An Assessment of Potential Collision Mortality of Migrating Indiana Bats (*Myotis sodalis*) and Virginia Big-eared Bats (*Corynorhinus townsendii virginianus*) Traversing Between Caves
Supplement to :

Biological Assessment for the Federally Endangered Indiana Bat (*Myotis sodalis*) and Virginia Big-eared Bat (*Corynorhinus townsendii virginianus*)

NedPower Mount Storm Wind Project, Grant County, West Virginia

Prepared For:

NedPower Mount Storm LLC
5160 Parkstone Drive, Suite 260
Chantilly, VA 20151

Prepared By:

Gregory D. Johnson
M. Dale Strickland

WEST, Inc.

Western Ecosystems Technology, Inc.
2003 Central Avenue
Cheyenne, Wyoming 82001

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Introduction

NedPower Mount Storm is proposing an approximately 300 megawatt (MW) wind farm in Grant County, West Virginia. Because the NedPower Mount Storm Wind Project is within the range of two federally endangered bat species, the Indiana bat (*Myotis sodalis*) and the Virginia big-eared bat (*Corynorhinus townsendii virginianus*), a Biological Assessment (BA) was prepared to address potential impacts of the project on these bats (see Johnson and Strickland 2003). Based on results of a habitat survey, information obtained on the ecology and habitat of the two endangered species, data on bat use of the project area, and current information on bat interactions with wind turbines, the BA concluded that construction and operation of the project would not likely affect either species. Although several factors were taken into consideration before making the "no affect" determination, two of the primary factors were that (1) habitat within the project area is not suitable breeding or foraging habitat for either species, and (2) available information on species composition of bats killed at other wind plants in the U.S. indicated that long-distance, non-hibernating bats including the hoary bat (*Lasiurus cinereus*), eastern red bat (*Lasiurus borealis*) and silver-haired bat (*Lasionycterus noctivagans*) were most prone to collisions with wind energy facilities and that neither migrating Indiana bats or Virginia big-eared bats traversing between caves would be highly susceptible to collision mortality.

The BA was submitted to the U.S. Fish and Wildlife Service (USFWS) in early October 2003. At the same time that the BA was being prepared, ongoing bat collision mortality was being documented at the recently-constructed Mountaineer Wind Project, also located in West Virginia approximately 17 miles west of the NedPower Mount Storm Project. While preliminary bat mortality data from the Mountaineer Site were included in the BA, the entire data set was not available to be evaluated.

Although no Indiana bats or Virginia big-eared bats were identified among the 475 mortalities at the Mountaineer Project, approximately 31% of the mortalities were comprised of little brown bats (*Myotis lucifugus*) and eastern pipistrelles (*Pipistrellus subflavus*), two species that have somewhat similar migration behavior as the Indiana bat. Therefore, the USFWS expressed some concerns about the project's possible effect on migrating Indiana bats as they move between summer breeding areas and winter hibernacula, and Virginia big-eared bats moving between caves. Although the BA did address the potential for the project to impact migrating bats, the USFWS requested that NedPower and its consultants should analyze the full set of fatality data from the Mountaineer Project prior to reaching any final conclusions on the effect of the proposed Mount Storm project on Indiana and Virginia big-eared bats. In addition, since completing the BA, an avian radar study was conducted at the Mount Storm site which included some data collection on bats. The USFWS also requested that these data be analyzed.

Therefore, the purpose of this report is to further assess the potential for the NedPower Mount Storm Project to impact Indiana bats migrating between summer breeding areas and hibernacula and Virginia big-eared bats moving between caves in the region. This report includes an analysis of the entire mortality data set from the Mountaineer Site, provides data on bat use of the Mount Storm Project area gleaned from the avian radar study conducted in the Fall of 2003, provides additional information on location of regional caves used by Indiana and Virginia big-eared bats, and further summarizes bat mortality data from other eastern wind plants built near Indiana bat hibernacula.

Bat Fatality Data from the Mountaineer Wind Project

The Mountaineer Wind Project is located on Backbone Mountain approximately 17 miles west of the proposed Mount Storm Wind Project. The Mountaineer site consists of 44 1.5 Megawatt wind turbines that are 102 m tall at the tip of the blade. Monitoring of the wind plant to measure avian and bat mortality occurred from April 4 through November 11, 2003. All turbines were searched 23 times during this period (7 in spring, 2 in summer, 14 in fall) on an approximately weekly basis. A carcass removal and observer efficiency study using bird carcasses was conducted in October. Bird carcasses lasted an average of 6.7 days before being removed and searcher efficiency averaged 27.6%. Between April 20 and November 9, 2003, 475 dead bats were found within the wind plant.

The fatalities included seven species of bats (Appendix A). As is the case at most other wind plants studied in the U.S. (see Johnson and Strickland 2003), most of the fatalities (66.5%) were comprised of three species of tree bats that migrate long distances and do not hibernate, including the eastern red bat (42.1% of the fatalities), hoary bat (18.5%), and silver-haired bat (5.9%) (Figure 1). In addition to these three species, two other species of bats comprised a significant proportion of the fatalities, including eastern pipistrelle (18.3% of the fatalities) and little brown bat (12.6% of the fatalities). Small numbers of northern long-eared myotis (*Myotis septentrionalis*) and big brown bat (*Eptesicus fuscus*) were also found, as were four unidentified bats. No Indiana bat or Virginia big-eared bat fatalities were found at the site. The large number of eastern pipistrelles and little brown bats at the Mountaineer Project is unique to this site. Of 801 bat fatalities identified at other U.S. wind plants, eastern pipistrelle comprised 2.2% and little brown bat comprised 2.1% of the fatalities (Johnson and Strickland 2003).

