National Park Service
U.S. Department of the Interior

Northeast Region
Philadelphia, Pennsylvania

Bat-swarming Inventory at Abandoned Mine Portals at New River Gorge National River, West Virginia

Natural Resources Technical Report NPS/NER/NRTR—2006/046

ON THE COVER
Top Left: Indiana bat (*Myotis sodalis*);
Top Right: Virginia big-eared bat (*Corynorhinus townsendii virginianus*) ;
Bottom Left: Mine N, New River Gorge National River with harp trap in place; and
Bottom Right: Mine A, New River Gorge National River without harp trap in place.
Photographs by Joshua B. Johnson.

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

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Summary

Abandoned mines provide summer roosts, fall swarming sites, and winter hibernacula for bats. During fall 2005, we surveyed for bats at 19 abandoned mine portals at New River Gorge National River (NERI), West Virginia. We captured 2,346 bats representing 8 species including 16 Virginia big-eared bats (*Corynorhinus townsendii virginianus*), 19 big brown bats (*Eptesicus fuscus*), 1 eastern red bat (*Lasiurus borealis*), 84 eastern small-footed bats (*Myotis leibii*), 732 little brown bats (*M. lucifugus*), 561 northern myotis (*M. septentrionalis*), 7 Indiana bats (*M. sodalis*), and 926 eastern pipistrelles (*Pipistrellus subflavus*). Virginia big-eared bats and Indiana bats are federally listed as endangered. Eastern small-footed bats are rare throughout their geographic range and are considered 'rare' in West Virginia. At mines C and J, Indiana bats were captured during 1 of 3 survey nights for the first time. Indiana bats were captured during all 3 survey nights at mine S. Although this may suggest Indiana bats hibernate in Mine S, it is not inconceivable that they are using the mine as a transient roost when migrating through the area. It is unknown if the entrance collapse at mine T is a factor in the absence of Virginia big-eared bats at mine K, a mine entrance known to be used by the species. The entrance at mine T should not be reopened to allow bat passage or improved airflow until it can be supported or reinforced to reduce the risk of future collapse, which could potentially trap bats in the mine.

NERI continues to provide habitat for many bat species, including rare eastern small-footed bats, and endangered Indiana bats and Virginia big-eared bats. Abandoned coal mines at NERI serve as an important habitat component for bats. However, the waterways, forests, and cliff lines at NERI should not be overlooked, as they may be equally important to bats, including rare and endangered species. Bat population monitoring at the NERI mines should continue. Surveys in March and April may provide more evidence to support the notion that bats are using mines as hibernacula.

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Introduction

Abandoned mines pose potential human safety and liability concerns on private and public lands. Mine structures become increasingly unstable because repeated freezing and thawing of water weakens mine walls and increases the risk of collapse. Moreover, mines may contain poisonous gases and deep shafts (Burghardt 2004). Consequently, abandoned mine entrances often are closed to prevent human access, sometimes before biological surveys are conducted (Pierson 1998). Although abandoned mine portals are a risk to human safety, they serve as roost sites to many bat species (Tuttle and Taylor 1998). Mines and caves should be conserved because they may serve as summer roosts, fall swarming sites, and/or hibernacula for many bats, including rare and endangered species (Cope and Humphrey 1977; USFWS 1982, 1984, 1999; Johnson et al. 2005).

There are 13 bat species documented in West Virginia (Merritt 1987; Kurta 1995; Whitaker and Hamilton 1998); 3 are federally listed as endangered (Virginia big-eared bat [*Corynorhinus townsendii virginianus*], gray bat [*Myotis grisescens*], and Indiana bat [*M. sodalis*]) and 2 are identified by the West Virginia Division of Natural Resources (WVDNR) as rare in West Virginia (Rafinesque's big-eared bat [*C. rafinesquii*] and eastern small-footed bat [*M. leibii*]). All 5 rare and endangered bat species in West Virginia could use abandoned mines as roosts. Of the remaining 8 bat species in West Virginia, big brown bats (*Eptesicus fuscus*), little brown bats (*M. lucifugus*), northern myotis (*M. septentrionalis*), and eastern pipistrelles (*Pipistrellus subflavus*) have been documented using mines or caves. Eastern red bats (*Lasiurus borealis*), hoary bats (*L. cinereus*), silver-haired bats (*Lasionycteris noctivagans*), and evening bats (*Nycticeius humeralis*) typically are not associated with mines or caves (Barbour and Davis 1969; Appendix). At New River Gorge National River (NERI), 12 bat species have been documented (Dumpert et al. 2003; Johnson et al. 2003), representing all known species to occur in West Virginia except gray bats.

Caves, mines, and tunnels are used as winter hibernacula, or as daytime and/or night roosts during the spring, summer, and fall (Gates et al. 1984; Raesly and Gates 1984, 1987). At NERI, Johnson et al. (2003) documented the majority (92.6%) of their captures during fall swarm. During fall, cavernicolous bats swarm, or fly in and out of and around, cave and mine entrances, presumably in search of mates and to select their hibernaculum (Davis and Hitchcock 1965; Cope and Humphrey 1977; Schowalter 1980). It is almost impossible to determine if bats are hibernating in caves or mines where they are captured during fall swarming without conducting internal surveys. However, conducting bat surveys within mines during winter, or at any time, is very dangerous. To further complicate assessment of mine use, bats may swarm at portals long distances from their hibernacula (Fenton 1969). In fall 2002, Johnson et al. (2003) conducted surveys at NERI mine entrances only once each. Conducting surveys for multiple nights at each cave or mine may provide a more accurate assessment of bat use (Gates et al. 1984). Consistent captures of a species at a mine entrance during fall may lend support to the notion that the species is using the mine as a hibernaculum, although it is not inconceivable that they are transients (Myers 1964).

The primary goals of this project were to:

1. identify bat species using abandoned mine portals at NERI during fall;
2. confirm the presence of previously documented species in specific areas at NERI; and
3. confirm the presence of any rare, threatened, or endangered species at NERI.

Study Area

We conducted bat surveys at abandoned coal mines at NERI in Fayette County, West Virginia. NERI contains approximately 28,329 ha (70,002 ac) located in the Appalachian Plateau physiographic province (Fenneman 1938) and is characterized by steep slopes and exposed rock cliffs ascending 300 m (984 ft) above the rivers to plateau-like ridge tops. Oaks (*Quercus* spp.) dominate the forest overstory, while the understory mainly consists of rhododendron (*Rhododendron maximum*). A survey of mines at NERI by Yuill (1988) identified 181 abandoned coal mine portals within the park's boundary. NERI contained about 36 abandoned mine portals that possibly could be used by bats (Droppleman et al. 2001). The abandoned coal mines are in the Fire Creek and Sewell coal seams (Yuill 1988), which are approximately mid-way up the slopes in the gorges. The mine benches were a few meters to over 50 m (164 ft) in width. Most mine benches were naturally reclaimed by vegetation, including multiflora rose (*Rosa multiflora*), greenbrier (*Smilax* spp.), and tree-of-heaven (*Ailanthus altissima*). Because the National Park Service converted some mine benches to permanent, interpretive hiking trails, 24 mine entrances were gated at NERI between 1987 and 1998 to keep people from entering the mines and to protect wildlife, including bats (Burghardt 2004).

Methods

We surveyed for bats at NERI mine entrances during fall (mid-August–late-September) 2005. Mine entrances were selected based on previous bat survey data (Johnson et al. 2003) and NPS requests. Nearly all mines at NERI that had open entrances were surveyed for bats in 2002. In this study, we focused our efforts on mines that were used by rare or endangered bats in 2002 (Johnson et al. 2003). Moreover, we sampled some NERI mines that were adjacent to private lands proposed for developments or mining operations (National Park Service, J. Perez, biologist, pers. comm., July 2005). We used harp traps (1×1 m; Bat Conservation and Management, Carlisle, PA) and/or mist nets (6×2.8 m or 9×2.8 m, [depending on entrance size] Avinet, Dryden, NY) to capture bats entering or exiting the mines or swarming around mine entrances. Harp traps were positioned in mine entrances and were surrounded with heavy bird netting or tarpaulin to prevent bats from bypassing the harp trap. Mist nets were positioned 1–2 m (3–6.5 ft) from mine entrances if harp traps were not used. If mist nets were used in conjunction with harp traps, they were positioned within 10 m (33 ft) of the mine entrance to capture bats that evaded capture by the harp trap or that were swarming around the entrance. Mine entrances were sampled 3 times each (1 time each in August, early September, and late September), in groups of 1–3, depending on their proximity, between sunset and 0000 hours. No less than 9 nights elapsed between consecutive samples of any mine entrance.

