

**MIST NET SURVEYS
AT THE PROPOSED BEECH RIDGE WIND FARM
GREENBRIER COUNTY, WEST VIRGINIA**

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1.0 INTRODUCTION

Invenergy Wind LLC has proposed construction of a 200 MW wholesale wind energy generation facility along approximately 23 miles of forested Appalachian Mountain ridgelines in Greenbrier County, West Virginia (Figure 1). Invenergy Wind LLC contracted BHE Environmental, Inc. to investigate the summer presence of bats within the Beech Ridge project area. Pursuant to recommendations made by the U.S. Fish and Wildlife Service (USFWS), fifteen sites were surveyed using mist nets between July 22 and July 26, 2005. Seventy-eight bats of six species were captured during this survey. Two additional bats were captured in nets but escaped before being identified. No federally listed species were captured.

2.0 BATS OF THE BEECH RIDGE PROJECT AREA

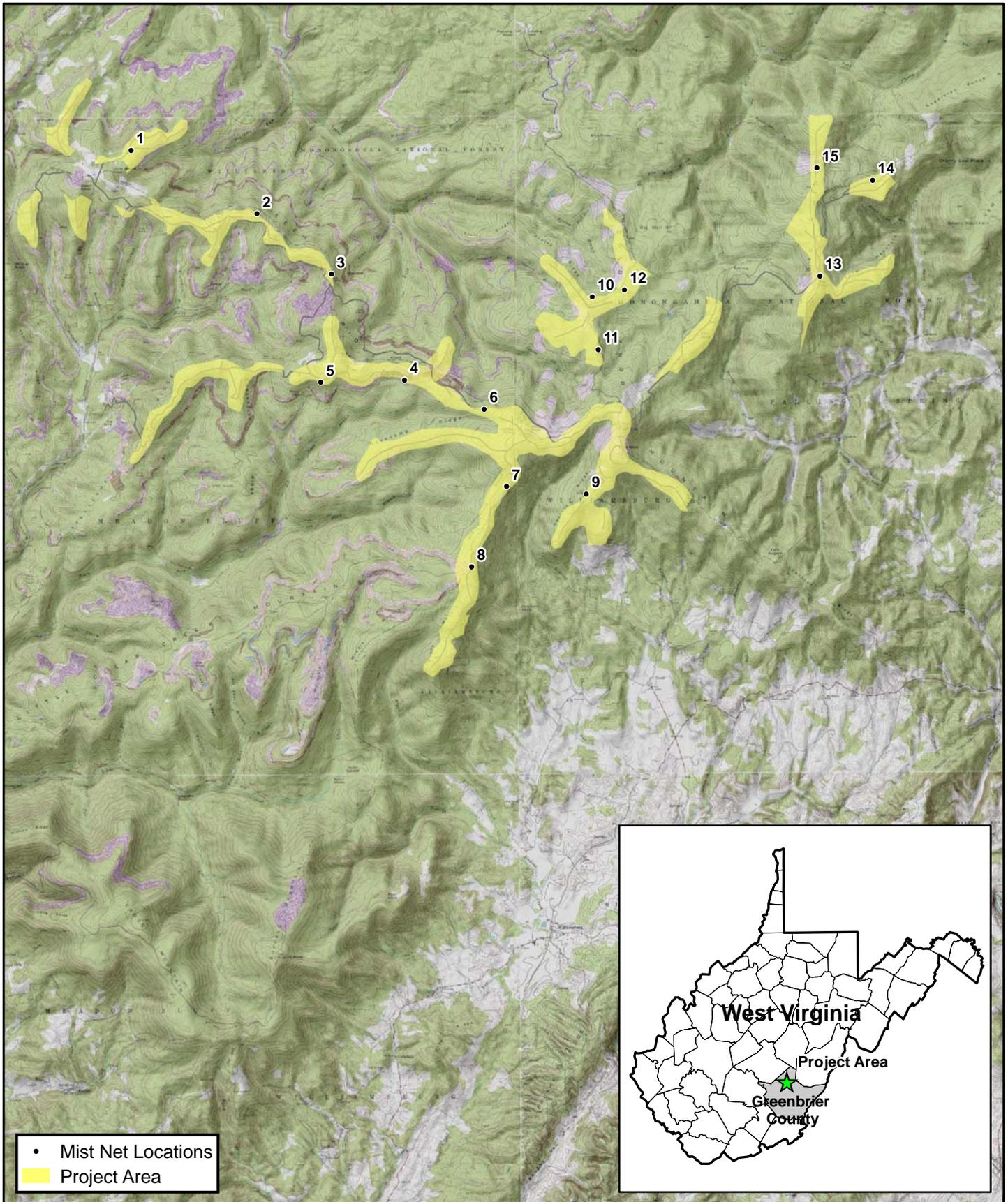
Thirteen species of bats inhabit West Virginia (Table 1). Except for the gray bat (*Myotis grisescens*), Rafinesque's big eared bat (*Corynorhinus rafinesquii*), and the evening bat (*Nycticeius humeralis*), each of the species has potential to occur in the project area.