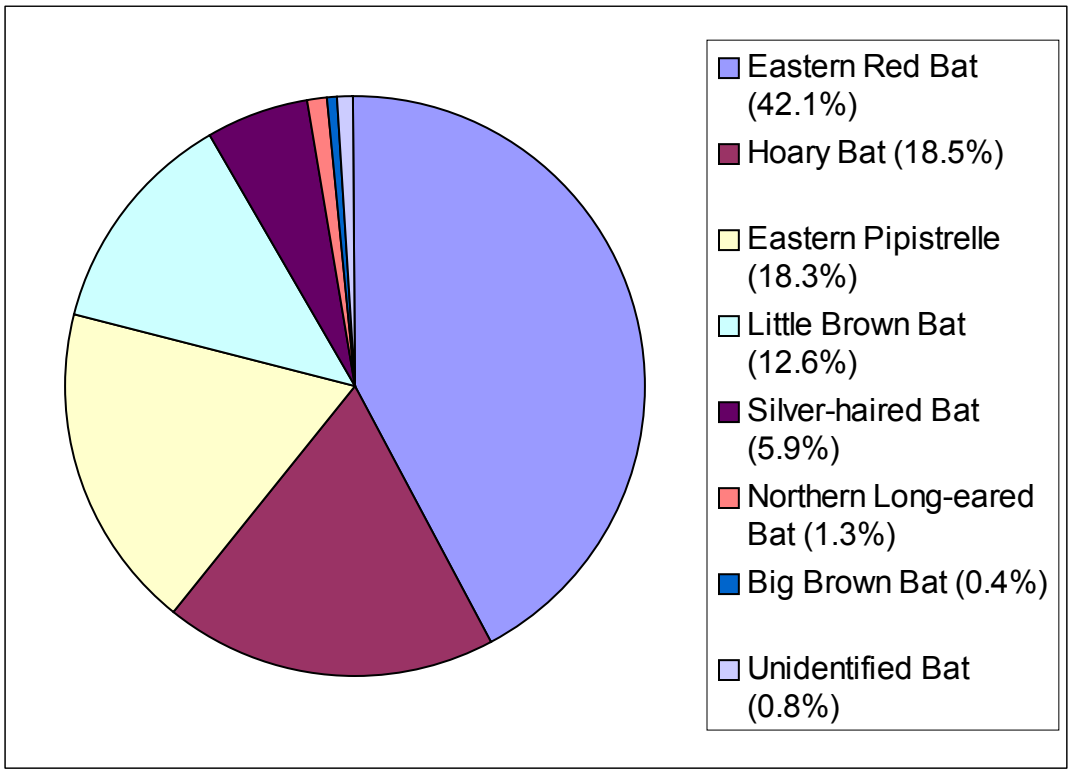

Figure 1. Composition of bat collision fatalities at the Mountaineer Wind Farm, 2003

The timing of bat mortality at the Mountaineer Project is typical of that found at other U.S. wind plants. Although a few individuals were found in the spring and early summer (Appendix B), virtually all of the mortality occurred from mid-August through the end of September (Figure 2), during the time period that bats are migrating from breeding areas to hibernacula in the U.S. or wintering areas in Mexico and South America. Some mortality likely began earlier than August 18, when the first search of the Fall migration season took place. Ninety-eight bats were found during the first search, and many of these likely collided with turbines during the preceding several days. The data from the Mountaineer Project support previous conclusions that migrating bats are at most risk of turbine collision and that resident, breeding or foraging bats have low risk of collision mortality.