Data collected from each captured bat included species (Menzel et al. 2002a), sex, age, and reproductive condition. We determined the age (juvenile/adult) of each bat by examining the level of epiphyseal-diaphyseal fusion (Kunz and Anthony 1982). We determined the reproductive condition of all female bats by palpating the abdomen and inspecting the mammary glands (Racey 1988). We used an Olympus Camedia C-5050 digital camera (New York, NY) to photograph vouchers of every species captured at NERI. We collected wing tissue samples from Virginia big-eared bats and Indiana bats, and wing tissue and hair samples from eastern small-footed bats. Tissue samples were collected for genetic analysis, primarily to examine the relatedness of NERI bat populations to other bat populations in the region (McCracken and Wilkinson 1988). We collected tissue samples with the permission of the National Park Service (National Park Service, J. Perez, biologist, pers. comm., July 2005) and under the auspices of WVDNR Scientific Collecting Permit and Addendum No. 2005.145. We used a 3 mm diameter dermal punch to take a tissue sample from each plagiopatagium, close to the bat's body. Hair samples were collected as part of a larger study to determine migration patterns of bats (Cryan et al. 2004). We used scissors to remove a small area (<1 cm^2) of interscapular hair. We banded the wings of Virginia big-eared bats with blue, anodized, aluminum bands provided by WVDNR (Barclay and Bell 1988). We uniquely marked the wings of Indiana bats and eastern small-footed bats with non-toxic paint markers to facilitate identification of recaptures within the same night. Bat recaptures at caves or mines during fall swarming typically are <5% (Fenton 1969; Marsh 1998).

Results

We surveyed for bats at 19 mine entrances and captured 2,346 bats representing 8 species, including 16 Virginia big-eared bats, 19 big brown bats, 1 eastern red bat, 84 eastern small-footed bats, 732 little brown bats, 561 northern myotis, 7 Indiana bats, and 926 eastern pipistrelles (Tables 1 and 2; Figures 1–8). We recaptured 1 Virginia big-eared bat (band B109) at mine I on 25 September 2005 that was banded at mine G on 9 September 2005. We captured none of the 6 Virginia big-eared bats that were wing-banded at NERI by Johnson et al. (2003) in 2002. Moreover, no wing-banded or paint-marked bats other than the aforementioned Virginia big-eared bat were recaptured.

Bats were captured at all mine entrances during all 3 samples. However, at most mine entrances, bat activity declined in successive samples (Table 3). Overall, bat activity was highest at Q-R-S, H, K, A, and B-C mine complexes and lowest at L, O, N, and D-E-F mine complexes. Mine S had the the highest overall activity of eastern small-footed bats, Indiana bats, and Virginia big-eared bats. Eastern small-footed bats were captured at all mine entrances except mine F. No rare or endangered bats were captured at mine F.

Sex ratios were male-biased in almost every instance. Only Virginia big-eared bats had an overall female-biased sex ratio. Sex ratios showed no apparent trends through fall (Table 4).

Wing tissue samples were taken from 12 Virginia big-eared bats, 6 Indiana bats, and 5 eastern small-footed bats. Hair samples were taken from 8 eastern small-footed bats. All samples were submitted immediately after the completion of the study to Craig Stihler, non-game biologist for the WVDNR, Elkins, West Virginia. We collected fecal samples from 42 eastern small-footed bats for study, because little is known about the dietary habits of this species.

During this study, only one bat, an adult male eastern pipistrelle, was injured and subsequently dispatched using approved techniques (IACUC Protocol Number F-AL-05-06). It was captured in a mist net at mine S on 2 September 2005. It is currently located in the mammal specimen collection at the University of Maryland, Center for Environmental Science, Appalachian Laboratory, Frostburg, Maryland.

Several wildlife species other than bats were observed at mine entrances. Woodrats (*Neotoma magister*) were seen at mines M, O, P, and A. We observed two northern copperhead snakes (*Agkistrodon contortrix mokasen*) at mine I and a black rat snake (*Elaphe obsoleta*) at mine J. A cave salamander (*Eurycea lucifuga*) was observed at mine C. An Appalachian seal salamander (*Desmognathus monticola*) was observed in the stream adjacent to mine complex D-E-F.

One mine entrance (mine T) that we had originally planned to sample was effectively closed to bat passage due to fallen rocks. All other surveyed mine entrances appeared to be in relatively stable condition, as described by Johnson et al. (2003).

Table 1. Bats captured at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005.

		Species[a]							
Mine	Total	COTO	EPFU	LABO	MYLE	MYLU	MYSE	MYSO	PISU
A	286	1	1	0	2	48	64	0	170
B	213	0	0	0	4	68	110	0	31
C	172	0	0	0	2	50	67	1	152
D	45	0	2	1	2	5	3	0	32
E	9	0	0	0	1	0	0	0	8
F	19	0	0	0	0	7	3	0	9
G	56	2	0	0	4	11	8	0	31
H	254	3	5	0	11	71	39	0	125
I	71	0	1	0	6	8	16	0	40
J	101	1	2	0	7	27	19	1	44
K	268	0	0	0	3	100	66	0	99
L	15	0	0	0	1	0	3	0	11
M	91	0	3	0	5	23	25	0	35
N	35	2	0	0	2	8	4	0	19
O	13	0	0	0	1	1	3	0	8
P	62	0	2	0	5	8	7	0	40
Q	131	2	0	0	3	62	35	0	29
R	24	0	0	0	3	11	3	0	7
S	481	5	3	0	22	224	86	5	136
T*	0	0	0	0	0	0	0	0	0
U*	0	0	0	0	0	0	0	0	0
Total	2,346	16	19	1	84	732	561	7	926

[a]Species abbreviations:

COTO = *Corynorhinus townsendii virginianus*
EPFU = *Eptesicus fuscus*
LABO = *Lasiurus borealis*
MYLE = *Myotis leibii*
MYLU = *Myotis lucifugus*
MYSE = *Myotis septentrionalis*
MYSO = *Myotis sodalis*
PISU = *Pipistrellus subflavus*.

*Referred to in text but not sampled for bats during this study.

Table 2. Bats captured at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005. Wing band identification numbers in parentheses.

Mine	Date	Species[c]	No. captured[d]	Male		Female	
				Adult	Juvenile	Adult	Juvenile
A	8/22/05	EPFU	1	1	0	0	0
		MYLU	23	12	2	7	2
		MYSE	28	24[c]	0	4	0
		PISU	107	64	7	21	14
	9/6/05	COTO	1	1 (B104)	0	0	0
		MYLE	1	1	0	0	0
		MYLU	13	13	0	0	0
		MYSE	29	19	0	9	1
		PISU	40	19	4	17	0
	9/21/05	MYLE	1	1	0	0	0
		MYLU	12	9	0	3	0
		MYSE	7	4	0	3	0
		PISU	23	16	1	6	0
B	8/23/05	MYLE	1	0	0	1[d]	0
		MYLU	30	14	8	5	3
		MYSE	51	36	8	5	2
		PISU	15	8	3	0	4
	9/7/05	MYLE	3	3	0	0	0
		MYLU	29	24	0	5	0
		MYSE	44	32	4	7	1
	9/7/05	PISU	14	9	2	3	0
	9/27/05	MYLU	9	8	0	1	0
		MYSE	15	8	0	7	0
		PISU	2	2	0	2	0
C	8/23/05	MYLE	2	1	1	0	0
		MYLU	16	7	3	4	2
		MYSE	28	11	4	5	8
		PISU	16	8	4	2	2
	9/7/05	MYLU	25	24	0	1	0
		MYSE	37	28	1	7	0
		PISU	29	13	0	16	0
	9/27/05	MYLU	9	8	0	1	0
		MYSE	2	0	1	1	0
		MYSO	1	1	0	0	0
		PISU	7	3	1	2	1
D	8/24/05	EPFU	2	2	0	0	0
		LABO	1	0	1	0	0
		MYLU	1	1	0	0	0
		MYSE	1	0	1	0	0
		PISU	23	12	8	0	3
	9/8/05	MYLE	2	2	0	0	0
		MYLU	1	1	0	0	0
		MYSE	1	1	0	0	0
		PISU	8	7	0	0	0
	9/20/05	MYLU	3	3	0	0	0
		MYSE	1	1	0	0	0
		PISU	1	1	0	0	0

Table 2. Bats captured at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005. Wing band identification numbers in parentheses (continued).

