Imperiled globally because of some factor that makes it vulnerable to extinction). It is ranked S1 or S2 in all occupied states/provinces and has possibly been extirpated in Massachusetts (NatureServe, http://www.natureserve.org/explorer). Although efforts have been made to protect critical winter hibernacula (i.e., caves and mines), populations have continued to decrease. A 2000−2001 Indiana myotis population survey revealed approximately 382,350 individuals; a 57% population decline since the 1960s (Clawson 2002). Therefore, population declines may be attributable to loss of summer habitat. Conversely, Indiana myotis populations have been stable in Pennsylvania, possibly because of hibernacula protection. In West Virginia, a 2000−2001 hibernacula census revealed an Indiana myotis population estimated at 9,700 individuals, compared to an estimated 1,500 individuals during the 1960s (Clawson 2002). Stable and increasing Indiana myotis populations in Pennsylvania and West Virginia may be attributed to discovery of new hibernacula or protection of known hibernacula. Although hibernacula protection is critical to Indiana myotis population recovery, conservation of summer habitat is equally imperative. Indiana myotis begin to emerge from hibernation in mid-April (Cope and Humphrey 1977) and migrate long distances, sometimes over 500 km (310 mi), to their summer ranges (Kurta and Murray 2002).

Roosting—Indiana myotis hibernate in over 300 caves and abandoned mines in 26 states. Over half the total Indiana myotis population hibernates in seven caves and one mine (Clawson 2002). Indiana myotis form tight clusters (>3,000 individuals/m^2 [10 ft^2]) in hibernation (Clawson et al. 1980). There are 92 Priority II (containing 500−30,000 individuals) and III (containing <500 individuals) Indiana myotis hibernacula in the central and southern Appalachian Mountains from central Pennsylvania to northeastern Alabama (Humphrey 1978; USFWS 1999; Menzel et al. 2001b). One Priority II and several Priority III Indiana myotis hibernacula exist in Pennsylvania (Clawson 2002). Canoe Creek Mine, a Priority II hibernaculum, is located about 20 km (12.4 mi) northeast of Allegheny Portage Railroad National Historic Site. Female Indiana myotis are

known to migrate from Canoe Creek Mine to central Maryland and the Susquehanna River (Butchkoski and Turner 2005). Two Priority III hibernacula exist in Somerset County; one about 45 km (28 mi) east of Fort Necessity National Battlefield (FONE) and one about 45 km (28 mi) northeast of FONE and 50 km (31 mi) southwest of Johnstown Flood National Memorial. Male Indiana myotis sometimes migrate very short distances (<20 km [12 mi]) or use hibernacula as summer roosts (Hobson and Holland 1995; Ford et al. 2002).

During summer, female Indiana myotis form maternity colonies of 20−100 individuals in primary roost trees, which typically are large-diameter (>35 cm [13.75 in]) dead trees with direct exposure to sunlight (Humphrey et al. 1977; Kurta et al. 1993a, b; Callahan et al. 1997; Britzke et al. 2003). Maternity colonies have been documented using live trees with limited exposure to sunlight as alternate or secondary roosts during elevated precipitation or temperature events (Callahan et al. 1997). Many tree species have been used as roost sites by Indiana myotis including red, silver, and sugar maple (*Acer rubrum, A. saccharinum, A. saccharum*), black birch (*Betula lenta*), bitternut, pignut, and shagbark hickory (*Carya cordiformis, C. glabra, C. ovata*), shortleaf, pitch, and Virginia pine (*Pinus echinata, P. rigida, P. virginiana*), cottonwood (*Populus deltoides*), white, black, and green ash (*Fraxinus americana, F. nigra, F. pennsylvanica*), sycamore (*Platanus occidentalis*), white, scarlet, shingle, northern red, and post oak (*Quercus alba, Q. coccinea, Q. imbricaria, Q. rubra, Q. stellata*), eastern hemlock (*Tsuga canadensis*), sassafras (*Sassafras albidum*), and American and slippery elm (*Ulmus americana, U. rubra*) (Humphrey et al. 1977; Brack 1983; Gardner et al. 1991; King 1992; Kurta et al. 1993a, b; Rommé et al. 1995; Caryl and Kurta 1996; Kiser and Elliott 1996; Kurta et al. 1996; Salyers et al. 1996; Callahan et al. 1997; MacGregor et al. 1999; Britzke et al. 2003). This is not a definitive list of Indiana myotis roost trees, as more tree species frequently are being added to the list (MacGregor et al. 1999). Roost trees have been documented in mixed mesophytic and mixed conifer-hardwood forests. In Indiana, Humphrey et al. (1977) and Brack (1983) located roosts in riparian areas. In Illinois, Gardner et al. (1991) documented 37 roosts in uplands and 11 roosts in bottomlands. Callahan et al. (1997) found roosts in Missouri upland and riparian areas. In western North Carolina/eastern Tennessee, Britzke et al. (2003) located roost trees at a mid-slope elevation of 1,158 m (3,799 ft), significantly higher than any previously recorded roost tree. The foraging habits of Indiana myotis in the Appalachian region are not well known. Few cases of Indiana myotis maternity colonies roosting in buildings have been documented. At Canoe Creek State Park in Blair County, Pennsylvania, a maternity colony of <30 Indiana myotis was documented roosting among thousands of little brown myotis in a church attic (Butchkoski and Hassinger 2002).

During autumn swarming, Indiana myotis may not day-roost in caves at which they are captured (Fenton 1969), but are known to day-roost in trees near (<7 km [4 mi]) their hibernacula or autumn swarming sites during summer and autumn (Kiser and Elliott 1996; MacGregor et al. 1999; Ford et al. 2002; Brack 2006). Female Indiana myotis may enter hibernation immediately upon arriving at their hibernacula (Cope and Humphrey 1977).

Reproduction—Female Indiana myotis give birth to one young each in June after a 50−60 day gestation. Young are capable of flight at age 4−5 weeks (Barbour and Davis 1969; Thomson 1982; Butchkoski and Hassinger 2002).

Foraging—Indiana myotis are known to forage in a variety of cover types. In Missouri, LaVal et al. (1977) found that bats foraged under the forest canopy on ridges and hilltops. Similar to Humphrey et al. (1977), LaVal et al. (1977) found that Indiana myotis foraging activity was concentrated 2−30 m (6.5−98 ft) above the forest floor. Indiana myotis also have been documented foraging along riparian areas (Humphrey et al. 1977; LaVal and LaVal 1980; Brack 1983; Ford et al. 2005) and upland forests (LaVal et al. 1977; LaVal and LaVal 1980; Brack 1983). Indiana myotis preferentially foraged in wooded areas rather than developed areas at a rural/urban interface in Indiana (Sparks et al. 2005). In Missouri, Callahan (1993) found Indiana myotis maternity roosts in stands that had been heavily logged within the past 20 years. Gardner et al. (1991) found that Indiana myotis in Illinois foraged in areas that had been logged using selection harvest techniques. In West Virginia, Indiana myotis activity was higher in intact forest cover than in forest gaps (Ford et al. 2005). Radio-tagged bats from the Blair County, PA, maternity colony were documented foraging mostly in a nearby section of intact forest with relatively flat (<10º slope) topography. Although the maternity roost site was located within known foraging distances of Lock Mountain (elevation 580 m [1,902 ft]), no bats were documented foraging on the slope or ridgetop (Butchkoski and Hassinger 2002). In Illinois, Indiana myotis had home ranges that averaged 144.7 ha (357.5 ac [±18.4 ha SE {45.5 ac}]) and encompassed forests and riparian habitats (Menzel et al. 2005). Carter (2006) emphasized the importance of maintaining riparian habitats to the conservation of Indiana myotis.

Indiana myotis consume a wide variety of insects, including coleopterans, dipterans, ephemeropterans, hemipterans, hymenopterans, lepidopterans, neuropterans, plecopterans, and tricopterans (Brack and LaVal 1985; Kurta and Whitaker 1998).

Status in Inventoried ERMN Park Units—We did not document any Indiana myotis at the four inventoried ERMN park units. Several parks are within migrating distances of Indiana myotis hibernacula and possibly are in migration routes. However, the few Indiana myotis from Canoe Creek Mine that have been radio-tagged, migrated east or southeast, away from the four inventoried ERMN park units. Habitat conditions exist that are suitable for Indiana myotis, but the species probably either does not occur at the parks, or occurs in such low numbers as to go undetected by our inventory.

Eastern pipistrelle (*Pipistrellus subflavus*)

Morphology—Of the four subspecies of eastern pipistrelle, only one (*P. s. subflavus*) occurs at the four inventoried ERMN park units. It is one of the smallest bats in the region, with weights ranging from 4–8 g, and lengths averaging 8 cm (3.1 in) (Fujita and Kunz 1984). Longevity records of >11 years have been recorded for eastern pipistrelles (Paradiso and Greenhall 1967).

Range and Migration—The eastern pipistrelle is considered common throughout its range, which includes the eastern half of the continental United States, south to the Gulf of Mexico coastline (Fujita and Kunz 1984). Eastern pipistrelles may migrate up to 120 km (74.5 mi), but typically migrate <50 km (31 mi) (Griffin 1940, 1945).

Roosting—During winter, eastern pipistrelles hibernate in storm sewers (Goehring 1954), mines (Pearson 1962; Menzel et al. 1997), and caves (Gates et al. 1984; Briggler and Prather 2003).

They typically are the first bat species to enter and last to leave hibernacula (LaVal and LaVal 1980).

During summer, eastern pipistrelles segregate sexually. Males typically roost solitarily in leaf clusters (Findley 1954), caves (Hall and Brenner 1968), and mines (Johnson et al. 2003b). Females have been documented forming maternity colonies of 11 individuals in a barn (Winchell and Kunz 1993), <29 individuals in barns, pavilions, sheds (Whitaker 1998), and <3 individuals in live- and dead-leaf clusters on broken branches of live trees (Carter et al. 1999; Veilleux et al. 2003). Females have been observed roosting singly in Spanish moss and understory trees (Menzel et al. 1999).

Reproduction—After a 44 day gestation period, females give birth to two young in June or early July (Wimsatt 1945, LaVal and LaVal 1980). The young become volant after 3 weeks (Lane 1946; Hoying 1983).

Foraging—Eastern pipistrelles are among the first bats to emerge at dusk to forage. They forage in forested riparian areas (Owen et al. 2004), over open water, in small forest gaps (Krusic and Neefus 1996), and along forest edges (Davis and Mumford 1962). Few studies have investigated home range size of eastern pipistrelles. A radio-tagged female in Georgia had a home range of 389.2 ha (961.7 ac) and foraged 1,137 m (3,730 ft), on average, from her roost (Krishon et al. 1997). A radio-telemetered female in South Carolina had a home range of 395.5 ha (977.2 ac) (Carter et al. 1999). Eastern pipistrelles have a diverse diet that includes coleopterans, dipterans, hemipterans, hymenopterans, lepidopterans, and tricopterans (Sherman 1939; LaVal and LaVal 1980; Carter et al. 2003).

Status in Inventoried ERMN Park Units—Eastern pipistrelles occur at all four ERMN park units in our inventory. The majority of eastern pipistrelle activity occurred at Friendship Hill National Historic Site (FRHI). Overall, eastern pipistrelle activity was lower than activity of all other documented species, with exception of hoary bats. Still, reproductively active females were documented, which indicates, at least, that FRHI is used as a maternity site.

Appendix C. Bat captures during mist netting at four Eastern Rivers and Mountains Network park units, 2005–2006. Data include mist net locations, Universal Transverse Mercator coordinates, dates, number of mist nets used during each night, times mist nets were opened and closed, ambient air temperature (°C) when mist nets were opened and closed, time each bat was captured, bat species, age (adult/juvenile), sex, reproductive condition, weight (g), forearm length (mm), and mist net height and width (m).

Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
ALPO	A	ALPO18	706832.873	4481679.312	6/21/2005	6	2114	0215	20.0	19.0	2155	EPFU	A	M	non-rep	18.00	47.5	7.8×12.0
	A	ALPO19	706810.200	4481662.340	6/22/2005	6	2114	0215	20.0	19.0	0040	MYSE	A	M	non-rep	8.50	38.5	2.6×6.0
	A	ALPO20	706798.089	4481648.452	6/21/2005	6	2114	0215	20.0	19.0	.	.	.	.	.	.	.	2.6×9.0
	A	ALPO21	706860.535	4481636.462	6/21/2005	6	2114	0215	20.0	19.0	.	.	.	.	.	.	.	2.6×12.0
	A	ALPO21	706860.535	4481636.462	7/5/2006	6	2050	2350	19.0	14.0	.	.	.	.	.	.	.	2.6×9.0
	A	ALPO20	706798.089	4481648.452	7/5/2006	6	2050	2350	19.0	14.0	.	.	.	.	.	.	.	2.6×9.0
	A	ALPO19	706810.200	4481662.340	7/5/2006	6	2050	2350	19.0	14.0	.	.	.	.	.	.	.	2.6×6.0
	A	ALPO18	706832.873	4481679.312	7/5/2006	6	2050	2350	19.0	14.0	.	.	.	.	.	.	.	7.8×12.0
	B	ALPO22	712959.755	4477487.142	6/22/2005	7	2100	0200	22.0	12.5	2120	MYLU	A	F	lactating	7.25	36.0	2.6×6.0
	B	ALPO22	712959.755	4477487.142	6/22/2005	7	2100	0200	22.0	12.5	2215	MYSE	A	F	non-rep	7.25	38.0	2.6×6.0
	B	ALPO22	712959.755	4477487.142	6/22/2005	7	2100	0200	22.0	12.5	2235	MYLU	A	F	lactating	8.75	39.0	2.6×6.0
	B	ALPO22	712959.755	4477487.142	6/23/2005	7	2100	0200	22.0	12.5	0025	MYLU	A	F	lactating	7.75	37.0	2.6×6.0
	B	ALPO23	712955.848	4477495.017	6/22/2005	7	2100	0200	22.0	12.5	2145	MYLU	A	F	lactating	8.50	37.5	7.8×12.0
	B	ALPO24	712943.125	4477507.140	6/22/2005	7	2100	0200	22.0	12.5	2155	EPFU	A	F	pregnant	25.50	47.0	2.6×6.0
	B	ALPO24	712943.125	4477507.140	6/22/2005	7	2100	0200	22.0	12.5	2215	MYLU	A	F	pregnant	10.50	38.5	2.6×6.0
	B	ALPO25	712936.660	4477512.517	6/23/2005	7	2100	0200	22.0	12.5	0200	MYSE	A	F	non-rep	7.00	36.5	2.6×12.0
	B	ALPO26	712922.967	4477535.052	6/22/2005	7	2100	0200	22.0	12.5	.	.	.	.	.	.	.	2.6×6.0
	B	ALPO22	712959.755	4477487.142	7/10/2006	7	2050	0150	22.0	18.0	2124	MYLU	A	M	non-rep	7.50	38.0	2.6×6.0
	B	ALPO22	712959.755	4477487.142	7/10/2006	7	2050	0150	22.0	18.0	2126	MYLU	A	F	post-lact	8.00	36.0	2.6×6.0
	B	ALPO23	712955.848	4477495.017	7/10/2006	7	2050	0150	22.0	18.0	.	.	.	.	.	.	.	7.8×12.0
	B	ALPO24	712943.125	4477507.140	7/10/2006	7	2050	0150	22.0	18.0	.	.	.	.	.	.	.	2.6×6.0
	B	ALPO25	712936.660	4477512.517	7/10/2006	7	2050	0150	22.0	18.0	.	.	.	.	.	.	.	2.6×12.0
	B	ALPO27	712927.077	4477512.048	7/10/2006	7	2050	0150	22.0	18.0	2215	MYLU	J	M	non-rep	6.75	38.0	2.6×12.0
	B	ALPO22	712959.755	4477487.142	7/22/2006	8	2050	0150	23.0	20.0	0020	MYSE	J	M	non-rep	5.25	33.0	2.6×6.0
	B	ALPO22	712959.755	4477487.142	7/22/2006	8	2050	0150	23.0	20.0	0045	MYLU	J	F	non-rep	6.50	36.5	2.6×6.0
	B	ALPO22	712959.755	4477487.142	7/22/2006	8	2050	0150	23.0	20.0	0045	LABO	A	M	non-rep	10.50	38.0	2.6×6.0
	B	ALPO28	712966.466	4477500.587	7/21/2006	8	2050	0150	23.0	20.0	2050	MYLU	J	F	non-rep	6.50	40.0	2.6×9.0
	B	ALPO23	712955.848	4477495.017	7/21/2006	8	2050	0150	23.0	20.0	2240	MYLU	A	M	non-rep	7.00	36.0	7.8×12.0
	B	ALPO23	712955.848	4477495.017	7/22/2006	8	2050	0150	23.0	20.0	0055	MYLU	A	M	non-rep	7.50	39.0	7.8×12.0
	B	ALPO25	712936.660	4477512.517	7/22/2006	8	2050	0150	23.0	20.0	0015	EPFU	A	M	yes	18.00	46.0	2.6×9.0
	B	ALPO24	712943.125	4477507.140	7/22/2006	8	2050	0150	23.0	20.0	0110	MYLU	J	F	non-rep	6.00	37.0	2.6×6.0
	B	ALPO27	712927.077	4477512.048	7/21/2006	8	2050	0150	23.0	20.0	2120	MYSE	J	M	non-rep	6.25	35.0	2.6×12.0
	C	ALPO29	707317.500	4481640.365	6/23/2005	6	2105	0205	22.0	17.0	2300	MYSE	A	M	non-rep	6.00	34.0	2.6×9.0
	C	ALPO30	707285.078	4481677.628	6/23/2005	6	2105	0205	22.0	17.0	2104	EPFU	A	M	non-rep	16.00	45.5	7.8×9.0
	C	ALPO30	707285.078	4481677.628	6/24/2005	6	2105	0205	22.0	17.0	0032	MYLU	A	M	non-rep	7.75	37.0	7.8×9.0
	C	ALPO31	707247.745	4481711.057	6/23/2005	6	2105	0205	22.0	17.0	.	.	.	.	.	.	.	2.6×6.0
	C	ALPO32	707210.000	4481718.435	6/23/2005	6	2105	0205	22.0	17.0	2347	MYLU	A	M	non-rep	8.00	38.5	2.6×6.0
	C	ALPO29	707317.500	4481640.365	7/19/2006	7	2115	0200	24.0	21.0	2325	MYLU	A	M	non-rep	7.00	37.0	2.6×6.0
	C	ALPO29	707317.500	4481640.365	7/20/2006	7	2115	0200	24.0	21.0	0015	MYLU	A	M	non-rep	8.50	36.0	2.6×6.0
	C	ALPO29	707317.500	4481640.365	7/20/2006	7	2115	0200	24.0	21.0	0055	MYLU	J	F	non-rep	7.25	38.0	2.6×6.0
	C	ALPO29	707317.500	4481640.365	7/20/2006	7	2115	0200	24.0	21.0	0050	MYLU	A	F	post-lact	8.00	36.0	2.6×6.0
	C	ALPO30	707285.078	4481677.628	7/20/2006	7	2115	0200	24.0	21.0	0115	MYLU	A	M	non-rep	7.50	36.0	7.8×9.0
	C	ALPO31	707247.745	4481711.057	7/19/2006	7	2115	0200	24.0	21.0	.	.	.	.	.	.	.	2.6×9.0

Appendix C. Bat captures during mist netting at four Eastern Rivers and Mountains Network park units, 2005–2006. Data include mist net locations, Universal Transverse Mercator coordinates, dates, number of mist nets used during each night, times mist nets were opened and closed, ambient air temperature (°C) when mist nets were opened and closed, time each bat was captured, bat species, age (adult/juvenile), sex, reproductive condition, weight (g), forearm length (mm), and mist net height and width (m) (continued).

Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
ALPO	C	ALPO33	707214.091	4481756.667	7/19/2006	7	2115	0200	24.0	21.0	2145	MYLU	A	M	non-rep	7.50	37.0	2.6×6.0
	C	ALPO33	707214.091	4481756.667	7/19/2006	7	2115	0200	24.0	21.0	2145	MYSE	A	F	post-lact	6.50	34.0	2.6×6.0
	C	ALPO32	707210.000	4481718.435	7/19/2006	7	2115	0200	24.0	21.0	2145	MYSE	A	F	post-lact	6.50	35.0	2.6×6.0
	D	ALPO34	710986.822	4478514.850	6/24/2005	5	2108	0210	23.5	18.0	2154	EPFU	A	M	non-rep	17.50	46.0	2.6×12.0
	D	ALPO34	710986.822	4478514.850	6/24/2005	5	2108	0210	23.5	18.0	2215	MYLU	A	F	lactating	8.00	37.0	2.6×12.0
	D	ALPO34	710986.822	4478514.850	6/24/2005	5	2108	0210	23.5	18.0	2233	MYSE	A	F	lactating	8.50	36.5	2.6×12.0
	D	ALPO34	710986.822	4478514.850	6/24/2005	5	2108	0210	23.5	18.0	2235	EPFU	A	M	yes	17.00	45.5	2.6×12.0
	D	ALPO34	710986.822	4478514.850	6/24/2005	5	2108	0210	23.5	18.0	2255	MYLU	A	F	lactating	8.50	37.0	2.6×12.0
	D	ALPO34	710986.822	4478514.850	6/24/2005	5	2108	0210	23.5	18.0	2255	MYSE	A	M	non-rep	6.50	37.0	2.6×12.0
	D	ALPO34	710986.822	4478514.850	6/25/2005	5	2108	0210	23.5	18.0	0030	MYSE	A	F	lactating	8.00	36.0	2.6×12.0
	D	ALPO34	710986.822	4478514.850	6/25/2005	5	2108	0210	23.5	18.0	0100	EPFU	A	M	yes	18.00	45.5	2.6×12.0
	D	ALPO35	711035.481	4478507.218	6/24/2005	5	2108	0210	23.5	18.0	2215	EPFU	A	M	non-rep	15.00	47.0	7.8×12.0
	D	ALPO35	711035.481	4478507.218	6/24/2005	5	2108	0210	23.5	18.0	2250	MYSE	A	F	lactating	8.25	37.5	7.8×12.0
	D	ALPO35	711035.481	4478507.218	6/25/2005	5	2108	0210	23.5	18.0	0045	MYSE	A	F	lactating	7.50	36.0	7.8×12.0
	D	ALPO35	711035.481	4478507.218	6/25/2005	5	2108	0210	23.5	18.0	0057	MYLU	A	F	pregnant	11.50	39.5	7.8×12.0
	D	ALPO36	711072.033	4478499.145	6/24/2005	5	2108	0210	23.5	18.0	2155	MYSE	A	M	non-rep	6.25	36.0	2.6×12.0
	D	ALPO36	711072.033	4478499.145	6/24/2005	5	2108	0210	23.5	18.0	2230	MYLU	A	F	lactating	7.50	36.0	2.6×12.0
	D	ALPO36	711072.033	4478499.145	6/24/2005	5	2108	0210	23.5	18.0	2330	MYLU	A	M	yes	7.50	36.0	2.6×12.0
	D	ALPO36	711072.033	4478499.145	6/24/2005	5	2108	0210	23.5	18.0	2330	MYLU	A	F	non-rep	8.50	33.0	2.6×12.0
	D	ALPO36	711072.033	4478499.145	6/25/2005	5	2108	0210	23.5	18.0	0001	MYSE	A	F	lactating	7.00	37.0	2.6×12.0
	D	ALPO36	711072.033	4478499.145	6/25/2005	5	2108	0210	23.5	18.0	0015	MYLU	A	F	pregnant	9.00	37.0	2.6×12.0
	D	ALPO36	711072.033	4478499.145	6/25/2005	5	2108	0210	23.5	18.0	0045	MYLU	A	F	pregnant	10.00	40.0	2.6×12.0
	D	ALPO36	711072.033	4478499.145	6/25/2005	5	2108	0210	23.5	18.0	0200	MYLU	A	M	non-rep	7.75	36.0	2.6×12.0
	D	ALPO34	710986.822	4478514.850	6/30/2005	5	2100	0200	22.0	20.0	0105	MYLU	A	M	non-rep	8.00	39.0	2.6×12.0
	D	ALPO35	711035.481	4478507.218	6/30/2005	5	2100	0200	22.0	20.0	0105	MYLU	N/A	N/A	N/A	N/A	N/A	7.8×12.0
	D	ALPO35	711035.481	4478507.218	6/30/2005	5	2100	0200	22.0	20.0	0200	EPFU	A	M	yes	18.00	46.0	7.8×12.0
	D	ALPO36	711072.033	4478499.145	6/29/2005	5	2100	0200	22.0	20.0	2215	EPFU	A	F	lactating	18.50	45.0	2.6×12.0
	D	ALPO36	711072.033	4478499.145	6/30/2005	5	2100	0200	22.0	20.0	0150	MYSE	A	M	non-rep	6.00	36.0	2.6×12.0
	D	ALPO34	710986.822	4478514.850	7/11/2006	5	2100	0200	24.0	21.0	.	.	.	.	.	.	.	2.6×12.0
	D	ALPO35	711035.481	4478507.218	7/11/2006	5	2100	0200	24.0	21.0	2155	EPFU	A	M	non-rep	19.50	45.0	7.8×9.0
	D	ALPO35	711035.481	4478507.218	7/11/2006	5	2100	0200	24.0	21.0	2200	EPFU	A	M	non-rep	17.50	46.0	7.8×9.0
	D	ALPO35	711035.481	4478507.218	7/11/2006	5	2100	0200	24.0	21.0	2155	EPFU	A	M	non-rep	14.50	42.0	7.8×9.0
	D	ALPO35	711035.481	4478507.218	7/11/2006	5	2100	0200	24.0	21.0	2215	EPFU	A	F	post-lact	18.50	45.0	7.8×9.0
	D	ALPO35	711035.481	4478507.218	7/11/2006	5	2100	0200	24.0	21.0	2215	EPFU	A	M	non-rep	15.50	45.0	7.8×9.0
	D	ALPO36	711072.033	4478499.145	7/11/2006	5	2100	0200	24.0	21.0	2215	EPFU	A	M	non-rep	17.50	45.0	2.6×9.0
	E	ALPO37	716090.138	4476936.539	6/27/2005	5	2110	0210	25.0	21.0	.	.	.	.	.	.	.	2.6×9.0
	E	ALPO38	716058.495	4476935.968	6/27/2005	5	2110	0210	25.0	21.0	.	.	.	.	.	.	.	2.6×6.0
	E	ALPO39	715952.663	4476946.918	6/27/2005	5	2110	0210	25.0	21.0	.	.	.	.	.	.	.	2.6×6.0
	E	ALPO40	715929.646	4476997.770	6/27/2005	5	2110	0210	25.0	21.0	2145	MYLU	N/A	N/A	N/A	N/A	N/A	2.6×9.0
	E	ALPO40	715929.646	4476997.770	6/27/2005	5	2110	0210	25.0	21.0	2145	MYLU	A	M	non-rep	6.75	37.0	2.6×9.0
	E	ALPO41	715934.302	4477000.710	6/27/2005	5	2110	0210	25.0	21.0	2145	MYLU	A	F	lactating	8.50	38.0	2.6×6.0
	E	ALPO41	715934.302	4477000.710	6/27/2005	5	2110	0210	25.0	21.0	2145	MYLU	A	F	non-rep	7.50	38.0	2.6×6.0
	E	ALPO41	715934.302	4477000.710	6/27/2005	5	2110	0210	25.0	21.0	2145	MYLU	A	F	lactating	8.00	38.0	2.6×6.0

Appendix C. Bat captures during mist netting at four Eastern Rivers and Mountains Network park units, 2005–2006. Data include mist net locations, Universal Transverse Mercator coordinates, dates, number of mist nets used during each night, times mist nets were opened and closed, ambient air temperature (°C) when mist nets were opened and closed, time each bat was captured, bat species, age (adult/juvenile), sex, reproductive condition, weight (g), forearm length (mm), and mist net height and width (m) (continued).

Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
ALPO	E	ALPO41	715934.302	4477000.710	6/27/2005	5	2110	0210	25.0	21.0	2145	MYLU	A	F	lactating	8.75	39.0	2.6×6.0
	E	ALPO39	715952.663	4476946.918	7/6/2006	5	2050	2350	18.0	13.0	.	.	.	.	.	.	.	2.6×6.0
	E	ALPO42	715907.009	4476954.948	7/6/2006	5	2050	2350	18.0	13.0	.	.	.	.	.	.	.	2.6×6.0
	E	ALPO43	715898.636	4476956.853	7/6/2006	5	2050	2350	18.0	13.0	.	.	.	.	.	.	.	2.6×6.0
	E	ALPO40	715929.646	4476997.770	7/6/2006	5	2050	2350	18.0	13.0	.	.	.	.	.	.	.	2.6×9.0
	E	ALPO41	715934.302	4477000.710	7/6/2006	5	2050	2350	18.0	13.0	2235	MYLU	A	F	non-rep	7.00	37.5	2.6×9.0
	F	ALPO44	682255.956	4470398.154	6/30/2005	3	2100	0200	25.0	20.0	2146	LABO	N/A	N/A	N/A	N/A	N/A	7.8×12.0
	F	ALPO44	682255.956	4470398.154	6/30/2005	3	2100	0200	25.0	20.0	2146	EPFU	A	F	lactating	17.00	44.0	7.8×12.0
	F	ALPO44	682255.956	4470398.154	7/1/2005	3	2100	0200	25.0	20.0	0119	MYLU	A	M	yes	6.75	36.0	7.8×12.0
	F	ALPO44	682255.956	4470398.154	7/1/2005	3	2100	0200	25.0	20.0	0155	LABO	A	M	non-rep	13.50	39.0	7.8×12.0
	G	ALPO45	682312.071	4471320.575	7/1/2005	5	2100	0210	25.0	19.0	2204	LABO	A	M	non-rep	11.00	38.0	2.6×12.0
	G	ALPO46	682303.019	4471285.330	7/1/2005	5	2100	0210	25.0	19.0	2145	EPFU	A	M	yes	16.00	44.5	7.8×9.0
	G	ALPO46	682303.019	4471285.330	7/2/2005	5	2100	0210	25.0	19.0	0038	MYLU	A	F	lactating	8.50	37.0	7.8×9.0
	G	ALPO47	682363.986	4471320.306	7/1/2005	5	2100	0210	25.0	19.0	2225	MYSE	A	M	non-rep	6.50	36.0	2.6×6.0
	G	ALPO46	682303.019	4471285.330	7/12/2006	5	2050	2230	23.0	23.0	2225	EPFU	A	M	non-rep	17.00	43.0	7.8×9.0
	G	ALPO45	682312.071	4471320.575	7/12/2006	5	2050	2230	23.0	23.0	.	.	.	.	.	.	.	2.6×12.0
	G	ALPO47	682363.986	4471320.306	7/12/2006	5	2050	2230	23.0	23.0	.	.	.	.	.	.	.	2.6×6.0
	G	ALPO46	682303.019	4471285.330	7/13/2006	5	2055	0155	24.0	21.0	2230	EPFU	A	M	non-rep	18.50	45.0	7.8×9.0
	G	ALPO46	682303.019	4471285.330	7/13/2006	5	2055	0155	24.0	21.0	2300	MYSE	A	M	non-rep	7.25	36.0	7.8×9.0
	G	ALPO46	682303.019	4471285.330	7/14/2006	5	2055	0155	24.0	21.0	0110	MYLU	A	M	non-rep	7.50	36.5	7.8×9.0
	G	ALPO45	682312.071	4471320.575	7/14/2006	5	2055	0155	24.0	21.0	0030	MYLU	A	M	non-rep	8.00	37.0	2.6×12.0
	G	ALPO47	682363.986	4471320.306	7/13/2006	5	2055	0155	24.0	21.0	.	.	.	.	.	.	.	2.6×6.0
	H	ALPO48	710334.711	4478631.660	7/18/2006	6	2100	0200	24.0	22.0	2340	MYLU	J	F	non-rep	7.50	33.0	2.6×9.0
	H	ALPO49	710359.543	4478624.431	7/18/2006	6	2100	0200	24.0	22.0	2215	EPFU	A	F	lactating	17.50	44.0	7.8×9.0
	H	ALPO49	710359.543	4478624.431	7/18/2006	6	2100	0200	24.0	22.0	2245	EPFU	A	F	lactating	20.50	42.0	7.8×9.0
	H	ALPO49	710359.543	4478624.431	7/19/2006	6	2100	0200	24.0	22.0	0010	LABO	A	M	non-rep	13.00	39.0	7.8×9.0
	H	ALPO50	710380.493	4478623.490	7/18/2006	6	2100	0200	24.0	22.0	2215	MYLU	A	F	non-rep	6.50	38.0	2.6×6.0
	H	ALPO50	710380.493	4478623.490	7/18/2006	6	2100	0200	24.0	22.0	2215	MYLU	A	M	non-rep	7.50	39.0	2.6×6.0
	H	ALPO50	710380.493	4478623.490	7/18/2006	6	2100	0200	24.0	22.0	2215	EPFU	A	F	lactating	21.00	48.0	2.6×6.0
	H	ALPO50	710380.493	4478623.490	7/19/2006	6	2100	0200	24.0	22.0	0130	EPFU	A	F	post-lact	15.75	46.0	2.6×6.0
	H	ALPO51	710414.654	4478617.300	7/18/2006	6	2100	0200	24.0	22.0	2150	MYLU	A	F	non-rep	9.00	39.0	2.6×9.0
	H	ALPO51	710414.654	4478617.300	7/18/2006	6	2100	0200	24.0	22.0	2150	EPFU	A	M	non-rep	15.00	46.0	2.6×9.0
	H	ALPO51	710414.654	4478617.300	7/18/2006	6	2100	0200	24.0	22.0	2310	MYLU	A	M	non-rep	7.00	38.0	2.6×9.0
	I	ALPO52	715061.719	4476629.408	7/20/2006	6	2105	0200	26.5	22.0	2150	EPFU	A	F	post-lact	19.00	46.0	2.6×6.0
	I	ALPO52	715061.719	4476629.408	7/20/2006	6	2105	0200	26.5	22.0	2340	MYLU	A	F	non-rep	8.25	37.0	2.6×6.0
	I	ALPO52	715061.719	4476629.408	7/21/2006	6	2105	0200	26.5	22.0	0030	MYLU	A	M	non-rep	7.50	38.0	2.6×6.0
	I	ALPO52	715061.719	4476629.408	7/21/2006	6	2105	0200	26.5	22.0	0050	MYLU	J	F	non-rep	6.25	36.5	2.6×6.0
	I	ALPO52	715061.719	4476629.408	7/21/2006	6	2105	0200	26.5	22.0	0130	MYLU	A	F	post-lact	7.75	37.0	2.6×6.0
	I	ALPO52	715061.719	4476629.408	7/21/2006	6	2105	0200	26.5	22.0	0150	LABO	A	M	non-rep	11.00	40.0	2.6×6.0
	I	ALPO52	715061.719	4476629.408	7/21/2006	6	2105	0200	26.5	22.0	0200	MYLU	J	F	non-rep	6.75	38.0	2.6×6.0
	I	ALPO52	715061.719	4476629.408	7/21/2006	6	2105	0200	26.5	22.0	0200	MYLU	A	M	non-rep	6.50	32.5	2.6×6.0
	I	ALPO53	715050.573	4476622.045	7/20/2006	6	2105	0200	26.5	22.0	.	.	.	.	.	.	.	2.6×6.0
	I	ALPO54	714998.955	4476632.823	7/20/2006	6	2105	0200	26.5	22.0	2120	EPFU	A	M	non-rep	15.25	45.0	7.8×9.0

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Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
ALPO	I	ALPO54	714998.955	4476632.823	7/20/2006	6	2105	0200	26.5	22.0	2124	MYLU	A	M	non-rep	7.00	38.0	7.8×9.0
	I	ALPO54	714998.955	4476632.823	7/20/2006	6	2105	0200	26.5	22.0	2129	MYLU	A	M	non-rep	7.25	37.0	7.8×9.0
	I	ALPO54	714998.955	4476632.823	7/20/2006	6	2105	0200	26.5	22.0	2155	MYSE	A	F	lactating	7.25	35.0	7.8×9.0
	I	ALPO54	714998.955	4476632.823	7/20/2006	6	2105	0200	26.5	22.0	2305	MYLU	J	F	non-rep	5.50	34.5	7.8×9.0
	I	ALPO54	714998.955	4476632.823	7/21/2006	6	2105	0200	26.5	22.0	0050	MYLU	J	M	non-rep	6.50	36.0	7.8×9.0
	I	ALPO54	714998.955	4476632.823	7/21/2006	6	2105	0200	26.5	22.0	0130	LABO	A	M	non-rep	14.50	43.0	7.8×9.0
	I	ALPO54	714998.955	4476632.823	7/21/2006	6	2105	0200	26.5	22.0	0130	EPFU	J	F	non-rep	15.75	47.0	7.8×9.0
	I	ALPO54	714998.955	4476632.823	7/21/2006	6	2105	0200	26.5	22.0	0130	MYLU	A	F	post-lact	7.50	35.5	7.8×9.0
	I	ALPO55	714948.205	4476655.320	7/20/2006	6	2105	0200	26.5	22.0	.	.	.	.	.	.	.	2.6×9.0
FONE	A	FONE15	620894.216	4407568.924	5/18/2005	5	2030	0130	16.0	11.0	.	.	.	.	.	.	.	2.6×12.0
	A	FONE16	620885.419	4407553.645	5/18/2005	5	2030	0130	16.0	11.0	.	.	.	.	.	.	.	2.6×6.0
	A	FONE18	620886.101	4407547.837	5/18/2005	5	2030	0130	16.0	11.0	2245	MYSE	A	M	non-rep	5.75	35.0	2.6×9.0
	A	FONE18	620886.101	4407547.837	5/18/2005	5	2030	0130	16.0	11.0	2310	MYSE	A	F	non-rep	6.00	36.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/18/2005	5	2030	0130	16.0	11.0	2100	MYSE	A	F	non-rep	6.25	37.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/18/2005	5	2030	0130	16.0	11.0	2110	MYSE	A	F	non-rep	8.50	36.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/18/2005	5	2030	0130	16.0	11.0	2110	MYSE	A	F	non-rep	7.25	34.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/18/2005	5	2030	0130	16.0	11.0	2135	MYSE	A	F	non-rep	5.50	35.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/18/2005	5	2030	0130	16.0	11.0	2147	MYSE	A	M	non-rep	6.00	35.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/18/2005	5	2030	0130	16.0	11.0	2245	MYSE	A	M	non-rep	6.00	36.5	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/18/2005	5	2030	0130	16.0	11.0	2323	MYSE	A	F	non-rep	7.50	36.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/18/2005	5	2030	0130	16.0	11.0	2350	MYSE	A	F	non-rep	5.75	37.0	2.6×9.0
	A	FONE49	620878.532	4407564.520	5/18/2005	5	2030	0130	16.0	11.0	.	.	.	.	.	.	.	2.6×9.0
	A	FONE67	620896.268	4407607.177	5/31/2005	7	2040	0145	18.0	10.0	2100	MYSE	A	M	non-rep	5.50	35.5	2.6×6.0
	A	FONE67	620896.268	4407607.177	5/31/2005	7	2040	0145	18.0	10.0	2100	MYSE	A	F	non-rep	5.50	36.0	2.6×6.0
	A	FONE62	620927.622	4407562.884	5/31/2005	7	2040	0145	18.0	10.0	.	.	.	.	.	.	.	2.6×12.0
	A	FONE67	620896.268	4407607.177	5/31/2005	7	2040	0145	18.0	10.0	.	.	.	.	.	.	.	7.8×12.0
	A	FONE18	620886.101	4407547.837	5/31/2005	7	2040	0145	18.0	10.0	2200	MYSE	A	M	non-rep	4.75	34.0	2.6×9.0
	A	FONE18	620886.101	4407547.837	5/31/2005	7	2040	0145	18.0	10.0	2200	MYSE	A	F	non-rep	7.50	37.0	2.6×9.0
	A	FONE18	620886.101	4407547.837	5/31/2005	7	2040	0145	18.0	10.0	2237	MYSE	A	F	non-rep	7.50	35.0	2.6×9.0
	A	FONE18	620886.101	4407547.837	5/31/2005	7	2040	0145	18.0	10.0	2320	MYSE	A	M	non-rep	6.50	34.5	2.6×9.0
	A	FONE18	620886.101	4407547.837	6/1/2005	7	2040	0145	18.0	10.0	0030	MYSE	A	F	non-rep	8.50	37.0	2.6×9.0
	A	FONE18	620886.101	4407547.837	6/1/2005	7	2040	0145	18.0	10.0	0125	MYSE	A	F	non-rep	6.25	34.5	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/31/2005	7	2040	0145	18.0	10.0	2100	MYSE	A	M	non-rep	6.00	38.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/31/2005	7	2040	0145	18.0	10.0	2100	MYSE	A	F	non-rep	6.50	38.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/31/2005	7	2040	0145	18.0	10.0	2100	MYSE	A	F	non-rep	6.00	37.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/31/2005	7	2040	0145	18.0	10.0	2100	MYSE	A	F	non-rep	8.00	35.5	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/31/2005	7	2040	0145	18.0	10.0	2100	MYSE	A	F	non-rep	7.50	36.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/31/2005	7	2040	0145	18.0	10.0	2100	MYSE	A	F	non-rep	6.50	37.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	5/31/2005	7	2040	0145	18.0	10.0	2220	MYSE	A	M	non-rep	5.75	35.5	2.6×9.0
	A	FONE19	620868.451	4407547.243	6/1/2005	7	2040	0145	18.0	10.0	0130	MYSE	A	M	non-rep	5.25	35.0	2.6×9.0
	A	FONE47	620644.227	4407634.100	7/25/2006	8	2048	0155	23.0	17.5	.	.	.	.	.	.	.	2.6×9.0
	A	FONE15	620894.216	4407568.924	7/25/2006	8	2048	0155	23.0	17.5	2108	LABO	A	M	yes	10.75	38.5	7.8×9.0
	A	FONE15	620894.216	4407568.924	7/25/2006	8	2048	0155	23.0	17.5	2122	EPFU	A	M	yes	18.00	48.0	7.8×9.0

Appendix C. Bat captures during mist netting at four Eastern Rivers and Mountains Network park units, 2005–2006. Data include mist net locations, Universal Transverse Mercator coordinates, dates, number of mist nets used during each night, times mist nets were opened and closed, ambient air temperature (°C) when mist nets were opened and closed, time each bat was captured, bat species, age (adult/juvenile), sex, reproductive condition, weight (g), forearm length (mm), and mist net height and width (m) (continued).

Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
FONE	A	FONE15	620894.216	4407568.924	7/25/2006	8	2048	0155	23.0	17.5	2135	LABO	J	F	non-rep	8.25	41.0	7.8×9.0
	A	FONE15	620894.216	4407568.924	7/25/2006	8	2048	0155	23.0	17.5	2126	MYLU	A	M	yes	9.00	38.0	7.8×9.0
	A	FONE16	620885.419	4407553.645	7/25/2006	8	2048	0155	23.0	17.5	2103	MYLU	A	M	non-rep	6.00	34.0	2.6×6.0
	A	FONE17	620877.904	4407556.340	7/25/2006	8	2048	0155	23.0	17.5	2154	MYSE	J	M	non-rep	7.25	36.0	2.6×12.0
	A	FONE17	620877.904	4407556.340	7/25/2006	8	2048	0155	23.0	17.5	2320	MYLU	A	M	yes	7.75	37.0	2.6×12.0
	A	FONE17	620877.904	4407556.340	7/25/2006	8	2048	0155	23.0	17.5	2345	MYLU	A	M	non-rep	8.00	38.0	2.6×12.0
	A	FONE17	620877.904	4407556.340	7/25/2006	8	2048	0155	23.0	17.5	2345	MYSE	J	F	non-rep	6.00	36.0	2.6×12.0
	A	FONE17	620877.904	4407556.340	7/25/2006	8	2048	0155	23.0	17.5	2350	LABO	.	.	.	.	.	2.6×12.0
	A	FONE17	620877.904	4407556.340	7/26/2006	8	2048	0155	23.0	17.5	0115	LABO	A	F	post-lact	14.00	42.0	2.6×12.0
	A	FONE18	620886.101	4407547.837	7/25/2006	8	2048	0155	23.0	17.5	2220	MYLU	A	M	non-rep	8.50	36.0	2.6×6.0
	A	FONE18	620886.101	4407547.837	7/25/2006	8	2048	0155	23.0	17.5	2350	MYLU	A	M	non-rep	7.00	37.5	2.6×6.0
	A	FONE18	620886.101	4407547.837	7/25/2006	8	2048	0155	23.0	17.5	2350	PISU	A	M	non-rep	6.00	34.0	2.6×6.0
	A	FONE19	620868.451	4407547.243	7/25/2006	8	2048	0155	23.0	17.5	2112	MYSE	A	F	post-lact	.	35.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	7/25/2006	8	2048	0155	23.0	17.5	2122	MYSE	A	F	post-lact	7.50	37.5	2.6×9.0
	A	FONE19	620868.451	4407547.243	7/25/2006	8	2048	0155	23.0	17.5	2122	MYSE	A	F	non-rep	6.75	36.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	7/25/2006	8	2048	0155	23.0	17.5	2122	MYSE	A	F	post-lact	7.50	37.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	7/25/2006	8	2048	0155	23.0	17.5	2345	MYLU	A	M	non-rep	8.50	38.0	2.6×9.0
	A	FONE15	620894.216	4407568.924	8/7/2006	7	2035	0135	25.0	23.5	2250	MYSE	A	M	non-rep	7.50	36.0	7.8×9.0
	A	FONE16	620885.419	4407553.645	8/7/2006	7	2035	0135	25.0	23.5	2135	MYLU	A	M	yes	8.50	36.0	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/7/2006	7	2035	0135	25.0	23.5	2155	MYSE	J	F	non-rep	6.50	38.0	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/7/2006	7	2035	0135	25.0	23.5	2205	MYSE	J	M	non-rep	6.00	36.0	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/7/2006	7	2035	0135	25.0	23.5	2220	MYLU	A	M	yes	8.00	37.0	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/7/2006	7	2035	0135	25.0	23.5	2300	MYLU	A	M	non-rep	7.00	37.0	2.6×9.0
	A	FONE17	620877.904	4407556.340	8/7/2006	7	2035	0135	25.0	23.5	2138	PISU	A	M	non-rep	7.50	35.0	2.6×12.0
	A	FONE18	620886.101	4407547.837	8/7/2006	7	2035	0135	25.0	23.5	2320	MYSE	A	F	post-lact	8.25	37.0	2.6×6.0
	A	FONE18	620886.101	4407547.837	8/8/2006	7	2035	0135	25.0	23.5	0005	MYLU	A	M	yes	7.50	38.0	2.6×6.0
	A	FONE19	620868.451	4407547.243	8/7/2006	7	2035	0135	25.0	23.5	2120	MYSE	J	F	non-rep	5.75	35.5	2.6×9.0
	A	FONE19	620868.451	4407547.243	8/7/2006	7	2035	0135	25.0	23.5	2155	MYSE	J	F	non-rep	6.00	36.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	8/7/2006	7	2035	0135	25.0	23.5	2220	MYSE	A	M	non-rep	6.25	36.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	8/7/2006	7	2035	0135	25.0	23.5	2245	MYSE	A	M	non-rep	6.00	35.0	2.6×9.0
	A	FONE15	620894.216	4407568.924	8/9/2006	7	2040	0140	20.0	15.0	2120	MYLU	A	M	non-rep	7.25	39.0	7.8×9.0
	A	FONE16	620885.419	4407553.645	8/9/2006	7	2040	0140	20.0	15.0	2115	MYLU	A	M	yes	7.50	38.0	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/9/2006	7	2040	0140	20.0	15.0	2135	MYSE	A	M	yes	6.00	37.0	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/9/2006	7	2040	0140	20.0	15.0	2135	MYSE	.	.	.	.	.	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/9/2006	7	2040	0140	20.0	15.0	2135	MYLU	A	M	yes	8.00	37.0	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/9/2006	7	2040	0140	20.0	15.0	2135	MYLU	J	M	yes	6.50	37.5	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/10/2006	7	2040	0140	20.0	15.0	0005	MYLU	A	M	non-rep	6.25	35.0	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/10/2006	7	2040	0140	20.0	15.0	0100	MYSE	A	M	non-rep	6.00	36.5	2.6×9.0
	A	FONE16	620885.419	4407553.645	8/10/2006	7	2040	0140	20.0	15.0	0115	LABO	A	M	non-rep	10.50	41.0	2.6×9.0
	A	FONE17	620877.904	4407556.340	8/9/2006	7	2040	0140	20.0	15.0	2340	MYLU	A	F	post-lact	7.50	37.0	2.6×12.0
	A	FONE18	620886.101	4407547.837	8/9/2006	7	2040	0140	20.0	15.0	2220	MYLU	A	M	non-rep	6.75	37.0	2.6×6.0
	A	FONE18	620886.101	4407547.837	8/9/2006	7	2040	0140	20.0	15.0	2340	MYLU	A	F	post-lact	8.00	37.5	2.6×6.0
	A	FONE18	620886.101	4407547.837	8/9/2006	7	2040	0140	20.0	15.0	2340	MYLU	A	M	yes	7.50	37.5	2.6×6.0

Appendix C. Bat captures during mist netting at four Eastern Rivers and Mountains Network park units, 2005–2006. Data include mist net locations, Universal Transverse Mercator coordinates, dates, number of mist nets used during each night, times mist nets were opened and closed, ambient air temperature (°C) when mist nets were opened and closed, time each bat was captured, bat species, age (adult/juvenile), sex, reproductive condition, weight (g), forearm length (mm), and mist net height and width (m) (continued).

Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
FONE	A	FONE18	620886.101	4407547.837	8/9/2006	7	2040	0140	20.0	15.0	2340	MYLU	A	M	yes	7.00	35.0	2.6×6.0
	A	FONE19	620868.451	4407547.243	8/9/2006	7	2040	0140	20.0	15.0	2135	MYSE	A	M	non-rep	6.25	34.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	8/9/2006	7	2040	0140	20.0	15.0	2135	MYSE	A	M	non-rep	6.00	35.5	2.6×9.0
	A	FONE19	620868.451	4407547.243	8/9/2006	7	2040	0140	20.0	15.0	2135	MYSE	J	F	non-rep	6.00	36.5	2.6×9.0
	A	FONE19	620868.451	4407547.243	8/9/2006	7	2040	0140	20.0	15.0	2245	MYSE	A	F	non-rep	6.50	36.0	2.6×9.0
	A	FONE19	620868.451	4407547.243	8/10/2006	7	2040	0140	20.0	15.0	0005	MYSE	A	F	non-rep	8.00	35.5	2.6×9.0
	A	FONE19	620868.451	4407547.243	8/10/2006	7	2040	0140	20.0	15.0	0025	MYSE	A	F	post-lact	7.00	37.5	2.6×9.0
	A	FONE19	620868.451	4407547.243	8/10/2006	7	2040	0140	20.0	15.0	0033	MYSE	A	F	post-lact	7.50	37.5	2.6×9.0
	A	FONE15	620894.216	4407568.924	8/11/2006	7	2035	0135	16.0	11.0	2345	MYLU	A	M	yes	7.25	37.5	7.8×9.0
	A	FONE16	620885.419	4407553.645	8/11/2006	7	2035	0135	16.0	11.0	.	.	.	.	.	.	.	2.6×9.0
	A	FONE17	620877.904	4407556.340	8/11/2006	7	2035	0135	16.0	11.0	2115	EPFU	A	M	yes	14.00	45.0	2.6×12.0
	A	FONE17	620877.904	4407556.340	8/11/2006	7	2035	0135	16.0	11.0	2200	LABO	A	M	yes	10.50	40.0	2.6×12.0
	A	FONE18	620886.101	4407547.837	8/11/2006	7	2035	0135	16.0	11.0	.	.	.	.	.	.	.	2.6×6.0
	A	FONE19	620868.451	4407547.243	8/11/2006	7	2035	0135	16.0	11.0	.	.	.	.	.	.	.	2.6×9.0
	B	FONE50	620009.505	4407788.422	5/20/2005	6	2030	0100	12.0	7.0	.	.	.	.	.	.	.	2.6×9.0
	B	FONE51	619893.423	4407759.367	5/20/2005	6	2030	0100	12.0	7.0	.	.	.	.	.	.	.	2.6×6.0
	B	FONE52	619951.832	4407706.129	5/20/2005	6	2030	0100	12.0	7.0	.	.	.	.	.	.	.	7.8×9.0
	B	FONE53	619956.158	4407678.957	5/20/2005	6	2030	0100	12.0	7.0	2140	MYSE	A	F	non-rep	7.50	36.0	2.6×12.0
	C	FONE54	620875.254	4408396.529	5/25/2005	5	2100	0200	14.0	9.0	.	.	.	.	.	.	.	2.6×12.0
	C	FONE55	620891.450	4408374.770	5/25/2005	5	2100	0200	14.0	9.0	.	.	.	.	.	.	.	7.8×12.0
	C	FONE56	620896.654	4408345.595	5/25/2005	5	2100	0200	14.0	9.0	.	.	.	.	.	.	.	2.6×12.0
	D	FONE57	620536.165	4407633.948	5/26/2005	3	2050	0150	21.0	14.0	.	.	.	.	.	.	.	7.8×6.0
	E	FONE58	619709.800	4410156.116	5/27/2005	5	2045	0130	20.0	11.0	.	.	.	.	.	.	.	7.8×9.0
	E	FONE60	619709.620	4410181.590	5/27/2005	5	2045	0130	20.0	11.0	.	.	.	.	.	.	.	2.6×12.0
	E	FONE59	619696.051	4410166.098	5/27/2005	5	2045	0130	20.0	11.0	.	.	.	.	.	.	.	2.6×12.0
	F	FONE63	616170.136	4415278.550	6/1/2005	5	2050	0150	18.0	14.0	.	.	.	.	.	.	.	2.6×6.0
	F	FONE64	616165.514	4415290.877	6/1/2005	5	2050	0150	18.0	14.0	2140	MYSE	A	F	non-rep	4.50	37.5	7.8×9.0
	F	FONE64	616165.514	4415290.877	6/1/2005	5	2050	0150	18.0	14.0	2140	EPFU	A	M	non-rep	15.25	43.5	7.8×9.0
	F	FONE65	616121.915	4415293.961	6/1/2005	5	2050	0150	18.0	14.0	.	.	.	.	.	.	.	2.6×6.0
	F	FONE20	616113.154	4415295.953	7/26/2006	5	2055	0200	24.0	23.0	.	.	.	.	.	.	.	2.6×6.0
	F	FONE21	616121.294	4415285.999	7/26/2006	5	2055	0200	24.0	23.0	2110	EPFU	A	M	yes	14.50	43.0	7.8×9.0
	F	FONE21	616121.294	4415285.999	7/26/2006	5	2055	0200	24.0	23.0	2130	LABO	A	M	yes	12.00	37.0	7.8×9.0
	F	FONE22	616127.036	4415286.209	7/26/2006	5	2055	0200	24.0	23.0	.	.	.	.	.	.	.	2.6×6.0
	G	FONE39	620477.474	4407577.298	6/2/2005	5	2045	0145	15.0	14.0	2330	MYSE	A	F	pregnant	8.00	37.0	2.6×9.0
	G	FONE37	620512.903	4407573.833	6/2/2005	5	2045	0145	15.0	14.0	2110	MYSE	A	F	non-rep	6.50	35.5	7.8×12.0
	G	FONE37	620512.903	4407573.833	6/2/2005	5	2045	0145	15.0	14.0	2110	MYSE	A	F	non-rep	5.50	36.5	7.8×12.0
	G	FONE37	620512.903	4407573.833	6/2/2005	5	2045	0145	15.0	14.0	2110	MYSE	A	F	pregnant	7.50	38.0	7.8×12.0
	G	FONE37	620512.903	4407573.833	6/2/2005	5	2045	0145	15.0	14.0	2330	MYSE	A	F	non-rep	7.50	37.0	7.8×12.0
	G	FONE66	620557.063	4407573.921	6/2/2005	5	2045	0145	15.0	14.0	.	.	.	.	.	.	.	2.6×12.0
	G	FONE39	620477.474	4407577.298	6/3/2005	5	2045	0145	18.0	14.0	.	.	.	.	.	.	.	2.6×9.0
	G	FONE37	620512.903	4407573.833	6/3/2005	5	2045	0145	18.0	14.0	.	.	.	.	.	.	.	7.8×12.0
	G	FONE66	620557.063	4407573.921	6/3/2005	5	2045	0145	18.0	14.0	.	.	.	.	.	.	.	2.6×12.0
	G	FONE66	620557.063	4407573.921	8/4/2006	6	2050	0150	21.5	19.0	2305	MYSE	A	M	non-rep	5.75	36.0	2.6×9.0

Appendix C. Bat captures during mist netting at four Eastern Rivers and Mountains Network park units, 2005–2006. Data include mist net locations, Universal Transverse Mercator coordinates, dates, number of mist nets used during each night, times mist nets were opened and closed, ambient air temperature (°C) when mist nets were opened and closed, time each bat was captured, bat species, age (adult/juvenile), sex, reproductive condition, weight (g), forearm length (mm), and mist net height and width (m) (continued).

Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
FONE	G	FONE66	620557.063	4407573.921	8/5/2006	6	2050	0150	21.5	19.0	0110	MYSE	J	M	non-rep	6.25	36.0	2.6×9.0
	G	FONE66	620557.063	4407573.921	8/5/2006	6	2050	0150	21.5	19.0	0145	MYSE	J	F	non-rep	5.50	36.0	2.6×9.0
	G	FONE37	620512.903	4407573.833	8/4/2006	6	2050	0150	21.5	19.0	.	.	.	.	.	.	.	7.8×12.0
	G	FONE38	620486.227	4407577.000	8/4/2006	6	2050	0150	21.5	19.0	.	.	.	.	.	.	.	2.6×9.0
	G	FONE39	620477.474	4407577.298	8/4/2006	6	2050	0150	21.5	19.0	2113	MYSE	J	M	non-rep	5.25	34.0	2.6×9.0
	H	FONE23	620967.201	4408128.097	7/27/2006	6	2100	0200	23.0	22.0	.	.	.	.	.	.	.	2.6×9.0
	H	FONE24	620921.725	4408144.481	7/27/2006	6	2100	0200	23.0	22.0	.	.	.	.	.	.	.	7.8×9.0
	H	FONE25	620892.077	4408147.151	7/27/2006	6	2100	0200	23.0	22.0	.	.	.	.	.	.	.	2.6×12.0
	H	FONE26	620869.262	4408157.982	7/27/2006	6	2100	0200	23.0	22.0	.	.	.	.	.	.	.	2.6×6.0
	I	FONE29	620184.418	4407287.565	7/31/2006	6	2045	0145	27.0	22.0	2205	MYLU	A	M	yes	7.50	37.0	5.2×6.0
	I	FONE27	620169.823	4407306.662	7/31/2006	6	2045	0145	27.0	22.0	2105	EPFU	A	M	non-rep	18.00	46.0	7.8×12.0
	I	FONE27	620169.823	4407306.662	7/31/2006	6	2045	0145	27.0	22.0	2122	EPFU	A	F	post-lact	19.50	48.0	7.8×12.0
	I	FONE27	620169.823	4407306.662	7/31/2006	6	2045	0145	27.0	22.0	2205	LABO	A	M	non-rep	13.00	40.0	7.8×12.0
	I	FONE28	620123.625	4407275.306	7/31/2006	6	2045	0145	27.0	22.0	.	.	.	.	.	.	.	2.6×9.0
	J	FONE30	620850.759	4408463.802	8/1/2006	6	2045	0145	26.5	23.0	.	.	.	.	.	.	.	2.6×6.0
	J	FONE31	620849.509	4408448.703	8/1/2006	6	2045	0145	26.5	23.0	2150	LABO	A	M	yes	11.75	39.0	7.8×12.0
	J	FONE31	620849.509	4408448.703	8/1/2006	6	2045	0145	26.5	23.0	2215	EPFU	A	F	post-lact	20.00	47.0	7.8×12.0
	J	FONE31	620849.509	4408448.703	8/1/2006	6	2045	0145	26.5	23.0	2215	EPFU	A	M	yes	17.50	46.5	7.8×12.0
	J	FONE32	620855.020	4408430.580	8/1/2006	6	2045	0145	26.5	23.0	.	.	.	.	.	.	.	2.6×9.0
	J	FONE33	620868.296	4408410.893	8/1/2006	6	2045	0145	26.5	23.0	.	.	.	.	.	.	.	2.6×9.0
	K	FONE34	619769.879	4410109.458	8/2/2006	5	2045	0145	27.0	23.0	.	.	.	.	.	.	.	7.8×9.0
	K	FONE35	619765.068	4410115.851	8/2/2006	5	2045	0145	27.0	23.0	.	.	.	.	.	.	.	2.6×9.0
	K	FONE36	619716.648	4410133.543	8/2/2006	5	2045	0145	27.0	23.0	.	.	.	.	.	.	.	2.6×6.0
	L	FONE40	620012.823	4407491.425	8/8/2006	8	2045	0145	20.0	15.0	.	.	.	.	.	.	.	7.8×9.0
	L	FONE41	620020.810	4407485.628	8/8/2006	8	2045	0145	20.0	15.0	.	.	.	.	.	.	.	5.2×6.0
	L	FONE42	620014.595	4407466.853	8/8/2006	8	2045	0145	20.0	15.0	.	.	.	.	.	.	.	2.6×6.0
	L	FONE43	620079.358	4407431.952	8/8/2006	8	2045	0145	20.0	15.0	.	.	.	.	.	.	.	2.6×6.0
	L	FONE44	620088.173	4407447.510	8/8/2006	8	2045	0145	20.0	15.0	.	.	.	.	.	.	.	2.6×6.0
	M	FONE45	620640.995	4407654.213	8/10/2006	7	2025	0130	24.0	18.0	2025	LABO	A	F	post-lact	13.00	41.0	5.2×6.0
	M	FONE46	620647.496	4407653.819	8/10/2006	7	2025	0130	24.0	18.0	.	.	.	.	.	.	.	7.8×12.0
	M	FONE47	620644.227	4407634.100	8/10/2006	7	2025	0130	24.0	18.0	2040	EPFU	A	M	yes	16.50	44.0	2.6×9.0
	M	FONE48	620641.642	4407626.603	8/10/2006	7	2025	0130	24.0	18.0	.	.	.	.	.	.	.	2.6×9.0
FRHI	A	FRHI16	592027.348	4403459.248	6/7/2005	7	2045	0145	24.0	19.0	2215	MYLU	A	F	pregnant	9.50	38.0	2.6×6.0
	A	FRHI16	592027.348	4403459.248	6/7/2005	7	2045	0145	24.0	19.0	2231	MYLU	A	F	pregnant	9.25	38.0	2.6×6.0
	A	FRHI16	592027.348	4403459.248	6/8/2005	7	2045	0145	24.0	19.0	0130	MYLU	A	F	non-rep	7.75	36.0	2.6×6.0
	A	FRHI13	591999.513	4403471.881	6/7/2005	7	2045	0145	24.0	19.0	.	.	.	.	.	.	.	2.6×6.0
	A	FRHI14	591994.699	4403438.135	6/7/2005	7	2045	0145	24.0	19.0	.	.	.	.	.	.	.	2.6×12.0
	A	FRHI15	591996.837	4403447.411	6/7/2005	7	2045	0145	24.0	19.0	2130	MYLU	A	F	pregnant	9.50	39.0	7.8×9.0
	A	FRHI15	591996.837	4403447.411	6/8/2005	7	2045	0145	24.0	19.0	0135	MYLU	A	F	pregnant	8.75	37.0	7.8×9.0
	A	FRHI17	591989.898	4403462.531	6/7/2005	7	2045	0145	24.0	19.0	2231	MYLU	A	F	pregnant	8.50	38.0	2.6×9.0
	A	FRHI17	591989.898	4403462.531	6/8/2005	7	2045	0145	24.0	19.0	0115	MYLU	A	M	non-rep	7.50	36.0	2.6×9.0
	A	FRHI14	591994.699	4403438.135	8/15/2006	6	2030	0130	21.0	16.0	.	.	.	.	.	.	.	2.6×12.0
	A	FRHI15	591996.837	4403447.411	8/15/2006	6	2030	0130	21.0	16.0	2145	EPFU	A	F	non-rep	17.00	47.0	7.8×9.0

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Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
FRHI	A	FRHI15	591996.837	4403447.411	8/16/2006	6	2030	0130	21.0	16.0	0040	MYLU	A	F	non-rep	8.00	37.0	7.8×9.0
	A	FRHI16	592027.348	4403459.248	8/15/2006	6	2030	0130	21.0	16.0	2052	EPFU	A	M	yes	15.50	44.0	2.6×9.0
	A	FRHI16	592027.348	4403459.248	8/15/2006	6	2030	0130	21.0	16.0	2115	EPFU	A	F	non-rep	18.50	43.0	2.6×9.0
	A	FRHI17	591989.898	4403462.531	8/15/2006	6	2030	0130	21.0	16.0	2115	EPFU	A	M	yes	18.50	45.0	2.6×6.0
	A	FRHI17	591989.898	4403462.531	8/16/2006	6	2030	0130	21.0	16.0	0047	MYSE	A	F	non-rep	6.50	36.0	2.6×6.0
	A	FRHI17	591989.898	4403462.531	8/16/2006	6	2030	0130	21.0	16.0	0107	MYLU	A	F	non-rep	7.50	37.5	2.6×6.0
	A	FRHI18	592031.461	4403455.650	8/22/2006	6	2030	0130	20.0	16.0	0030	MYSE	A	M	non-rep	6.00	35.0	2.6×6.0
	A	FRHI17	591989.898	4403462.531	8/21/2006	6	2030	0130	20.0	16.0	2105	EPFU	A	M	yes	18.25	42.0	2.6×9.0
	A	FRHI15	591996.837	4403447.411	8/21/2006	6	2030	0130	20.0	16.0	.	.	.	.	.	.	.	7.8×9.0
	A	FRHI16	592027.348	4403459.248	8/21/2006	6	2030	0130	20.0	16.0	2325	MYLU	A	F	non-rep	10.00	37.0	2.6×6.0
	B	FRHI27	591640.180	4403054.181	6/9/2005	7	2050	0150	24.0	20.0	2155	MYSE	A	M	non-rep	5.50	36.0	2.6×6.0
	B	FRHI22	591634.493	4403063.770	6/9/2005	7	2050	0150	24.0	20.0	.	.	.	.	.	.	.	2.6×9.0
	B	FRHI25	591677.774	4403051.682	6/9/2005	7	2050	0150	24.0	20.0	.	.	.	.	.	.	.	2.6×6.0
	B	FRHI21	591699.371	4403036.902	6/9/2005	7	2050	0150	24.0	20.0	.	.	.	.	.	.	.	7.8×12.0
	B	FRHI20	591712.574	4403013.865	6/9/2005	7	2050	0150	24.0	20.0	.	.	.	.	.	.	.	2.6×12.0
	B	FRHI19	591745.509	4403039.009	6/9/2005	7	2050	0150	24.0	20.0	2302	MYLU	A	F	pregnant	11.00	36.0	2.6×9.0
	B	FRHI23	591655.601	4403091.191	6/15/2005	6	2100	0200	20.0	19.0	.	.	.	.	.	.	.	2.6×9.0
	B	FRHI27	591640.180	4403054.181	6/16/2005	6	2100	0200	20.0	19.0	0150	MYLU	A	F	pregnant	10.00	38.0	2.6×6.0
	B	FRHI24	591645.055	4403061.705	6/15/2005	6	2100	0200	20.0	19.0	.	.	.	.	.	.	.	7.8×12.0
	B	FRHI26	591672.010	4403056.271	6/15/2005	6	2100	0200	20.0	19.0	.	.	.	.	.	.	.	2.6×9.0
	B	FRHI19	591745.509	4403039.009	8/16/2006	6	2025	0125	20.0	17.0	.	.	.	.	.	.	.	2.6×9.0
	B	FRHI25	591677.774	4403051.682	8/16/2006	6	2025	0125	20.0	17.0	.	.	.	.	.	.	.	2.6×9.0
	B	FRHI26	591672.010	4403056.271	8/16/2006	6	2025	0125	20.0	17.0	.	.	.	.	.	.	.	7.8×9.0
	B	FRHI27	591640.180	4403054.181	8/16/2006	6	2025	0125	20.0	17.0	.	.	.	.	.	.	.	2.6×6.0
	C	FRHI28	591522.654	4403705.723	6/10/2005	6	2050	0150	31.0	23.0	.	.	.	.	.	.	.	2.6×9.0
	C	FRHI29	591528.440	4403739.340	6/10/2005	6	2050	0150	31.0	23.0	.	.	.	.	.	.	.	7.8×6.0
	C	FRHI30	591515.165	4403758.756	6/10/2005	6	2050	0150	31.0	23.0	.	.	.	.	.	.	.	2.6×9.0
	C	FRHI31	591488.101	4403796.715	6/10/2005	6	2050	0150	31.0	23.0	.	.	.	.	.	.	.	2.6×9.0
	D	FRHI32	592492.342	4404384.211	6/13/2005	7	2050	0200	25.5	22.0	.	.	.	.	.	.	.	2.6×12.0
	D	FRHI33	592516.423	4404401.477	6/13/2005	7	2050	0200	25.5	22.0	.	.	.	.	.	.	.	2.6×6.0
	D	FRHI34	592486.551	4404393.212	6/13/2005	7	2050	0200	25.5	22.0	.	.	.	.	.	.	.	2.6×9.0
	D	FRHI35	592517.103	4404372.215	6/13/2005	7	2050	0200	25.5	22.0	.	.	.	.	.	.	.	7.8×6.0
	D	FRHI36	592590.044	4404415.372	6/13/2005	7	2050	0200	25.5	22.0	2255	MYSE	A	F	pregnant	8.00	36.0	2.6×6.0
	D	FRHI36	592590.044	4404415.372	6/14/2005	7	2050	0200	25.5	22.0	0105	MYLU	A	F	pregnant	10.50	37.0	2.6×6.0
	D	FRHI36	592590.044	4404415.372	6/14/2005	7	2050	0200	25.5	22.0	0105	MYsp	N/A	N/A	N/A	N/A	N/A	2.6×6.0
	E	FRHI41	591562.680	4403500.735	6/14/2005	6	2055	0200	22.0	19.0	0200	EPFU	A	M	non-rep	14.25	45.0	2.6×9.0
	E	FRHI38	591561.768	4403472.483	6/14/2005	6	2055	0200	22.0	19.0	2115	EPFU	A	M	non-rep	14.00	46.0	7.8×12.0
	E	FRHI38	591561.768	4403472.483	6/14/2005	6	2055	0200	22.0	19.0	2134	LABO	A	F	pregnant	19.50	38.0	7.8×12.0
	E	FRHI38	591561.768	4403472.483	6/14/2005	6	2055	0200	22.0	19.0	2249	EPFU	A	M	non-rep	17.00	44.5	7.8×12.0
	E	FRHI39	591568.253	4403470.194	6/14/2005	6	2055	0200	22.0	19.0	2240	MYSE	A	M	non-rep	7.00	36.0	2.6×12.0
	E	FRHI37	591566.343	4403427.982	6/14/2005	6	2055	0200	22.0	19.0	.	.	.	.	.	.	.	2.6×9.0
	E	FRHI38	591561.768	4403472.483	8/14/2006	6	2025	0100	26.0	24.0	2030	EPFU	A	M	yes	16.00	45.0	7.8×12.0
	E	FRHI39	591568.253	4403470.194	8/14/2006	6	2025	0100	26.0	24.0	.	.	.	.	.	.	.	2.6×9.0