West Virginia is generally considered to be outside the range of gray bats (BCI 2005a, WVDNR 2005). There is one record of two gray bats in Hellhole Cave in Pendleton County, which is located two counties north of Greenbrier County (WVDNR 2005, Garton et al. 1993), but there are no other summer or winter records of the species in West Virginia.

The Rafinesque's big-eared bat is also rare in West Virginia. It has been recorded in Fayette (immediately west of Greenbrier County) and Wayne (the westernmost county in West Virginia) counties (Natureserve 2005) and in Collison Cave in Nicholas County (immediately northwest of Greenbrier County) (Garton et al. 1993). However, records are limited to very few individuals.

The evening bat is classified by the WVDNR as SH, historically present in the state. Some range maps for the species exclude West Virginia, with records of the species in the state considered isolated or questionable (BCI 2005b).

The other 10 bat species in West Virginia include year-round residents as well as species present only during certain seasons (Table 1). The Indiana bat (*M. sodalis*) and Virginia big-eared bat (*C. townsendii virginianus*) are federally listed as endangered. Eight species are not federally listed, are not proposed for listing, and are not Candidate species. Although the West Virginia Nongame Wildlife and Natural Heritage Program (NWNHP) tracks populations of rare species, the state of West Virginia does not list species as threatened or endangered, and does not provide special protection to rare species.



- Mist Net Locations
- Project Area

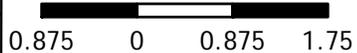


Figure 1. Locations of fifteen mist net sites at the proposed Beech Ridge wind farm project area, Greenbrier County, West Virginia.

August 2005

Project No. 1664.004

Miles



Base Map: 7.5 Minute USGS Topographic Map - Cornstalk, WV, Duo, WV, Fork Mountain, WV, Richwood, WV, Trout, WV, and Williamsburg, WV.



Table 1. Bats potentially present in West Virginia and in the Beech Ridge project area during summer, winter, and spring/fall migration.

Species	Status	Potential Seasonal Presence within Beech Ridge Project Area			Identified in Greenbrier County?*
		Summer	Winter	Migration	
Indiana bat (<i>Myotis sodalis</i>)	Federal: endangered WV: S1	Yes	No	Yes	Winter
Virginia big-eared bat (<i>Corynorhinus townsendii virginianus</i>)	Federal: endangered WV: S2	Yes	No	Yes**	No
Northern long-eared bat (<i>Myotis septentrionalis</i>)	None	Yes	No	Yes	Summer, winter
Eastern small-footed bat (<i>Myotis leibii</i>)	Federal: none WV: S1	Yes	Yes	Yes	Summer, winter
Little brown bat (<i>Myotis lucifugus</i>)	None	Yes	No	Yes	Summer, winter
Eastern pipistrelle (<i>Pipistrellus subflavus</i>)	None	Yes	Yes	Yes	Summer, winter
Big brown bat (<i>Eptesicus fuscus</i>)	None	Yes	Yes	Yes**	Summer, winter
Eastern red bat (<i>Lasiurus borealis</i>)	None	Yes	Yes	Yes	Summer
Hoary bat (<i>Lasiurus cinereus</i>)	None	Yes	Unlikely	Yes	Summer
Silver-haired bat (<i>Lasionycteris noctivagans</i>)	Federal: none WV: S2	No	Yes	Yes	Winter
Gray bat (<i>Myotis grisescens</i>)	Federal: endangered WV: SA	No	No	No	No
Rafinesque's big-eared bat (<i>Corynorhinus rafinesquii</i>)	Federal: none WV: S1	No	No	No	No
Evening bat (<i>Nycticeius humeralis</i>)	Federal: none WV: SH	Unlikely	No	Unlikely	No