Mine	Date	Species[a]	No. captured[b]	Male		Female	
				Adult	Juvenile	Adult	Juvenile
E	8/24/05	PISU	3	3	0	0	0
	9/8/05	PISU	4	2	2	0	0
	9/20/05	MYLE	1	1	0	0	0
		PISU	1	1	0	0	0
F	8/24/05	MYLU	4	4	0	0	0
		MYSE	2	2	0	0	0
		PISU	3	3	0	0	0
	9/8/05	MYLU	1	1	0	0	0
		PISU	3	3	0	0	0
	9/20/05	MYLU	2	1	1	0	0
		MYSE	1	1	0	0	0
		PISU	3	1	2	0	0
G	8/25/05	MYLE	2	2	0	0	0
		MYLU	4	4	0	0	0
		MYSE	5	3	0	0	1
		PISU	20	12	3	0	4
	9/9/05	COTO	1	0	0	1 (B105)	0
		MYLE	1	1	0	0	0
		MYLU	6	4	0	2	0
		MYSE	2	2	0	0	0
		PISU	4	3	0	1	0
	9/28/05	COTO	1	1 (B111)	0	0	0
		MYLE	1	0	0	1	0
		MYLU	1	1	0	0	0
		MYSE	1	1	0	0	0
		PISU	7	3	2	2	0
H	8/25/05	COTO	1	0	0	1 (B103)	0
		EPFU	3	1	0	2	0
		MYLE	6	6	0	0	0
		MYLU	37	29	1	6	1
		MYSE	17	16	1	0	0
		PISU	71	55	10	4	2
	9/9/05	COTO	1	1 (B106)	0	0	0
		EPFU	2	2	0	0	0
		MYLE	4	4	0	0	0
		MYLU	29	27	0	2	0
		MYSE	20	17	0	3	0
		PISU	35	20	3	9	1
	9/28/05	COTO	1	0	0	1 (B110)	0
		MYLE	1	0	0	1	0
		MYLU	5	3	1	1	0
		MYSE	2	2	0	0	0
		PISU	19	9	4	4	2

Table 2. Bats captured at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005. Wing band identification numbers in parentheses (continued).

Mine	Date	Species[a]	No. captured[b]	Male		Female	
				Adult	Juvenile	Adult	Juvenile
I	8/29/05	EPFU	1	1	0	0	0
		MYLE	3	3	0	0	0
		MYLU	4	2	0	2	0
		MYSE	11	8	0	1	1
		PISU	23	17	1	3	2
	9/16/05	MYLE	3	0	2	1	0
		MYLU	4	4	0	0	0
		MYSE	5	3	0	2	0
		PISU	11	8	0	3	0
	9/25/05	PISU	6	6	0	0	0
J	8/29/05	EPFU	2	1	1	0	0
		MYLE	5	4	0	1	0
		MYLU	18	13	2	3	0
		MYSE	6	4	1	1	0
		PISU	33	15	14	0	1
	9/16/05	COTO	1	0	0	1 (B108)	0
		MYLE	1	1	0	0	0
		MYLU	5	4	0	1	0
		MYSE	8	7	0	0	0
		MYSO	1	1	0	0	0
		PISU	8	7	1	0	0
	9/25/05	MYLE	1	0	0	1	0
		MYLU	4	4	0	0	0
		MYSE	2	2	0	0	0
		PISU	3	1	0	1	0
K	8/30/05	MYLE	1	1	0	0	0
		MYLU	27	24	0	3	0
		MYSE	21	18	0	3	0
	8/30/05	PISU	29	22	0	5	1
	9/12/05	MYLE	2	2	0	0	0
		MYLU	35	32	0	3	0
		MYSE	39	29	1	9	0
		PISU	40	21	3	15	1
	9/21/05	MYLU	38	36	0	2	0
		MYSE	6	6	0	0	0
		PISU	30	21	0	8	1
L	8/31/05	MYLE	1	1	0	0	0
		MYSE	1	1	0	0	0
		PISU	8	6	0	1	0
	9/13/05	MYSE	2	2	0	0	0
		PISU	2	1	1	0	0
	9/22/05	PISU	1	1	0	0	0

Table 2. Bats captured at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005. Wing band identification numbers in parentheses (continued).

Mine	Date	Species[a]	No. captured[b]	Male		Female	
				Adult	Juvenile	Adult	Juvenile
M	8/31/05	EPFU	1	1	0	0	0
		MYLE	3	2	1	0	0
		MYLU	15	14	0	0	1
		MYSE	16	15	1	0	0
		PISU	16	9	3	1	3
	9/13/05	EPFU	2	0	0	2	0
		MYLE	2	1	1	0	0
		MYLU	7	6	0	1	0
		MYSE	7	6	0	1	0
		PISU	8	7	0	1	0
	9/22/05	MYLU	1	1	0	0	0
		MYSE	2	2	0	0	0
		PISU	11	10	0	1	0
N	8/31/05	MYLU	2	2	0	0	0
		MYSE	1	1	0	0	0
		PISU	4	4	0	0	0
	9/13/05	MYLE	2	1	0	1	0
		MYLU	4	4	0	0	0
		MYSE	3	3	0	0	0
		PISU	6	2	1	1	0
	9/22/05	COTO	2	0	0	1 (B109)	0
		MYLU	2	2	0	0	0
		PISU	9	7	0	1	0
O	9/1/05	MYLU	1	1	0	0	0
		MYSE	1	1	0	0	0
	9/1/05	PISU	4	4	0	0	0
	9/14/05	MYLE	1	1	0	0	0
		MYSE	2	2	0	0	0
		PISU	1	0	1	0	0
	9/23/05	PISU	3	3	0	0	0
P	9/1/05	EPFU	2	1	0	1	0
		MYLE	3	1	0	2	0
		MYLU	4	4	0	0	0
		MYSE	2	2	0	0	0
		PISU	26	12	5	2	4
	9/14/05	MYLE	1	1	0	0	0
		MYLU	2	2	0	0	0
		MYSE	4	4	0	0	0
		PISU	8	6	0	2	0
	9/23/05	MYLE	1	1	0	0	0
		MYLU	2	2	0	0	0
		MYSE	1	0	0	1	0
		PISU	6	5	0	1	0

Table 2. Bats captured at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005. Wing band identification numbers in parentheses (continued).

Mine	Date	Species[a]	No. captured[b]	Male		Female	
				Adult	Juvenile	Adult	Juvenile
Q	9/2/05	MYLE	2	2	0	0	0
		MYLU	27	21	0	6	0
		MYSE	24	20	0	4	0
		PISU	13	11	0	2	0
	9/15/05	MYLE	1	1	0	0	0
		MYLU	26	22	0	4	0
		MYSE	10	7	0	2	1
		PISU	11	6	1	4	0
	9/29/05	COTO	2	1	0	1	0
		MYLU	9	9	0	0	0
		MYSE	1	0	0	1	0
		PISU	5	4	0	1	0
R	9/2/05	MYLE	3	3	0	0	0
		MYLU	3	3	0	0	0
		MYSE	1	1	0	0	0
		PISU	4	2	0	2	0
	9/15/05	MYLU	5	4	0	1	0
		MYSE	2	2	0	0	0
		PISU	2	2	0	0	0
	9/29/05	MYLU	3	2	0	1	0
		PISU	1	1	0	0	0
S	9/2/05	EPFU	2	2	0	0	0
		MYLE	7	6	0	1	0
		MYLU	104	96	0	8	0
		MYSE	40	38	0	2	0
		MYSO	2	1	1	0	0
		PISU	52	45	0	6	0
	9/15/05	COTO	1	0	0	1 (B107)	0
		MYLE	11	6	0	5	0
		MYLU	99	84	2	12	1
		MYSE	45	32	2	11	0
		MYSO	1	1	0	0	0
		PISU	64	38	9	12	4
	9/29/05	COTO	4	3	0	1	0
		EPFU	1	0	0	1	0
		MYLE	4	1	0	3	0
		MYLU	21	20	0	1	0
		MYSE	1	1	0	0	0
	9/29/05	MYSO	2	1	0	1	0
		PISU	20	16	2	2	0

Table 2. Bats captured at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005. Wing band identification numbers in parentheses (continued).

Mine	Date	Species[a]	No. captured[b]	Male		Female	
				Adult	Juvenile	Adult	Juvenile
Totals		COTO	16	7	0	8	0
		EPFU	19	12	1	6	0
		LABO	1	0	1	0	0
		MYLE	84	61	5	17	0
		MYLU	732	616	20	86	10
		MYSE	561	427	25	89	15
		MYSO	7	5	1	1	0
		PISU	926	597	99	161	51

[a]Species abbreviations:

COTO = *Corynorhinus townsendii virginianus* EPFU = *Eptesicus fuscus*
LABO = *Lasiurus borealis* MYLE = *Myotis leibii*
MYLU = *Myotis lucifugus* MYSE = *Myotis septentrionalis*
MYSO = *Myotis sodalis* PISU = *Pipistrellus subflavus*.

[b]Discrepancies in the total number of bats captured at each mine and the sum of males and females and/or the sum of juveniles and adults are because bats escaped before sex and/or age could be determined.
[c]Includes 1 male for which sex was not determined.
[d]Includes 1 female for which sex was not determined.

Figure 1. Virginia big-eared bat (*Corynorhinus townsendii virginianus*) captured at mine H, New River Gorge National River, 9 September 2005.