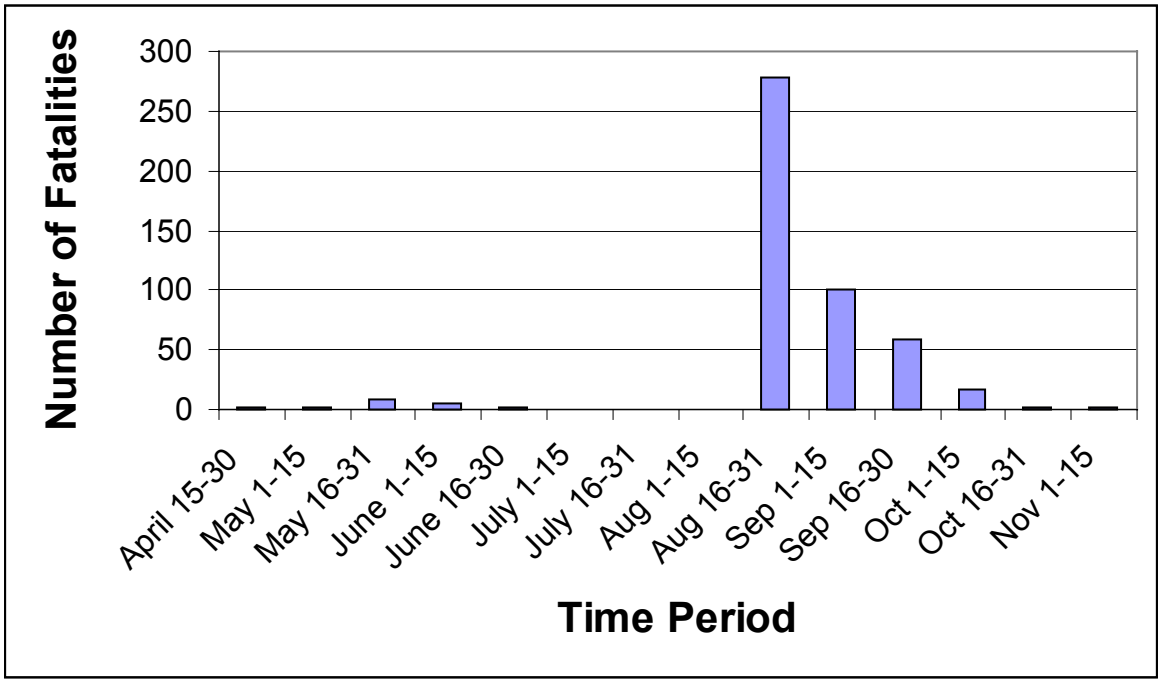

Figure 2. Timing of bat collision mortality at the Mountaineer Wind Project, 2003

Abundance, migration ecology and cave use of eastern pipistrelle, little brown bat, Indiana bat and Virginia big-eared Bat

The behavior of little brown bat and eastern pipistrelle is different from that of the migratory tree bats. Both species spend the winter in hibernacula, and migrate between summer breeding areas and hibernacula. The little brown bat is known to migrate up to several hundred kilometers (Davis and Hitchcock 1965, Griffin 1970, Humphrey and Cope 1976). Eastern pipistrelles tend to migrate shorter distances; the maximum known distance traveled by this species is 33 miles (Griffin 1940). Autumn migration of little brown bats in Indiana and north-central Kentucky occurred from the last week of July to mid-October (Humphrey and Cope 1976), and little brown bats departed from central Iowa to areas near hibernacula after late August (Kunz 1971). Dispersal of summer colonies of eastern pipistrelles to hibernacula also occurs as early as late July through August (Barbour and Davis 1969, LaVal and LaVal 1980). The timing of migratory or dispersal movements by these two species also corresponds to the timing of collision mortality that occurred at the Mountaineer site.

Although the Indiana bat is not highly migratory like the hoary and eastern red bat, the Indiana bat is considered a migratory species (LaVal and LaVal 1980) and banded individuals have been found as far as 325 miles from hibernacula (Gardner and Cook 2002), although they typically move much shorter distances between summer breeding areas and hibernacula. Indiana bats arrive at hibernation sites from mid-August to late October (Thomson 1982). The Indiana bat therefore has somewhat similar migration patterns and timing as the little brown bat and eastern pipistrelle.

Typical migration of Indiana bats from hibernacula to summer breeding areas is from the south to the north in the Midwest (Gardner and Cook 2002), and bats in Indiana depart from wintering caves northward in a V-shaped formation (Dr. John Whitaker, Indiana State University, pers. commun.). Less is known about movements in the eastern and southeastern U.S.; however, the available data indicate that Indiana bats in those states do not migrate large distances between summer and winter habitats (Gardner and Cook 2002). Studies in Pennsylvania and New York indicate Indiana bats typically migrate from approximately 30 to 60 miles from hibernacula (Sanders and Chenger 2000, Alan Hicks, New York Department of Environmental Conservation, pers. commun.). It is not known where Indiana bats that hibernate in West Virginia go to breed (C. Stihler, West Virginia DNR, V. Brack, Environmental Solutions & Innovations, Cincinnati, Ohio, P. Clem, University of Charleston, pers. commun.). Indiana bats that hibernate in West Virginia may move any direction to summer breeding grounds.

Most information on migrating bats is obtained by recovering individuals banded in hibernacula at summer breeding areas. Although these studies provide data on how far and what direction bats migrate from hibernacula, they provide no data on behavior of bats while migrating. Very few studies of migrating bats have been conducted due to the extreme difficulty of following the relatively weak signals of small transmitters over long distances. One study of Indiana bats migrating from their winter hibernaculum to summer breeding areas using radio-equipped individuals was conducted in Pennsylvania in 2000 (Sanders and Chenger 2000). Two female and two male bats were tracked during the study. All of these individuals headed in an easterly direction from the winter hibernaculum. One of the bats was tracked up to 60 miles from the hibernaculum. Three of these bats followed stream courses during their migration, and none of the bats appeared to use ridgelines as travel corridors, although each of the bats crossed over ridges during migration. At least two of the bats apparently used powerline rights-of-way to ascend the ridges. The proposed Nedpower Mount Storm project will not have any new above ground power lines, and no turbines will be placed within the right-of-way of existing above ground powerlines in the project area.

Other unpublished studies of migrating Indiana bats have also been conducted in Pennsylvania and New York. According to John Chenger, Bat Conservation and Management, Carlisle, Pennsylvania (pers. commun.), who has participated in most of these studies, Indiana bats migrating from hibernacula to breeding areas can move any direction. The ones studied in New York and Pennsylvania moved eastward or southward from their hibernacula. They can travel up to 20-25 mph and do not forage while migrating. Based on difficulties obtaining signals from radiomarked Indiana bats, Mr. Chenger believes they likely migrate at low altitudes, which he defined as treetop level or lower. Many of the bats they followed in Pennsylvania occasionally used streams and highways as travel corridors. They have also documented bats crossing over ridgelines using powerline and pipeline rights-of-way. All studies of migrating Indiana bats in the eastern U.S. have found that the bats generally move in a straight-line direction from

hibernacula to summer habitats without regard to topography or other land features (Cal Butchkoski, Pennsylvania Game Commission, pers. commun.).