*Absence of records in the county likely reflects survey effort and does not indicate absence of the species.

**Species is not migratory, but may be present during spring and fall.

West Virginia NWNHP Rank:

S1 = Five or fewer documented occurrences, or very few individuals remaining in the state. Extremely rare and critically imperiled, or because of factor(s) making the species vulnerable to extirpation.

S2 = Six to twenty documented occurrences, or few individuals remaining in the state. Very rare and imperiled, or ranked because of factor(s) making the species vulnerable to extirpation.

SH = Historically present in the state, not relocated in past 20 years, may be rediscovered.

3.0 METHODS

3.1 SITE SELECTION

Mist net sites were selected during field reconnaissance; site selection was based primarily upon extent of canopy cover and presence of an open flyway. Nets were deployed in areas that provided optimum chance to capture foraging bats (Figure 1).

3.2 MIST NETTING

Mist netting was conducted from July 22-26, 2005, and followed Indiana Bat Recovery Plan guidelines (USFWS 1999, Appendix A). As agreed to in a conversation and subsequent email exchange between BHE and Mr. Frank Pendelton (USFWS, Elkins Field Office), mist nets were to be deployed at fifteen sites within the project area.

Mist net sizes ranged from approximately 20 to 30 ft in height, and were 18 to 42 ft wide with one exception: a third net set was erected at Site No. 13 and measured 10 ft wide by 9 ft high. A net set consisted of two or three nets suspended (horizontally) between two poles. The nets were tiered and raised and lowered with a pulley system (Gardner et al. 1989). Two net sets were erected, and spaced at least 100 ft apart, at fourteen sites. The two net sets were operated for two calendar nights at these fourteen sites, resulting in a total of four net nights for each site surveyed (four net nights per site x fourteen sites = 56 net nights). At Site No. 13, three net sets were operated for two calendar nights, resulting in six net nights. The total for all fifteen sites was 62 net nights of survey. A "net night" is defined as the operation of one net set for one night.

Mist nets were of 2-ply, 50-denier, nylon construction with a mesh size of no larger than 1.5 inches. Hardware (metal poles, pulleys and ropes) similar to that described in Gardner et al. (1989) was used to suspend the nets across flight corridors. Nets were placed so that canopy cover and vegetation created a funneling effect to facilitate capture of bats to the maximum extent practicable. Mist nets were deployed at dusk (approximately 2100 hours) and monitored every 20 minutes for at least five hours from deployment. Temperature, wind speed and direction, percent cloud cover, and moon phase (if visible) typically were recorded approximately every hour during the survey. A standard mercury thermometer was used to record temperature. Wind speed, percent cloud cover, and moon phase were estimated.

3.3 BAT HANDLING PROCEDURES

Upon capture, bats were removed from the nets, identified to species, weighed, measured, and released unharmed at the capture site. The following data were recorded for each bat captured: species, age, sex, reproductive condition, right forearm length

(RFA; to nearest 0.1 millimeter using Vernier calipers), weight (to nearest half gram, using a Pesola® scale), time of capture, and capture height in net. All bats were identified to species based upon distinctive morphological characteristics (e.g., body size, hair color, ear length, tragus shape, presence/absence of a keeled calcar). Adult female bats were classified as reproductive if they were pregnant (determined by palpation of abdomen) or bore signs of nursing young (i.e., lack of hair surrounding the teats). Male bats whose testes were descended into the scrotum were considered reproductive.