Figure 2. Big brown bat (*Eptesicus fuscus*) captured at mine A, New River Gorge National River, 22 August 2005.

Figure 3. Eastern red bat (*Lasiurus borealis*) captured at mine D, New River Gorge National River, 24 August 2005.

Figure 4. Eastern small-footed bat (*Myotis leibii*) captured at mine B, New River Gorge National River, 23 August 2005.

Figure 5. Little brown bat (*Myotis lucifugus*) captured at mine A, New River Gorge National River, 22 August 2005.

Figure 6. Northern myotis (*Myotis septentrionalis*) captured at mine A, New River Gorge National River, 22 August 2005.

Figure 7. Indiana bat (*Myotis sodalis*) captured at mine S, New River Gorge National River, 2 September 2005.

Figure 8. Eastern pipistrelle (*Pipistrellus subflavus*) captured at mine A, New River Gorge National River, 22 August 2005.

Table 3. Mean number of bats captured per hour at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005.

			Species[a]							
Mine	Date	Hours trapped	COTO	EPFU	MYLE	MYLU	MYSE	MYSO	PISU	All species
A	8/22/05	4.83	0.00	0.21	0.00	4.76	5.79	0.00	22.14	32.90
	9/6/05	4.27	0.23	0.00	0.23	2.78	6.79	0.00	9.37	19.69
	9/21/05	5.00	0.00	0.00	0.20	2.40	1.40	0.00	4.60	8.60
	Subtotal	14.10	0.07	0.07	0.14	3.40	4.54	0.00	12.06	20.28
B	8/23/05	4.50	0.00	0.00	0.22	6.67	11.33	0.00	3.33	21.56
	9/7/05	4.83	0.00	0.00	0.62	6.00	9.11	0.00	2.90	18.62
	9/27/05	5.00	0.00	0.00	0.00	1.80	3.00	0.00	0.40	5.20
	Subtotal	14.33	0.00	0.00	0.28	4.74	7.68	0.00	2.16	14.86
C	8/23/05	4.50	0.00	0.00	0.44	3.56	6.22	0.00	3.56	13.78
	9/7/05	4.83	0.00	0.00	0.00	5.18	7.66	0.00	6.00	18.83
	9/27/05	5.00	0.00	0.00	0.00	1.80	0.40	0.20	1.40	3.80
	Subtotal	14.33	0.00	0.00	0.14	3.49	4.68	0.07	3.63	12.00
D	8/24/05	4.50	0.00	0.44	0.00	0.22	0.22	0.00	5.11	6.00[b]
	9/8/05	4.75	0.00	0.00	0.42	0.21	0.21	0.00	1.68	2.53
	9/20/05	4.75	0.00	0.00	0.00	0.63	0.21	0.00	0.21	1.05
	Subtotal	14.00	0.00	0.14	0.14	0.36	0.21	0.00	2.29	3.14[b]
E	8/24/05	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.67
	9/8/05	4.75	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.84
	9/20/05	4.75	0.00	0.00	0.21	0.00	0.00	0.00	0.21	0.42
	Subtotal	14.00	0.00	0.00	0.07	0.00	0.00	0.00	0.57	0.64
F	8/24/05	4.50	0.00	0.00	0.00	0.89	0.44	0.00	0.67	2.00
	9/8/05	4.75	0.00	0.00	0.00	0.21	0.00	0.00	0.63	0.84
	9/20/05	4.75	0.00	0.00	0.00	0.42	0.21	0.00	0.63	1.26
	Subtotal	14.00	0.00	0.00	0.00	0.50	0.21	0.00	0.64	1.36
G	8/25/05	4.50	0.00	0.00	0.44	0.89	1.11	0.00	4.44	6.89
	9/9/05	4.32	0.23	0.00	0.23	1.39	0.46	0.00	0.92	3.24
	9/28/05	5.00	0.20	0.00	0.20	0.20	0.20	0.00	1.40	2.20
	Subtotal	13.82	0.14	0.00	0.29	0.80	0.58	0.00	2.24	4.05
H	8/25/05	4.50	0.22	0.67	1.33	8.22	3.78	0.00	15.78	30.00
	9/9/05	4.32	0.23	0.46	0.93	6.71	4.63	0.00	8.10	20.22
	9/28/05	5.00	0.20	0.00	0.20	1.00	0.40	0.00	3.80	5.60
	Subtotal	13.82	0.22	0.36	0.80	5.14	2.82	0.00	9.04	18.38

Table 3. Mean number of bats captured per hour at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August – September) 2005 (continued).

			Species[a]							
Mine	Date	Hours trapped	COTO	EPFU	MYLE	MYLU	MYSE	MYSO	PISU	All species
I	8/29/05	4.50	0.00	0.22	0.67	0.89	2.44	0.00	5.11	9.33
	9/16/05	4.75	0.00	0.00	0.63	0.84	1.05	0.00	2.32	4.84
	9/25/05	4.75	0.00	0.00	0.00	0.00	0.00	0.00	1.26	1.26
	Subtotal	14.00	0.00	0.07	0.43	0.57	1.14	0.00	2.86	5.07
J	8/29/05	4.50	0.00	0.44	1.11	4.00	2.00	0.00	7.33	14.89
	9/16/05	4.75	0.21	0.00	0.21	1.05	1.68	0.21	1.68	5.05
	9/25/05	4.75	0.00	0.00	0.21	0.84	0.42	0.00	0.63	2.11
	Subtotal	14.00	0.07	0.14	0.50	1.93	1.36	0.07	3.14	7.21
K	8/30/05	4.07	0.00	0.00	0.25	6.63	5.16	0.00	7.13	19.16
	9/12/05	4.50	0.00	0.00	0.44	7.78	8.67	0.00	8.89	25.78
	9/21/05	5.00	0.00	0.00	0.00	7.60	1.20	0.00	6.00	14.80
	Subtotal	13.57	0.00	0.00	0.22	7.37	4.86	0.00	7.30	19.75
L	8/31/05	3.83	0.00	0.00	0.26	0.00	0.26	0.00	2.09	2.61
	9/13/05	4.50	0.00	0.00	0.00	0.00	0.44	0.00	0.44	0.89
	9/22/05	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20
	Subtotal	13.33	0.00	0.00	0.08	0.00	0.23	0.00	0.83	1.13
M	8/31/05	3.83	0.00	0.26	0.78	3.92	4.18	0.00	4.17	13.32
	9/13/05	4.50	0.00	0.44	0.44	1.56	1.56	0.00	1.78	5.78
	9/22/05	5.00	0.00	0.00	0.00	0.22	0.44	0.00	2.44	3.11
	Subtotal	13.33	0.00	0.23	0.38	1.73	1.88	0.00	2.62	6.83
N	8/31/05	3.83	0.00	0.00	0.00	0.52	0.26	0.00	1.04	1.83
	9/13/05	4.50	0.00	0.00	0.44	0.89	0.67	0.00	1.33	3.33
	9/22/05	5.00	0.40	0.00	0.00	0.40	0.00	0.00	1.80	2.60
	Subtotal	13.33	0.15	0.00	0.15	0.60	0.30	0.00	1.43	2.63
O	9/1/05	3.82	0.00	0.00	0.00	0.26	0.26	0.00	1.05	0.41
	9/14/05	4.50	0.00	0.00	0.22	0.00	0.44	0.00	0.22	0.89
	9/23/05	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.60
	Subtotal	13.32	0.00	0.00	0.08	0.08	0.23	0.00	0.60	0.98
P	9/1/05	3.82	0.00	0.52	0.79	1.05	0.79	0.00	6.81	9.69
	9/14/05	4.50	0.00	0.00	0.22	0.44	0.89	0.00	1.78	3.33
	9/23/05	5.00	0.00	0.00	0.20	0.40	0.20	0.00	1.20	2.00
	Subtotal	13.32	0.00	0.15	0.38	0.60	0.53	0.00	3.00	4.65

Table 3. Mean number of bats captured per hour at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August – September) 2005 (continued).