The Virginia big-eared bat differs from the other species in that it is considered non-migratory and seldom moves far from its home cave; however, it will occasionally move between cave roosts (Kunz and Martin 1982, C. Stihler, pers. commun). The longest movement known for Virginia big-eared bats in Kentucky and West Virginia was 40 miles (Barbour and Davis 1969).

In contrast to the endangered populations of Indiana and Virginia big-eared bat, little brown bats and eastern pipistrelles are considered common in West Virginia (Venable 1999). Based on winter cave surveys conducted by the West Virginia Department of Natural Resources (Table 1), wintering little brown bats outnumber Indiana bats by a factor of approximately 13:1, and outnumber Virginia big-eared bats by a factor of approximately 16:1. Eastern pipistrelles, on the other hand, have approximately the same wintering population size as the Indiana bat and are only slightly more abundant than the Virginia big-eared bat (Table 1).

Table 1. Numbers of little brown bat, eastern pipistrelle, Indiana bat and Virginia big-eared bat counted in West Virginia caves during surveys conducted by the West Virginia Department of Natural Resources

Winter	Number of Caves Surveyed	Number of bats counted			
		Little brown bat	Eastern pipistrelle	Indiana bat	Virginia big-eared bat
2000-2001[a]	26	116,083	2781	9045	6737
2001-2002	22	10,796	6059	703	3
2002-2003	14	2200	1894	261	1262
Total		129,079	10,734	10,009	8002

[a] The large numbers of bats reported in 2000-2001 reflect a survey of Hellhole Cave, which harbors the largest population of bats in West Virginia; this cave was not surveyed the other 2 years. To minimize disturbance of wintering bats, different caves were generally surveyed each year.

It is not known to what extent the overwintering population size of bats in West Virginia correlates with the number of bats migrating into or through the state, although there is likely some relationship Many of the eastern pipistrelles that migrate though northern West Virginia likely hibernate in the state because they apparently rarely travel more than 30 miles between summer breeding areas and hibernacula. The same is also true for Indiana bat, because this species does not typically travel beyond southern Virginia to hibernate (Craig Stihler, West Virginia DNR, pers. commun.). Cave surveys in West Virginia indicate that the wintering population sizes of eastern pipistrelle and Indiana bat are nearly identical in the state. However, eastern pipistrelles are probably somewhat more common because the cave surveys target the colder caves preferred by Indiana and Virginia big-eared bats, whereas pipistrelles can winter in warmer caves (Craig Stihler, West Virginia DNR, pers. commun.). If winter population sizes are correlated with the number of migrants in the state, this suggests that Indiana bats are much less susceptible to collision mortality than are eastern pipistrelles given that no Indiana bat fatalities were found at the Mountaineer site even though 87 eastern pipistrelles were. These data also suggest that Indiana bats are less susceptible to turbine collisions than little brown bats. If migrating little brown bats also outnumber Indiana bats by a factor of 13:1, and both species have similar susceptibility to turbine collisions, then one would expect that 4 or 5 Indiana bat

collision victims would have been found at the Mountaineer site, given that 60 little brown bats were killed at that site.

The West Virginia DNR has identified 34 Indiana bat hibernacula in West Virginia. Caves used as hibernacula by Indiana bats are located in Greenbrier, Hardy, Monroe, Pendleton, Pocahontas, Preston, Randolph, and Tucker Counties (see map in Appendix D). Surveys conducted in 1999 estimated the hibernating Indiana bat population in West Virginia at 11,000 individuals, or approximately 3% of the entire known population of this species (see Angus *et al*. 2001). The only designated critical habitat for Indiana bat in West Virginia is Hellhole Cave in Pendleton County, which contains 8500 hibernating Indiana bats, or 80% of the state's population.

Although there are no documented Indiana bat hibernacula in Grant County where the NedPower Mount Storm project is located, there are 23 caves used by this species within approximately 90 miles of both the proposed NedPower Mount Storm and existing Mountaineer wind projects in West Virginia. Other caves are located in surrounding states including Garrett and Washington Counties in Maryland, Shenandoah, Montgomery, and Wise Counties in Virginia, and Somerset, Blair and Miffen Counties in Pennsylvania, but exact location information was not available. Two caves are located approximately 18 miles south or southwest of the NedPower Mount Storm site. Four caves are located within approximately 17 miles of the Mountaineer site, two of which are approximately 7 miles from the site. Of the 23 caves identified in the area, 16 are located further south along the same ridgeline that the Mountaineer site is on.