4.0 RESULTS

4.1 SITE DESCRIPTIONS

The Beech Ridge project area lies at an average elevation of 3,800 feet above msl and is largely forested, with notable exceptions being corridors cleared for roads. Mist nets were placed in the best available locations within the project area boundary. In most instances, nets were placed across small roads or trails. No stream corridors were present within the ridgeline project area.

Pursuant to conversations with Mr. Frank Pendleton (USFWS, Elkins Field Office) BHE placed mist net sites in areas that 1) provided optimum chance to capture foraging bats, and 2) were distributed as evenly as practicable across the Beech Ridge project area to provide results representative for the entire area (Table 2). Photographs of all net sites are provided in Appendix B.

4.2 BATS CAPTURED

A total of 78 bats (excluding two individuals which escaped before they could be identified), representing six species, was captured at fifteen sites within the project area during 62 net nights of survey between July 22 and July 26, 2005 (Tables 2 and 3). Bats were captured at twelve of fifteen sites; no bats were captured at Site Nos. 4, 5, and 15. The following species were captured:

- little brown bats (*Myotis lucifugus*, n = 22; 28%),
- big brown bats (*Eptesicus fuscus*, n = 17; 22%),
- red bats (*Lasiurus borealis*, n = 13; 16%),
- eastern pipistrelles (*Pipistrellus subflavus*, n = 10; 13%),
- northern long-eared bats (*Myotis septentrionalis*, n = 10 ; 13%), and
- hoary bats (*Lasiurus cinerius*, n = 6; 8%).

No federally listed species were captured during the survey.

Table 2. Description of fifteen mist net sites surveyed at the Beech Ridge project area between July 22 - July 26, 2005.

Mist Net Site No.	Dates Surveyed (2005)	Net Placement	Percent Canopy Closure		Dominant Overstory Species	Dominant Understory Species
			Net Set No. 1	Net Set No. 2		
1	25 Jul-26 Jul	Two net sets placed over gravel access road	30	10	sugar maple (<i>Acer saccharum</i>) paper birch (<i>Betula papyrifera</i>) American beech (<i>Fagus grandifolia</i>)	sugar maple American beech striped maple (<i>A. pensylvanicum</i>)
2	23 Jul-24 Jul	Two net sets placed over gravel access road	50	30	sugar maple red maple (<i>A. rubrum</i>) northern red oak (<i>Quercus rubra</i>)	sugar maple American basswood (<i>Tilia americana</i>) sweet birch (<i>B. lenta</i>)
3	22 Jul-23 Jul	Two net sets placed over dirt-covered trail	40	40	sugar maple American beech American elm (<i>Ulmus americana</i>)	American beech American basswood black locust (<i>Robinia pseudoacacia</i>)
4	23 Jul-24 Jul	Two net sets placed over upland road	20	20	black locust red pine (<i>Pinus resinosa</i>) pin cherry (<i>Prunus pensylvanica</i>)	black locust autumn olive (<i>Eleagnus umbellate</i>) pin cherry
5	23 Jul-24 Jul	Two net sets placed over logging road	40	50	sugar maple red maple black cherry (<i>P. serotina</i>)	sugar maple red maple black locust
6	23 Jul-24 Jul	Two net sets placed over upland road	80	80	sugar maple northern red oak American beech	sugar maple American beech yellow birch (<i>B. allegheniensis</i>)
7	23 Jul-24 Jul	Two net sets placed over gravel road	70	70	red maple northern red oak yellow birch	striped maple red maple northern red oak yellow birch
8	24 Jul-25 Jul	Two net sets placed over gravel road	70	70	red maple northern red oak yellow birch	red maple striped maple northern red oak yellow birch