			Species[a]							
Mine	Date	Hours trapped	COTO	EPFU	MYLE	MYLU	MYSE	MYSO	PISU	All species
Q	9/2/05	4.25	0.00	0.00	0.47	6.35	5.65	0.00	3.06	15.25
	9/15/05	4.50	0.00	0.00	0.22	5.78	2.22	0.00	2.44	10.67
	9/29/05	5.00	0.40	0.00	0.00	1.80	0.20	0.00	1.00	3.40
	Subtotal	13.75	0.15	0.00	0.22	4.51	2.54	0.00	2.11	9.53
R	9/2/05	4.25	0.00	0.00	0.71	0.71	0.23	0.00	0.94	2.59
	9/15/05	4.50	0.00	0.00	0.00	1.11	0.44	0.00	0.44	2.00
	9/29/05	5.00	0.00	0.00	0.00	0.60	0.00	0.00	0.20	0.80
	Subtotal	13.75	0.00	0.00	0.22	0.80	0.22	0.00	0.51	1.75
S	9/2/05	4.25	0.00	0.47	1.65	24.47	9.41	0.47	12.24	48.71
	9/15/05	4.50	0.22	0.00	2.44	22.00	10.00	0.22	14.22	49.11
	9/29/05	5.00	0.80	0.20	0.80	4.20	0.20	0.40	4.00	10.60
	Subtotal	13.75	0.36	0.22	1.60	16.29	6.25	0.36	9.89	34.98
	Total	261.85	0.06	0.07	0.32	2.80	2.14	0.03	3.54	8.96[c]

[a]Species abbreviations:

COTO = *Corynorhinus townsendii virginianus*
EPFU = *Eptesicus fuscus*
MYLE = *Myotis leibii*
MYLU = *Myotis lucifugus*
MYSE = *Myotis septentrionalis*
MYSO = *Myotis sodalis*
PISU = *Pipistrellus subflavus*.

[b]Does not include 1 *Lasiurus borealis* captured at mine D on 24 August 2005.

Table 4. Sex ratio (male:female) of bats captured at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005.

		Species[a]							
Mine	Date	COTO	EPFU	MYLE	MYLU	MYSE	MYSO	PISU	All Species
A	8/22/05	–	1.00:0.00	–	1.56:1.00	6.00:1.00	–	2.03:1.00	2.29:1.00
	9/6/05	1.00:0.00	–	1.00:0.00	13.00:0.00	1.90:1.00	–	1.35:1.00	2.11:1.00
	9/21/05	–	–	1.00:0.00	3.00:1.00	1.33:1.00	–	2.83:1.00	2.58:1.00
	Subtotal	1.00:1.00	1.00:0.00	2.00:0.00	3.00:1.00	2.76:1.00	–	1.91:1.00	2.28:1.00
B	8/23/05	–	–	0.00:1.00	2.75:1.00	6.29:1.00	–	2.75:1.00	3.85:1.00
	9/7/05	–	–	3.00:0.00	4.80:1.00	4.50:1.00	–	3.67:1.00	4.25:1.00
	9/27/05	–	–	–	8.00:1.00	1.14:1.00	–	1.00:1.00	1.80:1.00
	Subtotal	–	–	3.00:1.00	3.86:1.00	4.00:1.00	–	2.67:1.00	3.67:1.00
C	8/23/05	–	–	2.00:0.00	1.67:1.00	1.15:1.00	–	3.00:1.00	1.70:1.00
	9/7/05	–	–	–	24.00:1.00	4.14:1.00	–	0.81:1.00	2.75:1.00
	9/27/05	–	–	–	8.00:1.00	1.00:1.00	1.00:0.00	1.33:1.00	2.80:1.00
	Subtotal	–	–	2.00:0.00	5.25:1.00	2.14:1.00	1.00:0.00	1.26:1.00	2.29:1.00
D	8/24/05	–	2.00:0.00	–	1.00:0.00	1.00:0.00	–	6.67:1.00	8.00:1.00[b]
	9/8/05	–	–	2.00:0.00	1.00:0.00	1.00:0.00	–	7.00:0.00	11.00:0.00
	9/20/05	–	–	–	3.00:0.00	1.00:0.00	–	1.00:0.00	5.00:0.00
	Subtotal	–	2.00:0.00	2.00:0.00	5.00:0.00	3.00:0.00	–	9.33:1.00	13.33:1.00[b]
E	8/24/05	–	–	–	–	–	–	3.00:0.00	3.00:0.00
	9/8/05	–	–	–	–	–	–	4.00:0.00	4.00:0.00
	9/20/05	–	–	1.00:0.00	–	–	–	1.00:0.00	2.00:0.00
	Subtotal	–	–	1.00:0.00	–	–	–	8.00:0.00	10.00:0.00
F	8/24/05	–	–	–	4.00:0.00	2.00:0.00	–	3.00:0.00	9.00:0.00
	9/8/05	–	–	–	1.00:0.00	–	–	3.00:0.00	4.00:0.00
	9/20/05	–	–	–	2.00:0.00	1.00:0.00	–	3.00:0.00	6.00:0.00
	Subtotal	–	–	–	7.00:0.00	3.00:0.00	–	9.00:0.00	19.00:0.00
G	8/25/05	–	–	2.00:0.00	4.00:0.00	3.00:1.00	–	3.75:1.00	4.80:1.00
	9/9/05	0.00:1.00	–	1.00:0.00	2.00:1.00	2.00:0.00	–	3.00:1.00	2.50:1.00
	9/28/05	1.00:0.00	–	0.00:1.00	1.00:0.00	1.00:0.00	–	2.50:1.00	2.67:1.00
	Subtotal	1.00:1.00	–	3.00:1.00	4.50:1.00	6.00:1.00	–	3.29:1.00	3.50:1.00
H	8/25/05	0.00:1.00	1.00:2.00	6.00:0.00	4.29:1.00	17.00:0.00	–	10.83:1.00	7.44:1.00
	9/9/05	1.00:0.00	2.00:0.00	4.00:0.00	13.50:1.00	5.67:1.00	–	2.30:1.00	4.93:1.00
	9/28/05	0.00:1.00	–	0.00:1.00	4.00:1.00	2.00:0.00	–	2.17:1.00	2.11:1.00
	Subtotal	1.00:2.00	1.50:1.00	10.00:1.00	6.10:1.00	12.00:1.00	–	4.59:1.00	5.30:1.00

Table 4. Sex ratio (male:female) of bats captured at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005.

		Species[b]							
Mine[a]	Date	COTO	EPFU	MYLE	MYLU	MYSE	MYSO	PISU	All Species
I	8/29/05	–	1.00:0.00	3.00:0.00	1.00:1.00	4.00:1.00	–	3.60:1.00	3.56:1.00
	9/16/05	–	–	2.00:1.00	4.00:0.00	1.50:1.00	–	2.67:1.00	2.83:1.00
	9/25/05	–	–	–	–	–	–	6.00:0.00	6.00:0.00
	Subtotal	–	1.00:0.00	5.00:1.00	3.00:1.00	2.75:1.00	–	4.00:1.00	3.67:1.00
J	8/29/05	–	2.00:0.00	4.00:1.00	5.00:1.00	5.00:1.00	–	29.00:1.00	9.17:1.00
	9/16/05	0.00:1.00	–	1.00:0.00	4.00:1.00	7.00:0.00	1.00:0.00	8.00:0.00	35.50:1.00
	9/25/05	–	–	0.00:1.00	4.00:0.00	2.00:0.00	–	1.00:1.00	3.50:1.00
	Subtotal	0.00:1.00	2.00:0.00	2.50:1.00	5.75:1.00	14.00:1.00	1.00:0.00	19.00:1.00	8.30:1.00
K	8/30/05	–	–	1.00:0.00	8.00:1.00	6.00:1.00	–	4.40:1.00	5.42:1.00
	9/12/05	–	–	2.00:0.00	10.67:1.00	3.33:1.00	–	1.50:1.00	3.14:1.00
	9/21/05	–	–	–	18.00:1.00	6.00:0.00	–	2.33:1.00	5.73:1.00
	Subtotal	–	–	3.00:0.00	11.50:1.00	4.50:1.00	–	2.16:1.00	4.24:1.00
L	8/31/05	–	–	1.00:0.00	–	1.00:0.00	–	6.00:1.00	8.00:1.00
	9/13/05	–	–	–	–	2.00:0.00	–	2.00:0.00	2.00:0.00
	9/22/05	–	–	–	–	–	–	1.00:0.00	2.00:0.00
	Subtotal	–	–	1.00:0.00	–	3.00:0.00	–	9.00:1.00	13.00:1.00
M	8/31/05	–	1.00:0.00	3.00:0.00	14.00:1.00	16.00:0.00	–	3.00:1.00	9.20:1.00
	9/13/05	–	0.00:2.00	2.00:0.00	6.00:1.00	6.00:1.00	–	8.00:1.00	4.20:1.00
	9/22/05	–	–	–	1.00:0.00	2.00:0.00	–	10.00:1.00	13.00:1.00
	Subtotal	–	1.00:2.00	5.00:0.00	10.50:1.00	24.00:1.00	–	4.83:1.00	7.27:1.00
N	8/31/05	–	–	–	2.00:0.00	1.00:0.00	–	4.00:0.00	7.00:0.00
	9/13/05	–	–	1.00:1.00	4.00:0.00	3.00:0.00	–	3.00:1.00	5.50:1.00
	9/22/05	0.00:1.00	–	–	2.00:0.00	–	–	7.00:1.00	4.50:1.00
	Subtotal	0.00:1.00	–	1.00:1.00	8.00:0.00	4.00:0.00	–	7.00:1.00	6.75:1.00
O	9/1/05	–	–	–	1.00:0.00	1.00:0.00	–	4.00:0.00	6.00:0.00
	9/14/05	–	–	1.00:0.00	–	2.00:0.00	–	1.00:0.00	4.00:0.00
	9/23/05	–	–	–	–	–	–	3.00:0.00	3.00:0.00
	Subtotal	–	–	1.00:0.00	1.00:0.00	3.00:0.00	–	8.00:0.00	13.00:0.00
P	8/1/05	–	1.00:1.00	1.00:2.00	4.00:0.00	2.00:0.00	–	2.83:1.00	2.78:1.00
	9/14/05	–	–	1.00:0.00	2.00:0.00	4.00:0.00	–	3.00:0.00	6.50:1.00
	9/23/05	–	–	1.00:0.00	2.00:0.00	0.00:1.00	–	5.00:1.00	4.00:1.00
	Subtotal	–	1.00:1.00	1.50:1.00	8.00:0.00	6.00:1.00	–	3.11:1.00	3.54:1.00

Table 4. Sex ratio (male:female) of bats captured at 19 abandoned coal mine entrances at New River Gorge National River, West Virginia, fall (August–September) 2005.