Unlike the other three species of bats, Virginia big-eared bats inhabit caves year round. Female Virginia big-eared bats form maternity colonies in caves in the summer. The location of males in the summer is largely unknown, but several "bachelor" colonies have been found in caves. Most males are solitary during the maternity period, but a few males may occupy caves used as maternity colonies (Barbour and Davis 1969, Humphrey and Kunz 1976). The largest population of Virginia big-eared bat in West Virginia is in Hellhole Cave in Pendleton County (Sample and Whitmore 1993), which harbors over 6350 bats. Hellhole Cave is also considered critical habitat for this bat (Stihler and Brack 1992). Other known major cave sites used by this bat include Cave Mountain Cave, Hoffman School Cave and Sinnit Cave, all of which are in Pendleton County, and Cave Hollow Cave in Tucker County (Bagley 1984).

There are 42 caves used by Virginia big-eared bats within approximately 54 miles of both the proposed Mount Storm and existing Mountaineer wind projects in West Virginia. There are five caves within 8 miles of the Mountaineer site, the closest of which is approximately 5 miles southwest of the site. In total nine caves occur along the Backbone Mountain ridgeline further south of the Mountaineer Project. Only two caves are present within five miles of the proposed Mount Storm site. The closest is approximately 3.5 miles southeast of the southern end of the project site. A 1999 fall survey documented the presence of two male and five female Virginia big-eared bats in the cave (Jeffrey Towner, USFWS, letter to Potesta & Associates dated 8-3-02).

Forty of the 42 Virginia big-eared bat caves in the region are located south of both the Mountaineer and Mount Storm project sites. The two northern-most caves are straight north of the Mountaineer Project and west of the Backbone Mountain ridgeline within West Virginia. It is unlikely any other caves are present north of the wind development areas, as this species has not been documented in Maryland or Pennsylvania. As a result, Virginia big-eared bats could traverse among 95% (40 of 42) of the known caves without having to cross either the Mountaineer or Mount Storm project areas.

Data Collected on Bats During the Fall 2003 Avian Radar Study of the Mount Storm Project Area

In the Fall of 2003, a radar study was conducted in the Mount Storm project area to examine passage rates of birds during migration (Mabee et al. 2004). The study involved 45 nights of radar observations between 3 September and 17 October. On Backbone Mountain, approximately 37% of the bat fatalities occurred during the same time period that the radar study took place at the NedPower Project. Five sites were sampled, including three along the ridgeline within the proposed development area at elevations of 3179 to 3442 feet, one site slightly west of the project area at an elevation of 2825 feet, and one site located in a valley east of the project area at an elevation of 1637 feet (Figure 3). Radar surveys were conducted between 8:30 p.m. and 2:30 a.m. Because migrating bat flight speeds overlap with flight speeds of birds, it was not possible to distinguish between birds and bats with the radar equipment.

However, to supplement the radar data, spotlight surveys using a vertically oriented 2,000,000 candlepower light beam were conducted to identify low-flying migrants, and bats could be distinguished from birds during these surveys at distances of up to 100 m above ground level. In addition, moon watching surveys were conducted to observe nocturnal migrants silhouetted against the moon, and bats could also be distinguished from birds during those surveys. A total of 14.3 hours were spent over 71 nights conducting spotlighting and moonlight surveys during the study period. Data collected during the visual surveys indicated that bats comprised a relatively small fraction of the targets detected during the radar surveys. Of 88 targets positively identified as either a bird or a bat, only 6 (6.8%) were bats (Appendix A). Bats were observed only on 5 of the 71 nights (7%) that visual surveys were conducted. Although it is not possible to put these numbers into perspective because comparable data are not available for any other wind project in the U.S., the data do suggest that the Mount Storm area is not within a major bat migration corridor.

In addition to those bats observed using spotlighting and moonlight surveys, on 16 September a steady procession of bats totaling approximately 20 to 25 individuals was observed with the naked eye at dusk while setting up a radar station. The bats were flying south at somewhat regular intervals over the course of about a 10-minute period near the radar station located in a valley east of the project area (1637 feet). All bats were flying from just below treetop level to ~15 m above the treetops (i.e., 10-30 m above ground level). No similar bat processions were observed on the Project Area ridgeline itself. This observation indicates that valley bottoms also may be used as travel corridors by migrating bats.

Bat Mortality at Windplants and other Tall Structures within the Range of the Indiana and Virginia Big-eared Bat

Of all currently-operating wind farms in the U.S., based on proximity to caves used by Indiana and Virginia big-eared bats, the one with theoretically the greatest potential to impact these bats would be the Mountaineer site. However, although a substantial number of bats were killed at this wind farm in 2003, the fact that no Indiana bats or Virginia big-eared bats were killed does provide evidence that these species are not highly susceptible to turbine collisions.

The Tennessee Valley Authority (TVA) has been studying a 3-turbine wind farm on Buffalo Mountain in Tennessee for three years (Nicholson 2003, Charles Nicholson, TVA, pers. commun.). During this time, they have documented 119 dead bats. Composition of the fatalities