Mist Net Site No.	Dates Surveyed (2005)	Net Placement	Percent Canopy Closure		Dominant Overstory Species	Dominant Understory Species
9	24 Jul-26 Jul	One net set placed over gravel road; second net set placed over logging road	20-30	20-30	sugar maple yellow birch black locust northern red oak	elderberry (<i>Sambucus canadensis</i>) witch hazel (<i>Hamamelis virginia</i>) smooth sumac (<i>Rhus glabra</i>)
10	24 Jul-25 Jul	Two net sets placed over upland road	80	70	pin cherry striped maple yellow birch	sugar maple American beech tulip poplar (<i>Liriodendron tulipifera</i>)
11	25 Jul-26 Jul	Two net sets placed over upland road	20	20	pin cherry sweet birch black locust sugar maple	sweet birch pin cherry sweet maple black locust
12	25 Jul-26 Jul	One net set placed near upland road; second net set placed over gravel road	95	20	sugar maple red maple northern red oak black locust	sugar maple northern red oak black locust staghorn sumac (<i>R. typhina</i>)
13	25 Jul-26 Jul	One net set placed over gravel road; second net set placed over logging road; third net set placed over waterhole	0-70	0-70 at Net Set Nos. 2 and 3	sugar maple northern red oak Allegheny blackberry (<i>Rubus allegheniensis</i>) yellow birch	elderberry Allegheny blackberry smooth sumac
14	25 Jul-26 Jul	Two net sets placed over gravel road	10	10	northern red oak red maple big leaf magnolia (<i>Magnolia macrophylla</i>)	striped maple pin cherry yellow birch
15	25 Jul-26 Jul	Two net sets placed over wooded trail	75	75	sugar maple red maple yellow birch	red maple yellow birch striped maple mountain maple (<i>A. spicatum</i>)

During the survey, air temperatures were within seasonal norms and met the criteria prescribed by the Indiana Bat Recovery Team for conducting mist net surveys. Nightly lows ranged from 50 to approximately 70°F. Occasional light rain fell in the early evening of July 25, but did not interfere with mist netting. Sky conditions were otherwise clear to partly cloudy during the survey.

5.0 DISCUSSION

BHE conducted a mist net survey of the Beech Ridge project area using methods prescribed by the Indiana Bat Recovery Team, at a level of effort recommended by the USFWS for investigating presence of bats within the proposed Beech Ridge wind farm project area. Timing of the survey and conditions in the field were appropriate for investigating presence of bats during the summer. No federally listed species were captured during the survey. Six species, all expected to occur in West Virginia, were captured during the survey. A description of each of these species can be found in the *Chiropteran Risk Assessment: Proposed Beech Ridge Wind Energy Generation Facility, Greenbrier County, West Virginia* (BHE Environmental, Inc 2005).

Capture of reproductively active female and/or juveniles of the following species suggests these species may occupy maternity roosts within or near the project area: little brown bats, big brown bats, eastern pipistrelles, northern long-eared bats, and hoary bats. No juvenile or female eastern red bats were captured during the survey.

Hoary bats and eastern red bats, species which roost in trees, made up approximately 24% of the total bat capture.

Table 3. Bat species captured during the mist net survey of fifteen sites at the proposed Beech Ridge project area, Greenbrier County, West Virginia from July 22-26, 2005.

Species	Juvenile	Adult Male	Adult Female			ESC	Total
			PL	L	NR		
Little brown bat (<i>Myotis lucifugus</i>)	4	12	3	0	2	1	22
Northern long-eared bat (<i>Myotis septentrionalis</i>)	4	4	2	0	0	0	10
Eastern pipistrelle (<i>Pipistrellus subflavus</i>)	1	8	0	0	0	1	10
Big brown bat (<i>Eptesicus fuscus</i>)	2	9	4	0	0	2	17
Hoary bat (<i>Lasiurus cinereus</i>)	2	3	0	1	0	0	6
Red bat (<i>Lasiurus borealis</i>)	0	7	0	0	0	6	13
Unknown	0	0	0	0	0	2	2
Total	13	43	9	1	2	12	80

Abbreviations: post-lactating (PL), lactating (L), non-reproductive (NR), and escaped (ESC)

Table 4. Sites, dates, number of species, and total number captured per site, at the Beech Ridge project area from July 22-26, 2005.