		Species[a]							
Mine	Date	COTO	EPFU	MYLE	MYLU	MYSE	MYSO	PISU	All Species
Q	9/2/05	–	–	2.00:0.00	3.50:1.00	5.00:1.00	–	5.50:1.00	4.50:1.00
	9/15/05	–	–	1.00:0.00	5.50:1.00	2.33:1.00	–	1.75:1.00	3.36:1.00
	9/29/05	1.00:1.00	–	–	9.00:0.00	0.00:1.00	–	4.00:1.00	4.67:1.00
	Subtotal	1.00:1.00	–	3.00:0.00	5.20:1.00	3.38:1.00	–	3.14:1.00	4.03:1.00
R	9/2/05	–	–	3.00:0.00	3.00:0.00	1.00:0.00	–	1.00:1.00	4.50:1.00
	9/15/05	–	–	–	4.00:1.00	2.00:0.00	–	2.00:0.00	8.00:1.00
	9/29/05	–	–	–	2.00:1.00	–	–	1.00:0.00	3.00:1.00
	Subtotal	–	–	3.00:0.00	4.50:1.00	3.00:0.00	–	2.50:1.00	5.00:0.00
S	9/2/05	–	2.00:0.00	6.00:1.00	12.00:1.00	19.00:1.00	2.00:0.00	7.50:1.00	11.12:1.00
	9/15/05	0.00:1.00	–	1.20:1.00	6.62:1.00	3.09:1.00	1.00:0.00	2.94:1.00	3.78:1.00
	9/29/05	3.00:1.00	0.00:1.00	1.00:3.00	20.00:1.00	1.00:0.00	1.00:1.00	9.00:1.00	5.38:1.00
	Subtotal	1.50:1.00	2.00:1.00	1.44:1.00	9.18:1.00	5.62:1.00	4.00:1.00	4.58:1.00	5.65:1.00
	Total	0.88:1.00	2.17:1.00	3.88:1.00	6.62:1.00	4.35:1.00	6.00:1.00	3.28:1.00	4.23:1.00[b]

[a]Species abbreviations:

COTO = *Corynorhinus townsendii virginianus*
EPFU = *Eptesicus fuscus*
MYLE = *Myotis leibii*
MYLU = *Myotis lucifugus*
MYSE = *Myotis septentrionalis*
MYSO = *Myotis sodalis*
PISU = *Pipistrellus subflavus*.

[b]Does not include 1 *Lasiurus borealis* captured at mine D on 24 August 2005.

Discussion

NERI continues to provide habitat to many bat species, including rare eastern small-footed bats, and endangered Indiana bats and Virginia big-eared bats. We documented all species captured by Johnson et al. (2003), with the exception of Rafinesque's big-eared bat, which was captured at Ames mine complex. We did not sample at the Ames mine complex in the current study. We captured more eastern pipistrelles and little brown bats than Johnson et al. (2003), but similar numbers of northern myotis. Minor differences between our results and findings of Johnson et al. (2003) likely can be explained by differences in sampling protocols. All mine entrances we sampled in 2005 were included in the 2002 survey (Johnson et al. 2003). We sampled mine entrances 3 times each; whereas, Johnson et al. (2003) sampled each mine entrance once during fall. Mine complexes such as H-K-T and Q-R-S had relatively high bat activity among mines sampled in 2002 and 2005. Capture rates at NERI were similar to those documented at limestone caves and mines in western Maryland (Agosta et al. 2005). The wide range of captures per hour among mine entrances is similar to results of fall swarming surveys at caves in western Maryland (Gates et al. 1984; Marsh 1998; Johnson and Gates 2004). Moreover, a decline in captures per hour as fall progressed is consistent with previous findings (Gates et al. 1984; Marsh 1998; Johnson and Gates 2004). However, it is unknown if the decline is a behavioral response (i.e., trap avoidance) to repeated trapping or a factor of bats entering hibernation as fall progressed. In fall swarming, it is common for sex ratios to be male-biased (Cope and Humphrey 1977; Gates et al. 1984; Johnson and Gates 2004). Cavernicolous female bats, on average, enter and exit hibernation before male bats. Bat species also differ in their hibernation timing. Eastern pipistrelles commonly are the first species to enter, and the last to emerge from, hibernation (LaVal and LaVal 1980). Eastern small-footed bats typically are the last to enter, and the first to emerge from, hibernation (Best and Jennings 1997).

We captured >2 times more eastern small-footed bats than Johnson et al. (2003) did in 2002. It is likely, although not certain, that eastern small-footed bats hibernate in mines at NERI, as suggested by 84 individuals captured at all but 1 mine entrance during fall swarming. Other studies have shown that eastern small-footed bats return to the same caves year after year and often hibernate near their summer range (Mohr 1936; van Zyll de Jong 1985).

We captured 7 Indiana bats at 3 mine entrances (J, C, and S). At mines J and C, Indiana bats were captured for the first time. In 2002, only 1 Indiana bat was captured, at mine S. During this study, we captured Indiana bats during every survey night at mine S. Although this may suggest Indiana bats hibernate in mine S, it is not inconceivable that they are migrating through the area and are possibly using the mine as a stopover during migration between their summer range and hibernaculum. Our Indiana bat captures at mine S confirm the importance of this mine; however, it is still unknown to what extent Indiana bats use the mine. It is possible that it is a hibernaculum, transient roost, and/or breeding site for Indiana bats, and for all other bat species captured there.

We documented Virginia big-eared bats at 3 mine entrances where Johnson et al. (2003) did not (G, N, and Q). However, we did not capture Virginia big-eared bats at 3 mine entrances where Johnson et al. (2003) captured them (K, D, and R). We captured fewer Virginia big-eared bats than Johnson et al. (2003) did in fall 2002 (16 vs. 25), largely because of fewer captures in the

G-I-J, H, and K mine complexes. It is unknown if the entrance collapse at mine T is a factor in the absence of Virginia big-eared bats at mine K. It is unknown if the portals are connected within or if airflow through one entrance affects the other. Cold air was blowing heavily from the entrance of mine K, as it was in 2002, before the entrance collapse. The collapsed and unstable entrance of mine T should not be reopened to allow bat passage or improved airflow until it can be supported or reinforced to reduce the risk of future collapse, which could potentially trap bats in the mine.

We did not sample mine U because it was distant from the other three Q-R-S entrances and would have required three additional nights of sampling. We focused our efforts at Q-R-S, which historically had higher rare and endangered bat species activity (Johnson et al. 2003). It is likely that the level of bat activity and species composition at mine U in fall 2005 was similar to that of 2002, as documented at the Q-R-S entrances.