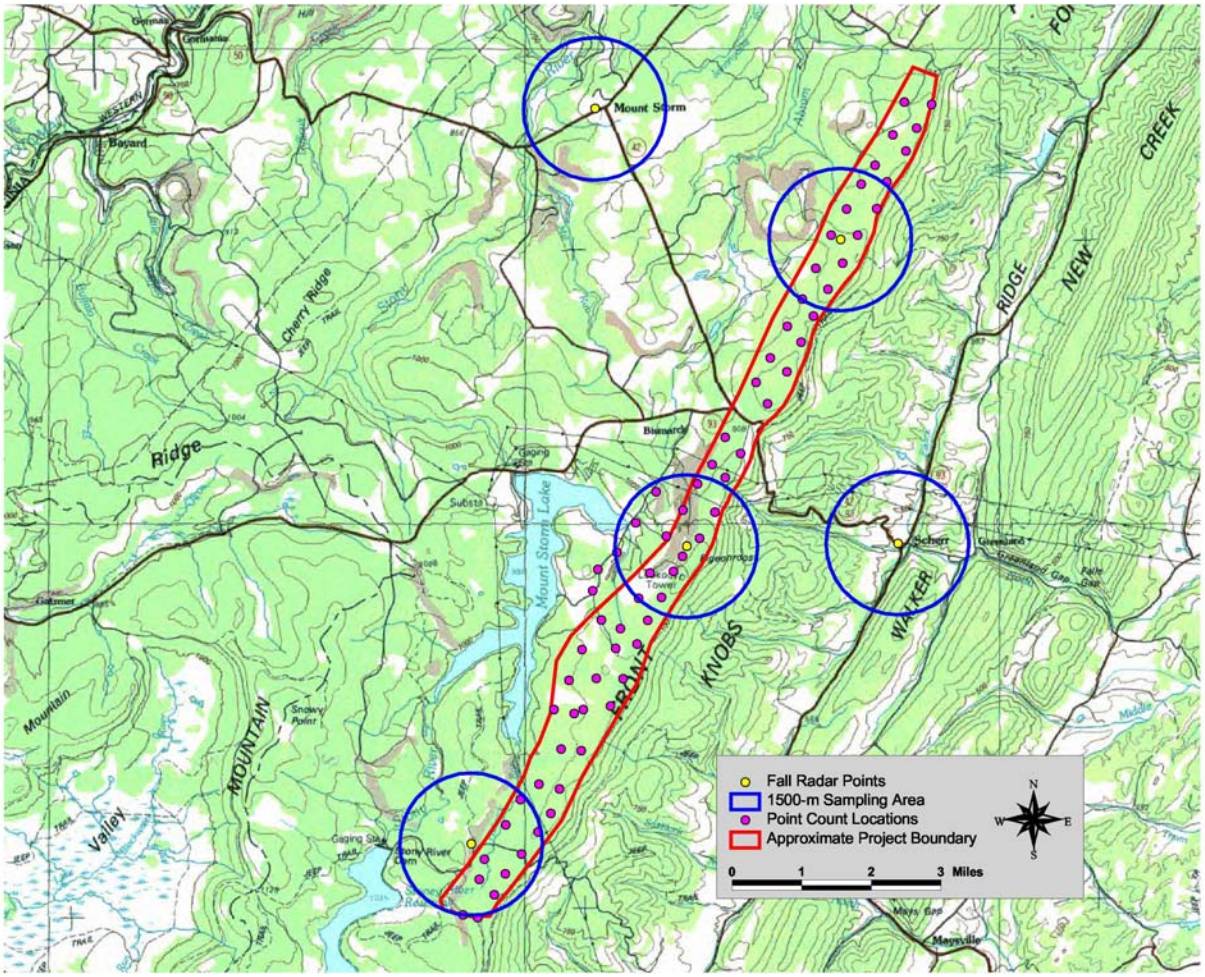

Figure 3. Location of the radar survey points, Mount Storm Project Area, Fall 2003

is somewhat similar to that at the Mountaineer site, although no little brown bat fatalities have been found. The fatalities have been comprised of 61% eastern red bat, 24% eastern pipistrelle, 10% hoary bat, 2% silver-haired bat, 2% big brown bat, and 1% Seminole bat. No Indiana bat fatalities have been documented at this site. In addition to mortality surveys, bat echolocation and mist net surveys have also been conducted at this wind plant. Although no Indiana bats were captured in mist nets, a few individuals were possibly detected with bat echolocation detectors, although further evaluations of the tapes are being conducted to verify species identifications.

There are three caves used as hibernacula by Indiana bats within approximately 50 miles of the Buffalo Mountain wind plant. The nearest is located 25 miles from the wind farm and has had 300-400 wintering Indiana bats in recent years. Another hibernaculum containing a few thousand Indiana bats is located 45 miles from the wind farm, and a third cave (population size unknown) is located approximately 50 miles from the site (Charles Nicholson, TVA, pers. commun.).

Post-construction mortality surveys have also been conducted at several other wind plants within the range of the Indiana bat. These include two wind plants in New York and one each in

Massachusetts, Pennsylvania, and Vermont. The two sites in New York are both located in farmland habitat. The Madison, New York wind farm has 7 turbines and a one-year post-construction fatality monitoring study was conducted there in 2001-2002 (Paul Kerlinger, Curry and Kerlinger, pers. commun.). This site is located 32 miles from an Indiana bat hibernacula containing approximately 3000 bats (Alan Hicks, New York Department of Environmental Conservation, pers. commun.). The other site, located near Copenhagen, New York, has two turbines that were searched for fatalities during the spring and fall migration in 1994 (Paul Kerlinger, Curry and Kerlinger, pers. commun.). This site is located 13 miles from an Indiana bat hibernacula containing approximately 2500-2700 bats (Alan Hicks, New York Department of Environmental Conservation, pers. commun.). No bat fatalities were found at either of these sites.