Site	Dates (2005)	Little brown bat (<i>Myotis lucifugus</i>)	Northern long eared bat (<i>Myotis septentrionalis</i>)	Eastern pipistrelle (<i>Pipistrellus subflavus</i>)	Big brown bat (<i>Eptesicus fuscus</i>)	Hoary bat (<i>Lasiurus cinereus</i>)	Red bat (<i>Lasiurus borealis</i>)	Unknown	Total
1	25 Jul-26 Jul	4	1	1	4	0	2	0	12
2	23 Jul-24 Jul	1	0	2	1	0	1	0	5
3	22 Jul-23 Jul	2	3	0	0	0	0	1	6
4	23 Jul-24 Jul	0	0	0	0	0	0	0	0
5	23 Jul-24 Jul	0	0	0	0	0	0	0	0
6	23 Jul-24 Jul	1	0	1	2	0	1	0	5
7	23 Jul-24 Jul	1	0	1	3	0	3	0	8
8	24 Jul-25 Jul	2	0	1	2	0	0	0	5
9	24 Jul-26 Jul	2	1	2	1	0	5	0	11
10	24 Jul-25 Jul	3	1	1	0	0	0	0	5
11	25 Jul-26 Jul	3	2	0	4	4	1	1	15
12	25 Jul-26 Jul	1	0	1	0	1	0	0	3
13	25 Jul-26 Jul	2	1	0	0	0	0	0	3
14	25 Jul-26 Jul	0	1	0	0	1	0	0	2
15	25 Jul-26 Jul	0	0	0	0	0	0	0	0
	Total	22	10	10	17	6	13	2	80

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APPENDIX A

Mist Netting Survey Guidelines from the Indiana Bat Recovery Plan

GUIDELINES FOR MIST NETTING INDIANA BATS

These guidelines were prepared by the Indiana Bat Recovery Team and are presented in the Indiana Bat (*Myotis sodalis*) Revised Recovery Plan (USFWS 1999).

RATIONALE

A typical mist net survey is an attempt to determine presence or probable absence of the species; it does not provide sufficient data to determine population size or structure. Following these guidelines will standardize procedures for mist netting. It will help maximize the potential for capture of Indiana bats at a minimum acceptable level of effort. Although the capture of bats confirms their presence, failure to catch bats does not absolutely confirm their absence. Netting effort as extensive as outlined below usually is sufficient to capture Indiana bats. However, there have been instances in which additional effort was necessary to detect the presence of the species.

NETTING SEASON

15 May - 15 August

These dates define acceptable limits for documenting the presence of summer populations of Indiana bats, especially maternity colonies. Several captures, including adult females and young of the year, indicate that a nursery colony is active in the area. Outside these dates, even when Indiana bats are caught, data should be carefully interpreted. If only a single bat is captured, it may be a transient or migratory individual.

EQUIPMENT

Mist nets - Use the finest, lowest visibility mesh commercially available:

- In the past, this was 1 ply, 40 denier monofilament - denoted 40/1
- Currently, monofilament is not available and the finest on the market is 2 ply, 50 denier nylon - denoted 50/2
- Mesh of approximately 1.5 (1.25 - 1.75) inch

Hardware - No specific hardware is required. There are many suitable systems of ropes and/or poles to hold the nets. See NET PLACEMENT below for minimum heights, habitats, and other netting requirements that affect the choice of hardware. The system of Gardner, et al. (1989) has met the test of time.

NET PLACEMENT

Potential travel corridors such as streams or logging trails typically are the most effective places to net. Place the nets approximately perpendicular across the corridor. Nets should fill the corridor, side to side, and from stream (or ground) level up to the overhanging canopy. A typical set is seven meters high consisting of three or more nets "stacked" on top one another and up to 20 m wide. (Different width nets may be purchased and used as the situation dictates.) Occasionally, it may be desirable to net where there is no good corridor. Take caution to get the nets up into the canopy. The typical equipment described in the section above may be inadequate for these situations, requiring innovation on the part of the observers.

RECOMMENDED NET SITE SPACING

Stream corridors - 1 net site per kilometer of stream.

Non-corridor land tracts - 2 net sites per square kilometer of forested habitat.