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Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
FRHI	E	FRHI40	591571.022	4403498.196	8/14/2006	6	2025	0100	26.0	24.0	.	.	.	.	.	.	.	2.6×12.0
	E	FRHI41	591562.680	4403500.735	8/14/2006	6	2025	0100	26.0	24.0	.	.	.	.	.	.	.	2.6×9.0
	F	FRHI42	592288.315	4403649.546	6/16/2005	7	2050	0150	18.0	15.0	.	.	.	.	.	.	.	2.6×6.0
	F	FRHI43	592275.790	4403654.563	6/16/2005	7	2050	0150	18.0	15.0	2145	EPFU	A	M	non-rep	14.50	44.0	2.6×6.0
	F	FRHI43	592275.790	4403654.563	6/16/2005	7	2050	0150	18.0	15.0	2200	MYSE	A	M	non-rep	7.00	36.0	2.6×6.0
	F	FRHI43	592275.790	4403654.563	6/16/2005	7	2050	0150	18.0	15.0	2200	MYLU	N/A	N/A	N/A	N/A	N/A	2.6×6.0
	F	FRHI43	592275.790	4403654.563	6/16/2005	7	2050	0150	18.0	15.0	2235	MYSE	A	F	pregnant	9.00	35.5	2.6×6.0
	F	FRHI43	592275.790	4403654.563	6/16/2005	7	2050	0150	18.0	15.0	2255	MYLU	A	F	pregnant	10.00	37.0	2.6×6.0
	F	FRHI43	592275.790	4403654.563	6/16/2005	7	2050	0150	18.0	15.0	2350	MYLU	A	F	lactating	9.50	35.5	2.6×6.0
	F	FRHI43	592275.790	4403654.563	6/16/2005	7	2050	0150	18.0	15.0	2355	MYSE	A	M	non-rep	6.50	35.5	2.6×6.0
	F	FRHI43	592275.790	4403654.563	6/17/2005	7	2050	0150	18.0	15.0	0040	MYLU	A	F	non-rep	8.50	36.0	2.6×6.0
	F	FRHI43	592275.790	4403654.563	6/17/2005	7	2050	0150	18.0	15.0	0050	MYLU	A	M	non-rep	7.50	36.5	2.6×6.0
	F	FRHI44	592247.537	4403683.128	6/16/2005	7	2050	0150	18.0	15.0	2235	MYSE	A	M	non-rep	7.50	35.0	2.6×12.0
	F	FRHI44	592247.537	4403683.128	6/16/2005	7	2050	0150	18.0	15.0	2325	MYLU	A	F	lactating	9.50	36.0	2.6×12.0
	F	FRHI45	592297.157	4403676.645	6/16/2005	7	2050	0150	18.0	15.0	2115	EPFU	A	F	lactating	20.50	46.5	7.8×12.0
	F	FRHI45	592297.157	4403676.645	6/17/2005	7	2050	0150	18.0	15.0	0040	MYLU	A	F	pregnant	9.00	35.5	7.8×12.0
	F	FRHI47	592323.366	4403707.218	6/16/2005	7	2050	0150	18.0	15.0	2135	EPFU	A	M	non-rep	15.75	43.0	2.6×9.0
	F	FRHI47	592323.366	4403707.218	6/16/2005	7	2050	0150	18.0	15.0	2200	EPFU	A	F	lactating	19.50	48.0	2.6×9.0
	F	FRHI47	592323.366	4403707.218	6/17/2005	7	2050	0150	18.0	15.0	0010	MYSE	A	M	non-rep	5.50	35.0	2.6×9.0
	F	FRHI47	592323.366	4403707.218	6/17/2005	7	2050	0150	18.0	15.0	0010	MYLU	A	F	pregnant	9.25	36.0	2.6×9.0
	F	FRHI48	592262.538	4403635.047	6/17/2005	7	2050	0105	16.0	13.0	2325	MYLU	A	M	non-rep	8.50	37.0	2.6×6.0
	F	FRHI43	592275.790	4403654.563	6/17/2005	7	2050	0105	16.0	13.0	.	.	.	.	.	.	.	2.6×6.0
	F	FRHI44	592247.537	4403683.128	6/17/2005	7	2050	0105	16.0	13.0	.	.	.	.	.	.	.	2.6×12.0
	F	FRHI47	592323.366	4403707.218	6/17/2005	7	2050	0105	16.0	13.0	2310	MYLU	A	F	lactating	9.50	37.0	2.6×9.0
	F	FRHI47	592323.366	4403707.218	6/17/2005	7	2050	0105	16.0	13.0	2325	MYSE	A	M	non-rep	6.25	35.0	2.6×9.0
	F	FRHI45	592297.157	4403676.645	6/17/2005	7	2050	0105	16.0	13.0	2100	PISU	A	F	non-rep	6.50	34.0	7.8×12.0
	F	FRHI45	592297.157	4403676.645	6/17/2005	7	2050	0105	16.0	13.0	2100	PISU	A	F	pregnant	7.75	34.0	7.8×12.0
	F	FRHI45	592297.157	4403676.645	6/17/2005	7	2050	0105	16.0	13.0	2115	EPFU	A	F	lactating	16.50	50.0	7.8×12.0
	F	FRHI45	592297.157	4403676.645	6/17/2005	7	2050	0105	16.0	13.0	2120	EPFU	A	F	lactating	18.75	46.0	7.8×12.0
	F	FRHI45	592297.157	4403676.645	6/17/2005	7	2050	0105	16.0	13.0	2220	MYLU	A	M	non-rep	8.50	36.5	7.8×12.0
	F	FRHI45	592297.157	4403676.645	6/17/2005	7	2050	0105	16.0	13.0	2225	MYLU	A	F	pregnant	9.75	37.0	7.8×12.0
	F	FRHI45	592297.157	4403676.645	6/17/2005	7	2050	0105	16.0	13.0	2225	MYLU	A	F	pregnant	10.00	37.0	7.8×12.0
	F	FRHI45	592297.157	4403676.645	6/18/2005	7	2050	0105	16.0	13.0	0005	MYLU	A	F	non-rep	8.25	38.5	7.8×12.0
	F	FRHI46	592326.706	4403670.177	8/17/2006	8	2020	0120	22.0	18.0	.	.	.	.	.	.	.	5.2×6.0
	F	FRHI45	592297.157	4403676.645	8/17/2006	8	2020	0120	22.0	18.0	.	.	.	.	.	.	.	7.8×12.0
	F	FRHI47	592323.366	4403707.218	8/17/2006	8	2020	0120	22.0	18.0	2125	EPFU	A	F	non-rep	21.50	50.0	2.6×6.0
	F	FRHI47	592323.366	4403707.218	8/17/2006	8	2020	0120	22.0	18.0	2335	MYSE	A	M	yes	6.50	37.0	2.6×6.0
	F	FRHI47	592323.366	4403707.218	8/17/2006	8	2020	0120	22.0	18.0	2353	EPFU	A	M	yes	18.25	46.5	2.6×6.0
	F	FRHI47	592323.366	4403707.218	8/17/2006	8	2020	0120	22.0	18.0	2358	MYLU	J	M	non-rep	7.75	38.0	2.6×6.0
	F	FRHI43	592275.790	4403654.563	8/17/2006	8	2020	0120	22.0	18.0	.	.	.	.	.	.	.	2.6×6.0
	F	FRHI48	592262.538	4403635.047	8/17/2006	8	2020	0120	22.0	18.0	2040	EPFU	A	M	yes	16.00	44.0	2.6×9.0
	F	FRHI48	592262.538	4403635.047	8/17/2006	8	2020	0120	22.0	18.0	2125	EPFU	A	F	non-rep	18.00	47.0	2.6×9.0
	F	FRHI47	592323.366	4403707.218	8/22/2006	8	2020	0120	21.0	18.0	.	.	.	.	.	.	.	2.6×6.0

Appendix C. Bat captures during mist netting at four Eastern Rivers and Mountains Network park units, 2005–2006. Data include mist net locations, Universal Transverse Mercator coordinates, dates, number of mist nets used during each night, times mist nets were opened and closed, ambient air temperature (°C) when mist nets were opened and closed, time each bat was captured, bat species, age (adult/juvenile), sex, reproductive condition, weight (g), forearm length (mm), and mist net height and width (m) (continued).

Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
FRHI	F	FRHI45	592297.157	4403676.645	8/22/2006	8	2020	0120	21.0	18.0	2300	LABO	A	F	non-rep	11.75	44.0	7.8×12.0
	F	FRHI43	592275.790	4403654.563	8/22/2006	8	2020	0120	21.0	18.0	.	.	.	.	.	.	.	2.6×6.0
	F	FRHI48	592262.538	4403635.047	8/22/2006	8	2020	0120	21.0	18.0	2125	EPFU	A	F	non-rep	21.00	47.5	2.6×9.0
	F	FRHI48	592262.538	4403635.047	8/22/2006	8	2020	0120	21.0	18.0	2300	MYSE	A	M	yes	6.00	36.0	2.6×9.0
	F	FRHI49	592274.215	4403608.552	8/22/2006	8	2020	0120	21.0	18.0	.	.	.	.	.	.	.	2.6×6.0
	F	FRHI50	592306.551	4403576.607	8/22/2006	8	2020	0120	21.0	18.0	.	.	.	.	.	.	.	2.6×9.0
	G	FRHI51	591480.142	4403423.681	8/18/2006	5	2025	0125	26.0	20.0	2035	PISU	A	M	yes	4.50	33.0	7.8×12.0
	G	FRHI51	591480.142	4403423.681	8/18/2006	5	2025	0125	26.0	20.0	2035	PISU	A	F	non-rep	5.00	34.0	7.8×12.0
	G	FRHI51	591480.142	4403423.681	8/18/2006	5	2025	0125	26.0	20.0	2140	MYSE	A	M	yes	6.25	35.0	7.8×12.0
	G	FRHI51	591480.142	4403423.681	8/18/2006	5	2025	0125	26.0	20.0	2215	EPFU	A	F	non-rep	16.50	46.0	7.8×12.0
	G	FRHI51	591480.142	4403423.681	8/18/2006	5	2025	0125	26.0	20.0	2350	EPFU	A	M	yes	17.50	48.5	7.8×12.0
	G	FRHI51	591480.142	4403423.681	8/18/2006	5	2025	0125	26.0	20.0	2350	EPFU	J	M	non-rep	15.50	46.0	7.8×12.0
	G	FRHI51	591480.142	4403423.681	8/18/2006	5	2025	0125	26.0	20.0	2350	EPFU	A	M	yes	19.50	44.0	7.8×12.0
	G	FRHI51	591480.142	4403423.681	8/19/2006	5	2025	0125	26.0	20.0	0045	EPFU	A	M	yes	17.00	42.0	7.8×12.0
	G	FRHI52	591483.623	4403412.471	8/18/2006	5	2025	0125	26.0	20.0	2025	EPFU	A	M	yes	15.50	47.0	2.6×9.0
	G	FRHI52	591483.623	4403412.471	8/18/2006	5	2025	0125	26.0	20.0	2140	EPFU	A	M	yes	14.75	44.0	2.6×9.0
	G	FRHI53	591483.727	4403403.684	8/18/2006	5	2025	0125	26.0	20.0	2215	EPFU	A	M	yes	15.50	44.0	2.6×12.0
	G	FRHI51	591480.142	4403423.681	8/24/2006	6	2020	0120	23.0	19.0	2030	EPFU	A	M	yes	17.50	47.0	7.8×12.0
	G	FRHI51	591480.142	4403423.681	8/25/2006	6	2020	0120	23.0	19.0	0120	EPFU	A	M	yes	14.00	46.0	7.8×12.0
	G	FRHI52	591483.623	4403412.471	8/24/2006	6	2020	0120	23.0	19.0	2310	MYLU	A	M	yes	6.50	37.0	2.6×9.0
	G	FRHI53	591483.727	4403403.684	8/24/2006	6	2020	0120	23.0	19.0	2335	MYLU	A	M	yes	7.75	36.5	2.6×12.0
	G	FRHI54	591465.958	4403349.873	8/24/2006	6	2020	0120	23.0	19.0	.	.	.	.	.	.	.	2.6×12.0
	H	FRHI54	591465.958	4403349.873	8/23/2006	6	2015	0115	25.0	18.0	2145	PISU	A	F	non-rep	6.50	36.0	2.6×12.0
	H	FRHI54	591465.958	4403349.873	8/23/2006	6	2015	0115	25.0	18.0	2245	EPFU	A	M	yes	17.50	47.0	2.6×12.0
	H	FRHI54	591465.958	4403349.873	8/24/2006	6	2015	0115	25.0	18.0	0100	EPFU	A	M	yes	14.50	45.5	2.6×12.0
	H	FRHI55	591483.619	4403326.369	8/23/2006	6	2015	0115	25.0	18.0	2255	EPFU	J	M	yes	13.50	46.0	2.6×12.0
	H	FRHI56	591487.056	4403330.096	8/23/2006	6	2015	0115	25.0	18.0	2105	EPFU	A	M	yes	18.50	46.0	7.8×9.0
	H	FRHI56	591487.056	4403330.096	8/23/2006	6	2015	0115	25.0	18.0	2256	EPFU	A	F	non-rep	15.25	47.0	7.8×9.0
	H	FRHI56	591487.056	4403330.096	8/24/2006	6	2015	0115	25.0	18.0	0040	PISU	A	M	yes	5.50	34.0	7.8×9.0
	H	FRHI57	591500.633	4403325.701	8/23/2006	6	2015	0115	25.0	18.0	.	.	.	.	.	.	.	2.6×9.0
JOFL	A	JOFL1	688705.570	4468432.017	7/6/2005	7	2100	0200	22.5	17.0	.	.	.	.	.	.	.	2.6×9.0
	A	JOFL2	688710.889	4468435.058	7/6/2005	7	2100	0200	22.5	17.0	.	.	.	.	.	.	.	2.6×9.0
	A	JOFL3	688716.413	4468441.695	7/6/2005	7	2100	0200	22.5	17.0	.	.	.	.	.	.	.	2.6×9.0
	A	JOFL4	688725.389	4468460.346	7/6/2005	7	2100	0200	22.5	17.0	.	.	.	.	.	.	.	2.6×12.0
	A	JOFL5	688737.630	4468473.802	7/6/2005	7	2100	0200	22.5	17.0	.	.	.	.	.	.	.	7.8×12.0
	B	JOFL6	688837.910	4468764.838	7/8/2005	5	2100	0200	17.0	17.0	2310	MYSE	A	F	lactating	7.50	36.0	2.6×12.0
	B	JOFL8	688850.771	4468737.018	7/8/2005	5	2100	0200	17.0	17.0	2145	MYLU	A	F	lactating	8.00	39.0	7.8×12.0
	B	JOFL8	688850.771	4468737.018	7/8/2005	5	2100	0200	17.0	17.0	2145	MYLU	A	M	yes	8.50	37.0	7.8×12.0
	B	JOFL8	688850.771	4468737.018	7/8/2005	5	2100	0200	17.0	17.0	2233	MYLU	A	F	lactating	9.00	38.0	7.8×12.0
	B	JOFL8	688850.771	4468737.018	7/9/2005	5	2100	0200	17.0	17.0	0015	MYLU	A	F	lactating	9.00	37.0	7.8×12.0
	B	JOFL7	688869.215	4468753.753	7/8/2005	5	2100	0200	17.0	17.0	2215	MYLU	A	M	non-rep	7.50	37.0	2.6×6.0
	B	JOFL7	688869.215	4468753.753	7/8/2005	5	2100	0200	17.0	17.0	2250	MYLU	A	M	non-rep	7.50	37.0	2.6×6.0
	B	JOFL6	688837.910	4468764.838	7/14/2006	6	2110	0200	27.0	22.0	.	.	.	.	.	.	.	2.6×12.0

Appendix C. Bat captures during mist netting at four Eastern Rivers and Mountains Network park units, 2005–2006. Data include mist net locations, Universal Transverse Mercator coordinates, dates, number of mist nets used during each night, times mist nets were opened and closed, ambient air temperature (°C) when mist nets were opened and closed, time each bat was captured, bat species, age (adult/juvenile), sex, reproductive condition, weight (g), forearm length (mm), and mist net height and width (m) (continued).