The Massachusetts and Vermont wind plants are both located in forested areas. The Princeton, Massachusetts wind farm has 8 turbines that were searched for fatalities in the fall and winter of 1993. No bats were found (Paul Kerlinger, Curry and Kerlinger, pers. commun.). This site is located 75 miles from a hibernaculum containing approximately 300 Indiana bats (Susie Vonoettinger, U.S. Fish & Wildlife Service, pers. commun.).

The Searsburg, Vermont wind farm has 11 turbines that were searched for fatalities from June through October 1996, and no bats were found (Paul Kerlinger, Curry and Kerlinger, pers. commun.). This site is located near several Indiana bat hibernacula. The closest is 22 miles away and contains 300 Indiana bats. Two additional hibernacula are located approximately 50 miles away; one contains 500 and the other contains 139 Indiana bats. A large hibernaculum containing 22,000 Indiana bats is located approximately 90 miles away, and another hibernaculum containing 5,000 Indiana bats is also located approximately 90 miles away (Susie Vonoettinger, U.S. Fish & Wildlife Service, pers. commun.).

The Pennsylvania wind plant has 8 turbines and is situated in farmland habitat. There was a one-year post-construction mortality study at this site in 2001-2002 and one little brown bat fatality was found (Paul Kerlinger, Curry and Kerlinger, pers. commun.). This wind farm is located approximately 10 miles from an Indiana bat hibernaculum containing 40 bats, 40 miles from another containing 20 bats, and 60 miles from another containing 700 Indiana bats (Cal Butchkoski, Pennsylvania Game Commission, pers. commun.).

None of the subspecies of big-eared bat (i.e., Townsend's, Virginia, or Ozark) are known to have been killed at wind plants in the U.S. However, the only wind plant sited in close proximity to caves used by this species is the Mountaineer site in West Virginia.

Bats are also known to occasionally collide with communication towers. The first reported incident was five eastern red bats that collided with a television tower in Kansas (Van Gelder 1956). During 25 years of monitoring a television tower in Florida, 54 bat collision victims representing seven species were documented (Crawford and Baker 1981). Twelve dead hoary bats were collected underneath another TV tower in Florida over an 18-year period (Zinn and Baker 1979). Similarly, small numbers (≤ 5) of eastern red bat collision victims have also been reported at communication towers in Missouri (Anonymous 1961), North Dakota (Avery and Clement 1972), Tennessee (Ganier 1962), and Saskatchewan, Canada (Gollop 1965). One yellow bat (*Lasiurus intermedius*) collision victim was found at a Florida TV tower (Taylor and Anderson 1973). Due primarily to concerns with avian collision mortality at communication towers, several mortality studies have been conducted at these towers. We reviewed the

communication tower literature, and found 66 publications that documented avian mortality events during spring and fall migration in states that are within the range of Indiana bat (which also encompasses the entire range of Virginia big-eared bat). Two of these avian mortality events were reported from Putnam County, West Virginia. In addition to the 66 reports documenting single avian mortality events, there have also been 26 multiple-day or multiple-year studies conducted to specifically examine collision mortality at cell towers in states within the range of the Indiana bat. One of these studies was conducted from 1978 to 1986 at a tower in Weston, West Virginia. References for the cell tower studies are included in the Bibliography. No Indiana or Virginia big-eared bat fatalities were documented among the casualties reported from any of these 92 studies conducted at communication towers. Although the studies were conducted to assess avian mortality, we assume that any bat mortality documented would have been reported, especially if it involved an endangered species. This suggests that neither of these two species are highly susceptible to collisions with tall structures.

Conclusions

Based on results of our review, we believe that construction and operation of the wind plant would not likely result in collision mortality of either migrating Indiana bats or Virginia big-eared bats traversing between caves.

This determination was based on the following:

1. No Indiana bat or Virginia big-eared bat fatalities have been documented at the nearby Mountaineer wind project, indicating little risk to these species of wind power development on high-elevation ridges in the mid-Atlantic region.
2. No Indiana bat fatalities have been documented during post-construction mortality studies at existing wind plants in West Virginia, Tennessee, Pennsylvania, New York, Massachusetts, and Vermont, all of which are located near Indiana bat hibernacula.
3. Likewise, no Indiana or Virginia big-eared bats have been killed at communication towers located within the range of these species, where 92 published accounts of avian (as well as some bat) mortality are available. This information indicates that these species are not highly susceptible to collision with tall structures.
4. Visual observation data collected during the radar study indicated relatively low use of the Mount Storm ridgeline by bats, as bats were only observed on 7% of the nights that surveys were conducted.
5. Although numerous caves used by Virginia big-eared bat occur in the region, 95% of these caves occur south of the proposed project area and bats could commute between these caves without crossing the Mount Storm project area. It therefore seems very unlikely that the Mount Storm project area would pose any threat to Virginia big-eared bats that traverse between caves.
6. Considering that 60 little brown bat fatalities were found at the Mountaineer site in 2003, and considering that this species outnumbers the Indiana bat by a factor of 13:1 in West Virginia hibernation sites, statistically one would expect 4 or 5 Indiana bat fatalities if winter population sizes reflect the number of bats migrating into or through the state. However, even though little brown bats have somewhat similar migration habits as Indiana bat, no Indiana bats were found, suggesting that the Indiana bat is less susceptible to turbine collision due to differences in behavior, migration routes, or some other factors.