MINIMUM LEVEL OF EFFORT

Netting at each site should consist of:

- At least three net nights (unless bats are caught sooner) (one net set up for one night = one net night)

- A minimum of 2 net locations at each site (at least 30 meters apart, especially in linear habitat such as a stream corridor)

- A minimum of 2 nights of netting

- Sample Period: begin at sunset and net for at least 5 hours

- Each net should be checked approximately every 20 minutes

- No disturbance near the nets, other than to check nets and remove bats

WEATHER CONDITIONS

Severe weather adversely affects capture of bats. If Indiana bats are caught during weather extremes, it is probably because they are at the site and active despite inclement weather. On the other hand, if bats are not caught, it may be that there are bats at the site but they may be inactive due to the weather. Negative results combined with any of the following weather conditions throughout all or most of a sampling period are likely to require additional netting:

- Precipitation

- Temperatures below 10°C

- Strong winds (Use good judgement: moving nets are more likely to be detected by bats.)

MOONLIGHT

There is some evidence that small myotine bats avoid brightly lit areas, perhaps as predator avoidance. It is typically best to set nets under the canopy where they are out of the moon light, particularly when the moon is ½-full or greater.

APPENDIX B

Photographs of Mist Net Sites



Photo 1. Mist Net Site No. 1.



Photo 2. Mist Net Site No. 2.



Photo 3. Mist Net Site No. 3.

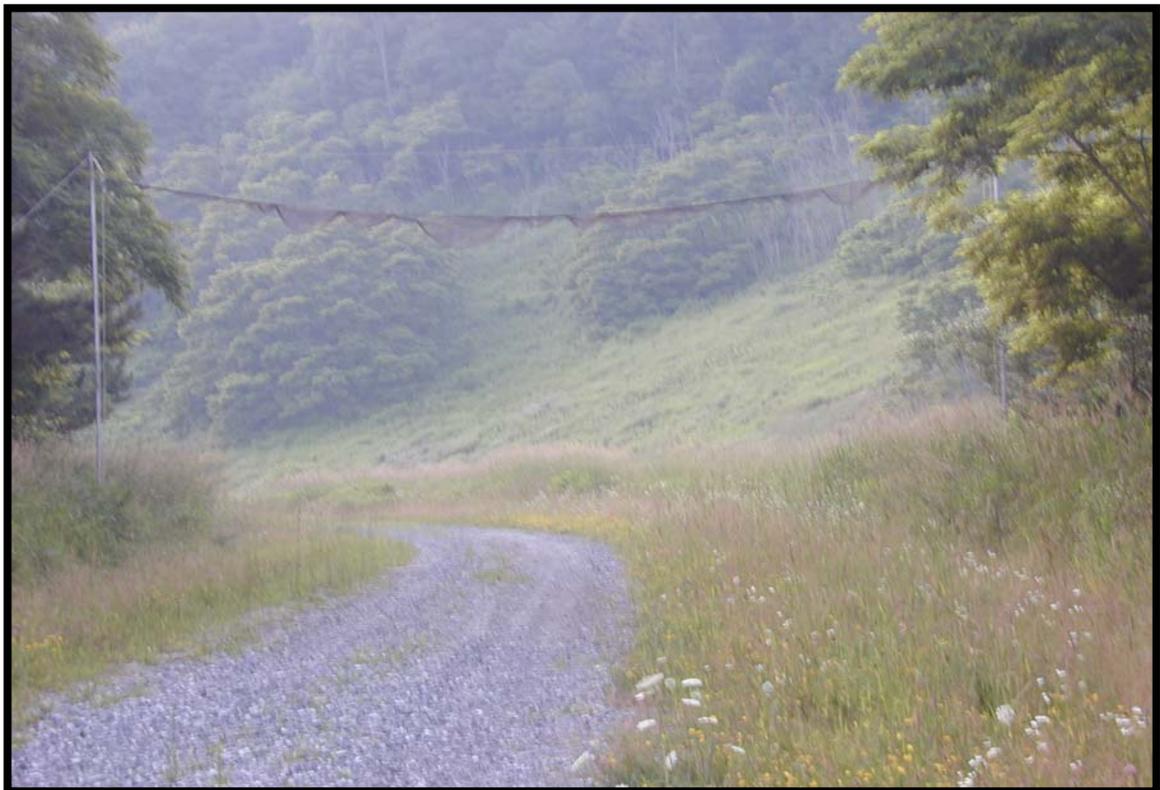


Photo 4. Mist Net Site No. 4.