Park[a]	Site No.	GPA Datafile	UTM X[b]	UTM Y[b]	Date	No. Nets	Time Open	Time Close	Temp Open	Temp Close	Time	Species[c]	Age	Sex	Repro. Cond.	Weight	Forearm	Net Dimensions
JOFL	B	JOFL7	688869.215	4468753.753	7/14/2006	6	2110	0200	27.0	22.0	2130	EPFU	A	F	post-lact	16.25	45.0	2.6×6.0
	B	JOFL7	688869.215	4468753.753	7/14/2006	6	2110	0200	27.0	22.0	2130	EPFU	A	M	non-rep	15.25	43.0	2.6×6.0
	B	JOFL7	688869.215	4468753.753	7/14/2006	6	2110	0200	27.0	22.0	2130	EPFU	A	F	post-lact	19.50	44.0	2.6×6.0
	B	JOFL7	688869.215	4468753.753	7/14/2006	6	2110	0200	27.0	22.0	2130	EPFU	A	M	non-rep	17.50	45.0	2.6×6.0
	B	JOFL7	688869.215	4468753.753	7/14/2006	6	2110	0200	27.0	22.0	2135	MYLU	A	M	non-rep	8.50	38.0	2.6×6.0
	B	JOFL7	688869.215	4468753.753	7/14/2006	6	2110	0200	27.0	22.0	2245	EPFU	A	M	non-rep	17.50	46.0	2.6×6.0
	B	JOFL7	688869.215	4468753.753	7/14/2006	6	2110	0200	27.0	22.0	2245	EPFU	J	M	non-rep	12.50	43.0	2.6×6.0
	B	JOFL7	688869.215	4468753.753	7/14/2006	6	2110	0200	27.0	22.0	2335	EPFU	J	M	non-rep	12.50	43.0	2.6×6.0
	B	JOFL8	688850.771	4468737.018	7/14/2006	6	2110	0200	27.0	22.0	2220	EPFU	A	M	non-rep	19.50	47.0	7.8×12.0
	B	JOFL8	688850.771	4468737.018	7/14/2006	6	2110	0200	27.0	22.0	2220	EPFU	A	F	post-lact	19.50	46.0	7.8×12.0
	B	JOFL8	688850.771	4468737.018	7/14/2006	6	2110	0200	27.0	22.0	2225	EPFU	A	M	non-rep	18.25	46.0	7.8×12.0
	B	JOFL8	688850.771	4468737.018	7/14/2006	6	2110	0200	27.0	22.0	2320	MYLU	J	F	non-rep	6.00	36.0	7.8×12.0
	B	JOFL8	688850.771	4468737.018	7/14/2006	6	2110	0200	27.0	22.0	2400	MYSE	A	M	non-rep	7.00	37.0	7.8×12.0
	B	JOFL8	688850.771	4468737.018	7/15/2006	6	2110	0200	27.0	22.0	2420	EPFU	A	F	lactating	19.50	44.0	7.8×12.0
	B	JOFL9	688841.654	4468683.681	7/14/2006	6	2110	0200	27.0	22.0	.	.	.	.	.	.	.	2.6×6.0
	B	JOFL10	688818.007	4468758.888	7/17/2006	8	2100	0200	26.0	19.0	.	.	.	.	.	.	.	2.6×9.0
	B	JOFL11	688843.050	4468745.212	7/17/2006	8	2100	0200	26.0	19.0	.	.	.	.	.	.	.	2.6×12.0
	B	JOFL8	688850.771	4468737.018	7/17/2006	8	2100	0200	26.0	19.0	2135	EPFU	J	F	non-rep	11.50	44.0	7.8×12.0
	B	JOFL8	688850.771	4468737.018	7/17/2006	8	2100	0200	26.0	19.0	2220	MYLU	A	F	non-rep	7.50	35.0	7.8×12.0
	B	JOFL8	688850.771	4468737.018	7/17/2006	8	2100	0200	26.0	19.0	2214	EPFU	J	M	non-rep	14.50	47.0	7.8×12.0
	B	JOFL12	688862.701	4468748.858	7/17/2006	8	2100	0200	26.0	19.0	.	.	.	.	.	.	.	2.6×12.0
	B	JOFL13	688868.023	4468754.643	7/17/2006	8	2100	0200	26.0	19.0	.	.	.	.	.	.	.	2.6×6.0
	B	JOFL7	688869.215	4468753.753	7/17/2006	8	2100	0200	26.0	19.0	.	.	.	.	.	.	.	2.6×6.0

[a] ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.

[b] Universal Transverse Mercator coordinates in North American Datum 83, 17 North.

[c] EPFU = *Eptesicus fuscus*;
LABO = *Lasiurus borealis*;
MYLU = *Myotis lucifugus*;
MYSE = *Myotis septentrionalis*;
MYsp = *Myotis* sp.;
PISU = *Pipistrellus subflavus*

Appendix D. Bat echolocation calls collected at four Eastern Rivers and Mountains Network park units, 2005–2006.

Park[a]	Site No.	UTM_X[b]	UTM_Y[b]	Date	Start Time	Total	NOID	EPFU	EPFUFB	EPFU/ LACI	LABO	LABOFB	LACI	MYLU	MYLUFB	MYSE	MYSEFB	MYsp	MYspFB	PISU	PISUFB
ALPO	1	707628	4481286	6/20/2005	2114	5	2	2	0	0	1	0	0	0	0	0	0	0	0	0	0
				6/23/2005	2331	17	7	10	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/7/2006	2057	5	0	2	0	0	0	0	0	2	0	0	0	1	0	0	0
				7/20/2006	2141	16	6	3	0	0	0	0	0	1	0	0	0	6	0	0	0
	2	707557	4481676	6/20/2005	2142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/23/2005	2359	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
				7/7/2006	2126	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
				7/20/2006	2207	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	707109	4481832	6/20/2005	2232	4	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0
				6/23/2005	2159	9	2	1	0	0	1	0	0	0	0	2	0	3	0	0	0
				7/7/2006	2204	5	1	1	0	0	0	0	0	0	0	0	0	3	0	0	0
				7/18/2006	2341	13	0	1	0	0	0	0	0	7	0	0	0	5	0	0	0
	4	706975	4481623	6/20/2005	2300	6	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/23/2005	2256	8	1	3	0	0	2	0	0	1	0	0	0	0	0	1	0
				7/7/2006	2231	6	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/18/2006	2245	10	2	6	0	0	1	0	0	1	0	0	0	0	0	0	0
	5	706656	4481512	6/20/2005	2322	8	2	0	0	0	3	0	0	0	0	1	0	2	0	0	0
				6/23/2005	2231	5	2	0	0	0	1	0	0	0	0	1	0	1	0	0	0
				7/7/2006	2256	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
				7/18/2006	2310	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	6	715928	4476992	6/21/2005	0033	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/23/2005	2123	14	7	1	0	0	1	0	2	0	0	0	0	3	0	0	0
				7/18/2006	2211	14	2	4	0	0	0	0	0	0	0	0	0	8	0	0	0
				7/19/2006	2130	38	4	0	0	0	0	0	0	0	0	18	2	16	1	0	0
	7	708117	4480888	6/21/2005	2111	8	0	4	0	0	1	0	0	0	0	3	0	0	0	0	0
				6/24/2005	2317	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
				7/7/2006	2349	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/20/2006	2109	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	710268	4478908	6/21/2005	2140	11	1	10	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/24/2005	2345	6	1	2	0	0	1	0	0	0	0	1	0	0	0	1	0
				7/11/2006	2107	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				7/11/2006	2300	18	4	13	0	0	0	0	0	0	0	0	0	1	0	0	0
	9	711191	4478483	6/21/2005	2207	21	4	10	0	0	4	0	0	1	0	1	0	0	0	1	0
				6/25/2005	0028	11	6	1	0	0	0	0	0	0	0	2	0	2	0	0	0
				7/11/2006	2136	9	2	6	0	0	0	0	0	0	0	1	0	0	0	0	0
				7/11/2006	2330	17	4	12	0	0	0	0	0	0	0	0	0	1	0	0	0
	10	712950	4477494	6/21/2005	2242	209	28	0	0	0	1	0	0	21	0	0	0	87	0	72	34
				6/24/2005	2114	218	31	57	3	0	3	1	0	72	0	7	0	39	3	16	3
				7/19/2006	2058	79	4	7	0	0	1	0	0	11	5	4	0	39	2	13	8
				7/19/2006	2257	131	1	16	0	0	0	0	0	40	22	0	0	37	13	37	14
	11	715344	4476219	6/21/2005	2319	19	10	5	0	0	0	0	0	0	0	0	0	4	0	0	0
				6/24/2005	2144	18	2	15	1	0	0	0	0	0	0	0	0	1	0	0	0
				7/18/2006	2107	10	2	5	0	0	0	0	0	2	0	0	0	1	0	0	0
				7/19/2006	2228	46	6	25	1	0	2	0	0	5	1	0	0	8	2	0	0

Appendix D. Bat echolocation calls collected at four Eastern Rivers and Mountains Network park units, 2005–2006 (continued).

Park[a]	Site No.	UTM_X[b]	UTM_Y[b]	Date	Start Time	Total	NOID	EPFU	EPFUFB	EPFU/ LACI	LABO	LABOFB	LACI	MYLU	MYLUFB	MYSE	MYSEFB	MYsp	MYspFB	PISU	PISUFB
ALPO	12	714788	4476723	6/21/2005	2347	23	1	16	0	0	2	0	0	3	0	0	0	0	0	1	0
				6/24/2005	2208	56	4	49	4	0	2	0	0	1	0	0	0	0	0	0	0
				7/18/2006	2120	32	2	22	0	0	6	0	0	2	0	0	0	0	0	0	0
				7/19/2006	2204	45	2	37	3	0	0	0	0	5	0	0	0	0	0	1	1
	13	683670	4471805	6/30/2005	2107	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/30/2005	2309	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/12/2006	2118	33	1	32	2	0	0	0	0	0	0	0	0	0	0	0	0
				7/13/2006	2231	18	2	16	0	0	0	0	0	0	0	0	0	0	0	0	0
	14	682966	4471846	6/30/2005	2130	13	3	10	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/30/2005	2332	18	6	2	0	0	9	0	0	1	0	0	0	0	0	0	0
				7/12/2006	2142	73	4	6	0	0	0	0	0	51	13	0	0	12	1	0	0
				7/13/2006	2254	22	0	17	0	0	0	0	0	4	1	0	0	1	0	0	0
	15	682359	4471511	6/30/2005	2153	16	4	11	0	0	0	0	0	1	0	0	0	0	0	0	0
				6/30/2005	2356	27	5	2	0	0	5	0	0	1	0	0	0	14	0	0	0
				7/13/2006	2101	3	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0
				7/13/2006	2317	39	1	1	0	0	0	0	0	26	5	0	0	11	1	0	0
	16	682151	4470780	6/30/2005	2215	12	3	5	0	0	2	0	0	1	0	0	0	1	0	0	0
				7/1/2005	0021	14	3	1	0	0	2	0	0	0	0	4	0	2	0	2	1
				7/13/2006	2345	12	0	9	0	0	0	0	0	1	0	0	0	1	0	1	0
				7/13/2006	2129	3	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0
	17	682190	4470018	6/30/2005	2241	9	4	3	0	0	0	0	0	0	0	0	0	1	0	1	0
				7/1/2005	0045	60	12	23	0	0	12	3	0	0	0	0	0	0	0	13	0
				7/13/2006	2151	28	5	10	0	0	1	0	0	6	0	0	0	3	0	3	1
				7/14/2006	0007	33	3	29	0	0	1	0	0	0	0	0	0	0	0	0	0
FONE	1	620932	4407602	5/17/2005	2100	52	12	0	0	0	0	0	0	37	9	0	0	3	0	0	0
				5/25/2005	2325	6	2	0	0	0	3	0	0	0	0	1	0	0	0	0	0
				7/24/2006	2110	26	1	18	1	0	4	0	0	0	0	0	0	0	0	3	3
				7/28/2006	2308	3	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
	2	620722	4408181	5/17/2005	2134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				5/25/2005	2226	3	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0
				7/24/2006	2140	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/28/2006	2238	16	3	4	0	0	0	0	0	0	0	8	0	1	0	0	0
	3	620220	4407640	5/17/2005	2201	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				5/31/2005	2241	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/24/2006	2239	4	0	0	0	0	1	0	0	1	0	0	0	2	0	0	0
				7/28/2006	2140	39	5	1	0	0	1	0	0	0	0	23	1	9	0	0	0
	4	620143	4407283	5/17/2005	2226	4	1	0	0	0	2	0	0	0	0	1	0	0	0	0	0
				5/25/2005	2258	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
				7/24/2006	2302	12	2	1	2	0	0	0	0	7	1	0	0	2	0	0	0
				7/28/2006	2107	57	2	3	0	0	52	0	0	0	0	0	0	0	0	0	0
	5	619952	4407776	5/17/2005	2250	7	4	0	0	0	0	0	0	0	0	3	0	0	0	0	0
				5/31/2005	2203	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/24/2006	2236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/28/2006	2141	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix D. Bat echolocation calls collected at four Eastern Rivers and Mountains Network park units, 2005–2006 (continued).