All captured bat species, with the exception of eastern red bats, are using mines at NERI for some purpose. Eastern red bats are not commonly associated with mines or caves (Barbour and Davis 1969). The few records of eastern red bats using caves mostly are accounts of dead specimens (Quay and Miller 1955). In late summer and early fall, bats arrive at mine 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; Veith et al. 2004). However, it is unknown which bat species, if any, use the mines at NERI as hibernacula. To further complicate assessment of mine use, bats may swarm at portals long distances from their hibernacula. In Canada, Fenton (1969) found that little brown bats captured at a cave during fall swarming hibernated at a cave >800 km (497 mi) away, although many hibernated within 160 km (99 mi). During fall swarming, bats may visit a cave or mine many times (Fenton 1969; Marsh 1998), thus increasing the chance of capture. However, complete turnover in individuals captured on consecutive nights has been observed (Barbour and Davis 1969; Fenton 1969). Conducting surveys on multiple nights at each cave or mine may provide a more accurate assessment of bat use (Gates et al. 1984). Consistent captures of a species at a mine entrance during fall may lend support to the suggestion that the species is using the mine as a hibernaculum, although it is not inconceivable that they are transients (Myers 1964). We consistently captured Indiana bats at mine S and Virginia big-eared bats at mine H. These mines are, at minimum, important swarming sites at NERI. Swarming bats may not day-roost in mines at which they are captured (Fenton 1969). Although it was sometimes difficult to determine if bats were entering or exiting the mines based on our trapping methods and results, on a few occasions we did observe bats emerging from mines, indicating mines probably were being used as day roosts. Virginia big-eared bats were observed emerging from mines N, G, and Q before capture in harp traps. These observations verify that some mines are used as day roosts, or at least transient day roosts, adding to their importance to bats. Virginia big-eared bats and eastern small-footed bats at NERI may be day-roosting in mines or on cliff lines during fall. Indiana bats are known to day-roost in trees near their hibernacula or fall swarming sites during summer and fall (MacGregor et al. 1999; Ford et al. 2002).

Bats may be more likely to have hibernated at caves where they are captured during spring emergence than during fall swarming, although this has not been examined extensively. Timing harp trap surveys likely is more critical during spring than fall. Bats exiting hibernacula in spring may not return until the following fall (Hall and Brenner 1968; Gates et al. 1984).

Chances of capturing exiting bats, particularly at mines where very few individuals of rare or endangered species may hibernate, may be very low. However, Cope and Humphrey (1977) observed swarming behavior exhibited by female Indiana bats (*Myotis sodalis*) at their hibernaculum in spring. Indiana bats are known to emerge from hibernation from mid-March through May in other parts of their range (USDA Forest Service, W. M. Ford, personal communication; Cope and Humphrey 1977; Hobson and Holland 1995). During spring in western Maryland, eastern small-footed bats have been captured as early as mid-March and as late as mid-May (Gates et al. 1984).

Management Implications

The abandoned coal mines at NERI serve as an important habitat component for bats. However, the large tracts of intact forest, proximity of mines to reliable water sources, and cliff lines associated with NERI also are important habitat components. Without foraging structure, water sources, and alternate roost sites, it is unlikely that the more sensitive bat species (e.g., Indiana bat, Virginia big-eared bat, or eastern small-footed bats) would occur at NERI in the numbers recorded in this study. Protecting these resources, as well as the mines, will benefit all bats in the area.

Bat population monitoring at NERI mines should continue. Surveys in March and April may provide more evidence that bats are using NERI mines as hibernacula. However, spring surveys may require much more effort than fall surveys because of the irregular timing of bats emerging from hibernation (Cope and Humphrey 1977; Whitaker and Rissler 1992). Neither spring emergence nor fall swarming surveys will absolutely confirm presence of hibernating bats in NERI mines. Conducting internal surveys is the only method that can reliably assess hibernating bat communities; however, that is very dangerous and should only be attempted by qualified personnel aware of the risks to life and limb. Mines where Indiana bats and Virginia big-eared bats were captured should be surveyed, at most, every other year to minimize disturbance and likelihood of mine abandonment by bats. However, more frequent visits to mines containing rare and/or endangered bats may be necessary to monitor vandalism.

Trapping over water sources during summer months may identify foraging areas of big-eared bats and eastern small-footed bats that may be roosting in the rock cliffs at NERI. Moreover, presence of Indiana bats at NERI during summer may be verified through additional mist netting. The extent to which Indiana bats use NERI is poorly understood and warrants further investigation.

National Park Service staff should contact Craig Stihler to determine the status of the genetics study and isotope analysis for rare and endangered bats at NERI. This study may increase our knowledge on the importance of rare and endangered bat communities at NERI from a metapopulation standpoint. Eastern small-footed bats and Virginia big-eared bats are not known to migrate long-distances, such as that observed for Indiana bats (Kurta and Murray 2002). Populations of eastern small-footed bats, and particularly Virginia big-eared bats, may be disjunct from other populations within their geographic ranges (Johnson et al. 2005).

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Appendix. Accounts of cavernicolous bat species documented at abandoned coal mines at New River Gorge National River, West Virginia, 2005.

Family Vespertilionidae

All bat species inhabiting or potentially inhabiting New River Gorge National River (NERI) belong to the Vespertilionidae family. This family contains 42 genera and 355 species on 6 continents (Nowak 1994). Within the United States, 10 genera and 45 species occur. Potentially, 7 genera and 13 species occur within NERI, based on geographic ranges (Harvey et al. 1999). We captured 7 cavernicolous bat species at NERI.

Virginia big-eared bat (*Corynorhinus townsendii virginianus*)

Morphology - Of the 3 subspecies of Townsend's big-eared bat, 1 (*C. t. virginianus*) is represented at NERI. Weights typically range from 5–13 g and head to tail lengths range from 9–11 cm (Kunz and Martin 1982). Longevity records of >16 years have been reported for Townsend's big-eared bat (*C. t. townsendii*) (Paradiso and Greenhall 1967).

Range and migration—The Virginia big-eared bat is listed as endangered throughout its range in western North Carolina, eastern Kentucky, West Virginia, and western Virginia due to population declines primarily caused by human disturbance at hibernacula and maternity roosts

(U.S. Fish and Wildlife Service 1984). Migratory distances typically are <65 km between hibernacula and summer roosts (Barbour and Davis 1969).

Roosting - Virginia big-eared bats typically use naturally formed limestone caves as hibernacula and as maternity roosts (Rippy and Harvey 1965; White and Seginak 1987; Adam et al. 1994; Lacki et al. 1994), although a summer colony in Kentucky has been documented roosting in a sandstone rock shelter (Lacki et al. 1994), indicating they use other types of roost structures. At NERI, Johnson et al. (2005) documented Virginia big-eared bats roosting in abandoned coal mines. Virginia big-eared bats commonly return to their same roosts year after year (Pearson et al. 1952). In the western United States, Townsend's big-eared bats are known to roost in hard rock mines (Alcorn 1944; Pearson et al. 1952). *Corynorhinus t. townsendii* and *C. mexicanus* are reported to use abandoned gold, silver, copper, and lead mines as hibernacula and maternity roosts in Mexico (Lopez-Gonzalez and Torres-Morales 2004). The largest hibernating population of Virginia big-eared bats (>6,000 individuals) occurs in Hellhole Cave, Pendleton County, West Virginia (Stihler and Brack 1992).

Reproduction - Maternity colonies in West Virginia may consist of 100–1,300 individuals. Females give birth to 1 young each during summer (WVDNR 2003).

Foraging - Virginia big-eared bats forage in the forest canopy (Dalton et al. 1986; Sample and Whitmore 1993). The high-resolution echolocation call of the Virginia big-eared bat allows it to glean insects from foliage (Griffin et al. 1963). Adam et al. (1994) reported that the primary foraging habitat of the Virginia big-eared bat in the Daniel Boone National Forest was intact forest adjacent to cliff lines. However, in western Virginia, Dalton et al. (1986, 1989) reported Virginia big-eared bats foraging in pastures where their roost cave was located.

Although Virginia big-eared bats are considered Lepidopteran- (moth) specialists, they are known to consume a variety of insects including Coleopterans (beetles), Dipterans (flies), Homopterans (leaf hoppers), Hymenopterans (flying ants), Neuropterans (lacewings),

Tricopterans (caddisflies), and Plecopterans (stoneflies) (Dalton et al. 1986, Sample and Whitmore 1993, Burford and Lacki 1998).

Big brown bat (*Eptesicus fuscus*)

Morphology—Of the 11 subspecies of big brown bat, 1 (*E. f. fuscus*) is represented at NERI. Big brown bats are 1 of the largest bat species that occur at NERI. Weights typically range from 13–25 g and head to tail lengths range from 10–13 cm (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 U.S., Central America, and northern South America (Kurta and Baker 1990). Migratory distances typically are <80 km 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 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). Big brown bats often are observed foraging around streetlights (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, Dipterans, Hemipterans (stinkbugs, squashbugs), Homopterans, Hymenopterans, Lepidopterans, Orthopterans (locusts, katydids, crickets, grasshoppers), and Tricopterans. The majority of the big brown bat's diet consists of coleopterans including many agricultural pests such as spotted cucumber beetles (Griffith and Gates 1985; Whitaker 1995; Agosta and Morton 2003; Carter et al. 2003).

Eastern small-footed bat (*Myotis leibii*)

Morphology - The eastern small-footed myotis is monotypic and is 1 of the smallest bats that occur at NERI. Weights range from 3–6 g and head to tail lengths average about 8 cm (Best and Jennings 1997). Longevity records of up to 9 years have been reported (Cockrum 1956).