Photo 5. Mist Net Site No. 5.



Photo 6. Mist Net Site No. 6.



Photo 7. Mist Net Site No. 7.



Photo 8. Mist Net Site No. 8.



Photo 9. Mist Net Site No. 9.



Photo 10. Mist Net Site No. 10.



Photo 11. Mist Net Site No. 11.



Photo 12. Mist Net Site No. 12.



Photo 13. Mist Net Site No. 13.



Photo 14. Mist Net Site No. 14.

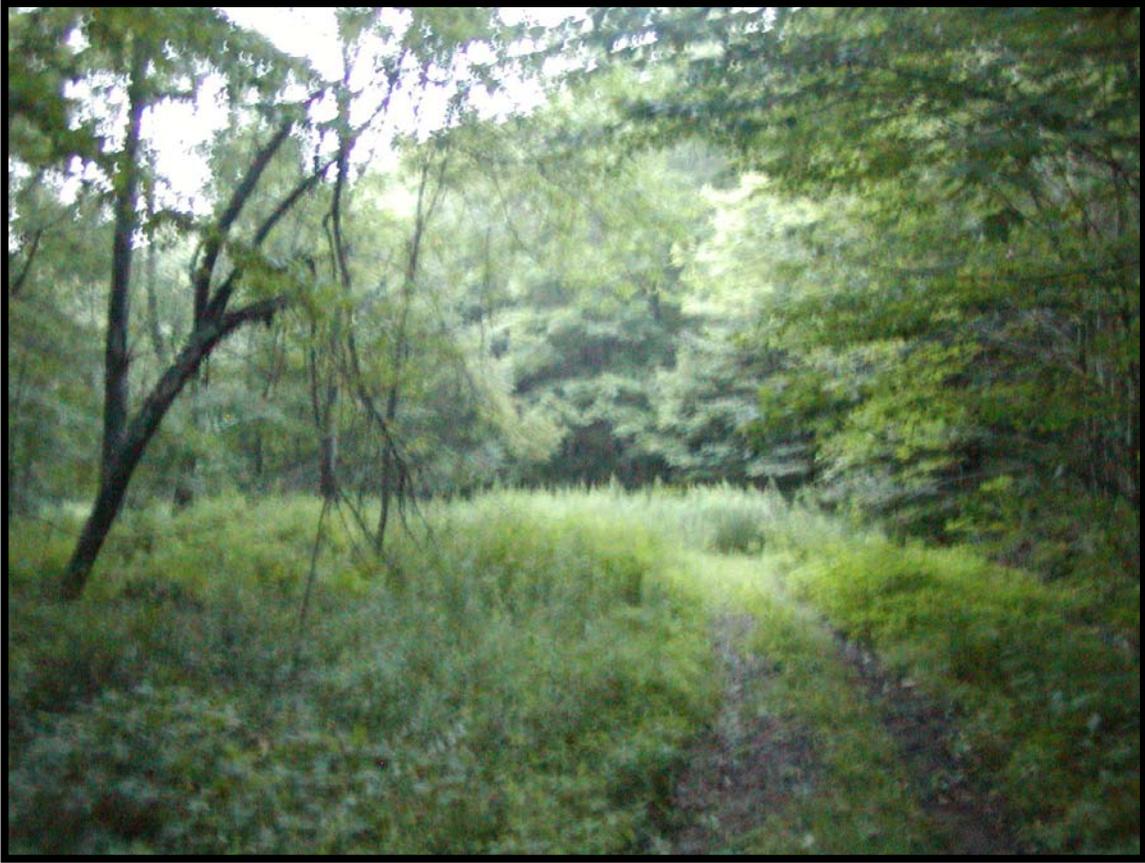


Photo 15. Mist Net Site No. 15.