Park[a]	Site No.	UTM_X[b]	UTM_Y[b]	Date	Start Time	Total	NOID	EPFU	EPFUFB	EPFU/ LACI	LABO	LABOFB	LACI	MYLU	MYLUFB	MYSE	MYSEFB	MYsp	MYspFB	PISU	PISUFB
FONE	6	621161	4407875	5/17/2005	2325	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				5/25/2005	2149	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
				7/24/2006	2109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/28/2006	2308	3	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0
	7	616054	4415316	5/23/2005	2105	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
				6/1/2005	2323	63	22	2	0	0	34	1	0	0	0	1	0	4	0	0	0
				7/26/2006	2100	6	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/27/2006	2152	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	8	616342	4415280	5/23/2005	2137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/1/2005	2351	10	2	0	0	0	0	0	0	5	0	0	0	3	0	0	0
				7/26/2006	2124	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/27/2006	2217	20	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	619760	4410102	5/23/2005	2212	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				5/31/2005	2310	7	4	1	0	0	0	0	0	0	0	1	0	1	0	0	0
				7/26/2006	2212	13	3	1	0	0	9	0	0	0	0	0	0	0	0	0	0
				7/27/2006	2055	92	4	80	9	0	6	0	0	0	0	0	0	0	0	2	0
	10	619703	4410166	5/23/2005	2235	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/1/2005	2104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/26/2006	2235	6	0	0	0	0	0	0	0	1	0	4	0	1	0	0	0
				7/27/2006	2118	2	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0
	11	620840	4408442	5/23/2005	2304	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				5/31/2005	2102	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				7/24/2006	2139	19	1	0	0	0	7	0	0	1	0	0	0	10	1	0	0
				7/28/2006	2237	29	8	0	0	0	0	0	0	5	0	2	0	14	0	0	0
	12	619905	4407219	5/23/2005	2336	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/1/2005	2137	9	0	0	0	0	5	0	0	2	0	0	0	2	0	0	0
				7/24/2006	2310	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/28/2006	2110	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	13	620646	4407644	5/25/2005	2054	5	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0
				5/31/2005	2337	21	6	0	0	0	13	0	0	1	0	0	0	1	0	0	0
				7/24/2006	2210	26	3	0	0	0	0	0	0	19	8	1	0	3	0	0	0
				7/28/2006	2200	20	3	1	1	0	0	0	0	7	3	1	0	8	1	0	0
	14	620774	4407863	5/25/2005	2124	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/1/2005	2237	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
				7/24/2006	2209	3	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0
				7/28/2006	2207	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRHI	1	591524	4403413	6/7/2005	2102	90	11	13	0	0	59	0	5	0	0	0	0	0	0	2	0
				6/10/2005	2222	5	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0
				8/14/2006	2036	51	4	47	4	0	0	0	0	0	0	0	0	0	0	0	0
				8/18/2006	2319	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	591661	4403065	6/6/2005	2126	132	24	3	0	0	0	0	0	2	0	0	0	0	0	103	21
				6/10/2005	2347	45	15	7	0	10	2	1	0	0	0	0	0	0	0	11	0
				8/15/2006	2315	3	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0
				8/17/2006	2032	125	4	96	5	0	16	0	0	0	0	0	0	0	0	9	3

Appendix D. Bat echolocation calls collected at four Eastern Rivers and Mountains Network park units, 2005–2006 (continued).

Park[a]	Site No.	UTM_X[b]	UTM_Y[b]	Date	Start Time	Total	NOID	EPFU	EPFUFB	EPFU/ LACI	LABO	LABOFB	LACI	MYLU	MYLUFB	MYSE	MYSEFB	MYsp	MYspFB	PISU	PISUFB
FRHI	3	591701	4403825	6/6/2005	2205	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/10/2005	2249	13	2	11	0	0	0	0	0	0	0	0	0	0	0	0	0
				8/14/2006	2137	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
				8/18/2006	2253	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	591989	4403432	6/6/2005	2225	5	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0
				6/10/2005	2319	6	2	0	0	0	1	0	0	0	0	0	0	3	0	0	0
				8/14/2006	2204	9	3	5	0	0	0	0	0	1	0	0	0	0	0	0	0
				8/18/2006	2116	12	4	8	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	592320	4403628	6/6/2005	2302	8	3	0	0	0	0	0	0	0	0	0	0	5	0	0	0
				6/13/2005	2056	17	4	2	0	0	0	0	0	0	0	0	0	0	0	11	0
				8/14/2006	2250	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
				8/18/2006	2146	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	6	592571	4404401	6/6/2005	2339	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/13/2005	2132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				8/15/2006	2033	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				8/17/2006	2302	5	2	0	0	0	0	0	0	0	0	1	0	2	0	0	0
	7	592321	4404032	6/8/2005	2055	23	4	14	5	1	3	2	0	0	0	0	0	0	0	1	0
				6/13/2005	2224	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				8/14/2006	2316	15	2	7	0	0	1	0	0	0	0	0	0	1	0	4	0
				8/18/2006	2214	9	1	2	0	0	4	0	0	0	0	0	0	0	0	2	0
	8	592184	4404346	6/8/2005	2125	9	4	3	0	0	0	0	0	0	0	0	0	2	0	0	0
				6/13/2005	2254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				8/15/2006	2100	5	0	0	0	0	0	0	0	0	0	0	0	5	1	0	0
				8/17/2006	2238	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	591583	4404159	6/8/2005	2153	11	1	4	0	4	0	0	0	0	0	0	0	2	0	0	0
				6/13/2005	2324	5	2	0	0	0	1	0	0	1	0	0	0	0	0	1	0
				8/15/2006	2134	10	4	5	0	0	0	0	0	0	0	0	0	0	0	1	0
				8/17/2006	2209	63	4	56	0	0	3	0	0	0	0	0	0	0	0	0	0
	10	591333	4403686	6/8/2005	2222	6	1	0	0	0	0	0	0	0	0	1	0	4	0	0	0
				6/13/2005	2351	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				8/15/2006	2203	18	5	13	1	0	0	0	0	0	0	0	0	0	0	0	0
				8/17/2006	2141	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	591611	4402538	6/8/2005	2303	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				6/10/2005	2057	5	3	1	0	0	0	0	1	0	0	0	0	0	0	0	0
				8/15/2006	2242	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
				8/17/2006	2102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	592347	4402892	6/8/2005	2343	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
				6/10/2005	2131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				8/14/2006	2107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				8/18/2006	2046	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
JOFL	1	688896	4468772	7/6/2005	2103	91	15	69	10	2	4	1	1	0	0	0	0	0	0	0	0
				7/8/2005	2339	5	2	0	0	0	3	1	0	0	0	0	0	0	0	0	0
				7/14/2006	2058	25	3	12	1	0	1	0	8	0	0	0	0	1	0	0	0
				7/17/2006	2306	6	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix D. Bat echolocation calls collected at four Eastern Rivers and Mountains Network park units, 2005–2006 (continued).

Park[a]	Site No.	UTM_X[b]	UTM_Y[b]	Date	Start Time	Total	NOID	EPFU	EPFUFB	EPFU/ LACI	LABO	LABOFB	LACI	MYLU	MYLUFB	MYSE	MYSEFB	MYsp	MYspFB	PISU	PISUFB
JOFL	2	689018	4468712	7/6/2005	2130	161	52	0	0	0	27	5	0	76	11	0	0	3	0	3	0
				7/8/2005	2311	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
				7/14/2005	2158	11	1	6	0	0	0	0	0	3	0	0	0	1	0	0	0
				7/17/2006	2243	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	688850	4468544	7/6/2005	2206	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
				7/8/2005	2228	5	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0
				7/14/2006	2127	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
				7/17/2006	2221	7	1	0	0	0	0	0	0	0	0	3	0	3	0	0	0
	4	688796	4468049	7/6/2005	2233	20	5	3	0	1	5	0	0	1	0	3	0	2	0	0	0
				7/8/2005	2202	41	13	5	0	0	3	0	0	10	0	1	0	9	0	0	0
				7/14/2006	2235	18	3	3	0	0	0	0	0	4	0	1	0	6	0	1	0
				7/17/2006	2153	22	3	0	0	0	5	0	1	9	3	0	0	4	0	0	0
	5	689185	4468667	7/6/2005	2300	3	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
				7/8/2005	2136	20	4	12	0	2	1	0	1	0	0	0	0	0	0	0	0
				7/14/2006	2302	8	1	5	0	0	0	0	1	1	0	0	0	0	0	0	0
				7/17/2006	2128	14	5	7	0	0	1	0	0	0	0	0	0	1	0	0	0
	6	689343	4468931	7/6/2005	2324	4	2	0	0	1	0	0	0	0	0	0	0	0	0	1	1
				7/8/2005	2114	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
				7/14/2006	2325	3	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
				7/17/2006	2103	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] ALPO = Allegheny Portage Railroad National Historic Site;
FONE = Fort Necessity National Battlefield;
FRHI = Friendship Hill National Historic Site;
JOFL = Johnstown Flood National Memorial.

[b] NOID = Unidentifiable bat call;
EPFU = *Eptesicus fuscus*;
EPFU/LACI = undetermined *E. fuscus* or *Lasiurus cinereus* call;
LABO = *Lasiurus borealis*;
LACI = *Lasiurus cinereus*;
MYLU = *Myotis lucifugus*;
MYSE = *Myotis septentrionalis*;
MYsp = *Myotis* sp.;
PISU = *Pipistrellus subflavus*;
FB = feeding buzz.

Appendix E. An Assessment of the "Bat Problem" at the Gallatin House, Friendship Hill National Historic Site (FRHI), Point Marion, Pennsylvania.

On the afternoon of 4 October 2004, Ed Gates and Josh Johnson accompanied Connie Ranson, National Park Service , to the Gallatin House at FRHI to assess a "bat problem" at the NPS landmark. We thoroughly searched rooms, closets, fireplace openings, and other locations throughout the house using high-intensity spotlights and headlamps. No conclusive sign or evidence of recent bat activity, e.g., droppings or dead bats, were found in the house. Connie told us that there were droppings on the floor in certain rooms, but they had been removed, and plastic sheets placed over the carpeting, prior to our visit. We then searched around the outside of the house, checking into any cracks or openings or other structures that might house bats. We located two roosting big brown bats (*Eptesicus fuscus*) behind window shutters on the second floor porch. Droppings had accumulated on the porch floor beneath the bats. We also noted droppings beneath a nearby window shutter, but no bats were found behind that shutter. After walking around the house and checking shutters with lights, we located three additional big brown bats roosting singly behind shutters. We then searched the Carriage House for signs of bat use with lights. No evidence of use was observed, e.g., droppings, dead bats, etc.; but the Carriage House contained what looked like good roosting areas for bats.

The big brown bat is an abundant bat species that ranges from extreme northern Canada, throughout the United States, and south to the extreme southern tip of Mexico. Maternity colonies have been found beneath loose bark and in small tree cavities and in buildings, barns, bridges, and even bat houses. Prey includes ground beetles, scarab beetles, cucumber beetles, snout beetles and stink bugs, in addition to numerous species of moths and leafhoppers. Because they often take up residence in buildings and other man-made structures, they increasingly have come into close human contact. No other bat species were observed at the house or its outbuildings during our visit.

Bat Conservational International (BCI), Inc., http://www.batcon.org/, has the following to say about bats in buildings:

Most problems with bats arise only when large colonies attempt to live in buildings. It helps to keep things in perspective: by some estimates, over 80% of bats roosting in buildings are never detected by the human occupants. When too many bats take up residence in your attic, they can become a nuisance, even to people who like them. Fortunately, most problems are small enough to solve on your own.

The first step is to make careful observations to see where bats exit. The next day, hang polypropylene bird netting (available at garden centers and some hardware stores) over the holes. Use duct tape or staples to secure the netting several inches above the bats' exit hole, extending at least a foot to each side and below, allowing it to hang loosely. In the evening, when the bats leave to feed, they will be able to drop below the netting to gain flight. When they attempt to return, however, they will no longer be able to fly into the hole, the netting acting as a one-way excluder.

You can make permanent repairs later. Wait at least two or three nights to ensure that no bats have been trapped inside. Excluding bats should not be attempted in June or July when

flightless young may be present. The best time is in fall or winter after bats have left to hibernate. Check and repair other possible entries, such as chimneys, vents, and loose screens. Bats potentially can enter through holes as small as 3/4" in diameter or crevices ⅜×⅞". They do not chew insulation or make new holes.

Our recommendations are:

1) Because the Gallatin House is open to the public and many people fear bats or have concerns over health and safety, bat entry into the Gallatin House should probably be minimized to reduce potential contact with visitors to the historic site.
   a. Prior to bat-proofing the Gallatin House, bat-specific artificial roosts, e.g., bat houses, should be established nearby, providing these bats with more suitable roost sites into which they can relocate if roosts inside or outside the house are made unusable.
   b. To reduce entry into the house, the NPS should consider screening chimney openings and any other large openings into the house in late fall or winter after bats leave for their hibernacula.
   c. During the spring/summer 2005–2006 bat inventory, UMCES personnel, including Josh Johnson, offered to visit the house at dusk and note any openings where bats emerge. These openings can also be sealed in late fall or winter after bats leave for their hibernacula. Small openings can be filled with caulk.
2) Bats roosting beneath exterior shutters may be less of a nuisance problem for the park visitor; however, maintenance staff could come into contact with the bats or their droppings during their job.
   a. To minimize bats roosting behind shutters, the shutters could be extended slightly away from the house, increasing the distance between shutter and house and lessening their attractiveness as daytime roosts.
   b. Or, the NPS could recognize that the bats roosting beneath the shutters are a part of the fauna of FRHI and leave the shutters opened against the house, thereby providing the bats with daytime roosts.

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NPS D-050 November 2007

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