Range and migration - The eastern small-footed bat is considered rare throughout its range, which 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). In West Virginia, it is a state-listed "rare" species. Low over-winter survival rates may be the cause of its relative rarity (Hitchcock et al. 1984).

Roosting - During winter, eastern small-footed bats 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 bats 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).

Reproduction - Little is known about maternity roosts or reproduction of eastern small-footed bats, 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 bats. Individuals have been observed foraging <3 m from the forest floor (van Zyll de Jong 1985). An analysis of 4 eastern small-footed bats in western Maryland found their diets consisted of Lepidopterans, Coleopterans, Dipterans, Neuropterans, and Homopterans (McDowell-Griffith 1983).

Little brown bat (*Myotis lucifugus*)

Morphology - Of the 6 subspecies of little brown bat, 1 (*M. l. lucifugus*) occurs at NERI. Little brown bat weights range from 4–8 g, and head to tail lengths average 9 cm (Fenton and Barclay 1980). Little brown bats have been documented living ≤30 years (Griffin and Hitchcock 1965; Keen and Hitchcock 1980).

Range and migration - The little brown bat is considered common throughout its range, which includes Alaska, east through Canada, all continental U.S. except for the plains states, and parts of Florida and coastal areas of the southeast U.S. (Fenton and Barclay 1980). Little brown bats migrate <272 km (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 bats occupy northern and southern latitudes in the eastern U.S. year round (Barbour and Davis 1969).

Roosting - Little brown bats 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 woodpiles during summer (Fenton and Barclay 1980). Maternity colonies of hundreds and 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 bat 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 3 weeks (Anthony and Kunz 1977).

Foraging - Little brown bats 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 bats had a mean home range size of 30.1 ± 15.0 ha when pregnant and 17.6 ± 9.1 when lactating (Henry et al. 2002).

The diet of little brown bat is diverse and includes Coleopterans, Dipterans, Ephemeropterans (mayflies), Hemipterans, Homopterans, Hymenopterans, Lepidopterans, Neuropterans, Tricopterans (Buchler 1976; LaVal and LaVal 1980; Warner 1985; Carter et al. 2003)

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 (Caceres and Barclay 2000). A longevity record of >18.5 years has been reported (Hall et al. 1957).

Range and migration - The northern myotis is considered common throughout its range, which is the eastern half of continental U.S. and southern Canada (Caceres and Barclay 2000). Migrations of 56 km (Caire et al. 1979; Nagorsen and Brigham 1993) and 88 km 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. 2003), 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. (2002b) found that northern myotis maternity colonies preferred roosting in understory black locust (*Robinia pseudoacacia*) 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. 2002b). The young become volant at 4 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 (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, Homopterans, Hemipterans, Ephemeropterans, Plecoptera, and Neuropterans (LaVal and LaVal 1980; Griffith and Gates 1985; Brack and Whitaker 2001; Carter et al. 2003).

Indiana bat (*Myotis sodalis*)

Morphology - The Indiana bat is monotypic. Its weight ranges from 5–11 g, and head to tail lengths range from 8–9 cm (Whitaker and Hamilton 1998). Longevity records of >20 years have been reported (LaVal and LaVal 1980).

Range and migration - The geographic range of Indiana bats includes midwestern U.S., east to the Appalachian Mountains, through New England (Thomson 1982). Indiana bats were listed as an endangered species in 1967 under the Endangered Species Act of 1966 because of significant population declines. Although efforts have been made to protect critical winter hibernacula (i.e., caves and mines), populations have continued to decrease. A 2000−2001 Indiana bat 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 bat populations have been stable in Pennsylvania, possibly because of hibernacula protection. In West Virginia, a 2000/2001 hibernacula census revealed an Indiana bat population estimated at 9,700 individuals, compared to an estimated 1,500 individuals during the 1960s (Clawson 2002). Stable and increasing Indiana bat 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 bat population recovery, conservation of summer habitat is equally imperative. Indiana bats begin to emerge from hibernation in mid-April (Cope and Humphrey 1977) and migrate long distances, sometimes over 500 km, to their summer ranges (Kurta and Murray 2002).

Roosting - Indiana bats hibernate in over 300 caves and abandoned mines in 26 states. Over half the total Indiana bat population hibernate in 7 caves and 1 mine (Clawson 2002). Indiana bats form tight clusters (>3,000 individuals/m^2) in hibernation (Clawson et al. 1980). There are 92 Priority II (containing 500−30,000 individuals) and III (containing <500 individuals) Indiana bat hibernacula in the central and southern Appalachian Mountains from central Pennsylvania to northeastern Alabama (Humphrey 1978; USFWS 1999; Menzel et al. 2001). One Priority II and several III Indiana bat hibernacula exist in West Virginia (Stihler and Brack 1992; Ford et al. 2002). During summer, male Indiana bats sometimes migrate very short distances (<20 km) or use hibernacula as summer roosts (Hobson and Holland 1995; Ford et al. 2002). Currently, it is unclear where many female Indiana bats migrate to from West Virginia and Pennsylvania hibernacula. Captures of female Indiana bats in West Virginia during summer are rare (Owen et al. 2001).

During summer, female Indiana bats form maternity colonies of 20−100 individuals in primary roost trees, which typically are large-diameter (>35 cm) 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 bats including red (*Acer*

rubrum), silver (*A. saccharinum*), and sugar (*A. saccharum*) maple, black birch (*Betula lenta*), bitternut (*Carya cordiformis*), pignut (*C. glabra*) and shagbark (*C. ovata*) hickory, shortleaf, pitch (*P. rigida*), and Virginia (*P. virginiana*) pine, cottonwood (*Populus deltoides*), white (*Fraxinus americana*), black (*F. nigra*), and green (*F. pennsylvanica*) ash, sycamore (*Platanus occidentalis*), white (*Quercus alba*), scarlet (*Q. coccinea*), shingle (*Q. imbricaria*), northern red (*Q. rubra*), and post (*Q. stellata*) oak, eastern hemlock (*Tsuga canadensis*), sassafras (*Sassafras albidum*), and American (*Ulmus americana*) and slippery (*U. rubra*) elm (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 bat 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 1158 m, significantly higher than any previously recorded roost tree. The foraging habits of Indiana bats in the Appalachian region are not well known. Few cases of Indiana maternity colonies roosting in buildings have been documented. In Blair County, Pennsylvania, a maternity colony of <30 Indiana bats was documented roosting in a church attic (Butchkoski and Hassinger 2002).

Reproduction - Female Indiana bats give birth to 1 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 bats 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 bat foraging activity was concentrated 2−30 m above the forest floor. Indiana bats 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 bats 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 bat maternity roosts in stands that had been heavily logged within the past 20 years. Gardner et al. (1991) found that Indiana bats in Illinois foraged in areas that had been logged using selection harvest techniques. In West Virginia, Indiana bat activity was higher in intact forest cover than in forest gaps (Ford et al. 2005). Radio-tagged bats from the Blair County, Pennsylvania, maternity colony were documented foraging mostly in a nearby section of intact forest with relatively flat (<10º slope) topography. Although the church was located within known foraging distances of Lock Mountain (elevation 580 m), no bats were documented foraging on the slope or ridgetop (Butchkoski and Hassinger 2002).

Indiana bats consume a wide variety of insects including Coleopterans, Dipterans, Ephemeropterans, Hemipterans, Homopterans, Hymenopterans, Lepidopterans, Neuropterans, Plecopterans, and Tricopterans (Brack and LaVal 1985; Kurta and Whitaker 1998).

Eastern pipistrelle (*Pipistrellus subflavus*)

Morphology - Of the 4 subspecies of eastern pipistrelle, only 1 (P. s. subflavus) occurs at NERI. It is 1 of the smallest bats at NERI, with weights ranging from 4–8 g, and lengths averaging 8 cm (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 U.S., south to the Gulf of Mexico coastline (Fujita and Kunz 1984). Eastern pipistrelles may migrate up to 120 km, but typically migrate <50 km (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. 2003). Females have been documented forming maternity colonies of 11 individuals in a barn (Winchell and Kunz 1993); <29 individuals in barns, pavilions, and 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 (Tillandsia usneoides) and understory trees (Menzel et al. 1999).

Reproduction - After a 44 day gestation period, females give birth to 2 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 and 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-telemetered female in Georgia had a home range of 389.2 ha and foraged 1137 m on average from her roost (Krishon et al. 1997). A radio-telemetered female in South Carolina had a home range of 395.5 ha (Carter et al. 1999). Eastern pipistrelles have a diverse diet that includes Coleopterans, Dipterans, Hemipterans, Homopterans, Hymenopterans, Lepidopterans, and Tricopterans (Sherman 1939; LaVal and LaVal 1980; Carter et al. 2003).

As the nation's primary conservation agency, the Department of the Interior has responsibility for most of our nationally owned public land and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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