7. Considering that 87 eastern pipistrelles were found at the Mountaineer site in 2003, and considering that this species has relatively similar population sizes as Indiana bat in West Virginia caves, one would have expected similar numbers of Indiana bat fatalities. However, even though eastern pipistrelle also has somewhat similar migration habits as the Indiana bat, the fact that none were found again suggests that Indiana bat is much less susceptible to turbine collision than eastern pipistrelle.
8. Telemetry studies of migrating Indiana bats in Pennsylvania and New York have found that migrating Indiana bats move from hibernacula to summer ranges in a straight-line direction generally without regard to topography or other land features. In no cases have radiomarked Indiana bats used ridgelines as travel corridors while migrating. These data also suggested that Indiana bats migrate at altitudes below those occupied by turbine blades proposed for this project.

Based on the above factors we believe the possibility of a take of an Indiana bat or Virginia big-eared bat is very remote.

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Appendix A. Numbers of bat fatalities by species at the Mountaineer Wind Farm, 2003

Species	Number Found	Percent
Eastern Red Bat	200	42.1
Hoary Bat	88	18.5
Eastern Pipistrelle	87	18.3
Little Brown Bat	60	12.6
Silver-haired Bat	28	5.9
Northern Long-eared Bat	6	1.3
Big Brown Bat	2	0.4
Unidentified Bat	4	0.8
TOTAL	475	100

Appendix B. Numbers of bat fatalities by time period at the Mountaineer Wind Farm, 2003

Date (2003)	Number Found	Percent Found
April 15-30	1	0.2
May 1-15	1	0.2
May 16-31	9	1.9
June 1-15	5	1.1
June 16-30	1	0.2
July 1-15	0	0
July 16-31	0	0
Aug 1-15	0	0
Aug 16-31	278	58.8
Sep 1-15	100	21.1
Sep 16-30	58	12.3
Oct 1-15	17	3.6
Oct 16-31	1	0.2
Nov 1-15	2	0.4

Appendix C. Numbers of birds and bats observed during spotlight and moonlight surveys at the NedPower Mount Storm wind project.

Date	Survey technique	Minutes sampled	Number observed	
			Birds	Bats
Center of Ridgeline				
6-Sept	Moon	45		
6-Sept	Spotlight	10		
7-Sept	Moon	31		
7-Sept	Spotlight	5		
8-Sept	Moon	42		1
10-Sept	Spotlight	10		
11-Sept	Moon	8		
13-Sept	Spotlight	5		
15-Sept	Spotlight	10		
16-Sept	Spotlight	9	1	
17-Sept	Spotlight	5	1	
19-Sept	Spotlight	10		1
20-Sept	Spotlight	4		
21-Sept	Spotlight	10		2
22-Sept	Spotlight	18		
23-Sept	Spotlight	10	6	
24-Sept	Spotlight	10		
25-Sept	Spotlight	10		
26-Sept	Spotlight	10	15	
27-Sept	Spotlight	10		
28-Sept	Spotlight	10		
29-Sept	Spotlight	8	5	
30-Sept	Moon	5		
30-Sept	Spotlight	10		
1-Oct	Spotlight	10	2	
2-Oct	Spotlight	15	11	
3-Oct	Spotlight	10		
4-Oct	Moon	10		
4-Oct	Spotlight	10		
5-Oct	Moon	15		
5-Oct	Spotlight	10		
6-Oct	Moon	20		
6-Oct	Spotlight	10	1	
8-Oct	Spotlight	5		
9-Oct	Spotlight	10		
10-Oct	Spotlight	10		
11-Oct	Moon	35	6	
11-Oct	Spotlight	10	1	
12-Oct	Moon	10	6	
13-Oct	Spotlight	10		
16-Oct	Spotlight	10		
17-Oct	Spotlight	5		
Subtotal		520 (8.7 hours)	55	4
North Ridgeline				
9-Sept	Moon	22		
11-Sept	Spotlight	10		1
15-Sept	Spotlight	10		
24-Sept	Spotlight	10		
30-Sept	Spotlight	10	5	

2-Oct	Moon	5		
2-Oct	Spotlight	5		
4-Oct	Spotlight	5		
6-Oct	Spotlight	10	2	
8-Oct	Moon	20	4	
11-Oct	Spotlight	5		
12-Oct	Spotlight	5		
15-Oct	Spotlight	8		
Subtotal		125 (2.1 hours)	11	1
South Ridgeline				
9-Sept	Spotlight	5		
11-Sept	Spotlight	5	1	
15-Sept	Spotlight	2.5		
17-Sept	Spotlight	5		
26-Sept	Spotlight	10	11	
28-Sept	Spotlight	9		
29-Sept	Spotlight	5	2	
2-Oct	Spotlight	6		
4-Oct	Spotlight	5		
6-Oct	Spotlight	5		
8-Oct	Moon	15		
8-Oct	Spotlight	10		
12-Oct	Spotlight	5		
15-Oct	Moon	10		
Subtotal		97.5 (1.6 hours)	14	0
East Valley				
10-Sept	Moon	24		
14-Sept	Spotlight	5		
3-Oct	Moon	5		
7-Oct	Moon	15		
13-Oct	Moon	10	1	
Subtotal		59 (1.0 hours)	1	0
West Ridge				
10-Sept	Moon	22.5		
14-Sept	Spotlight	7		
1-Oct	Moon	5		
7-Oct	Moon	15		
9-Oct	Moon	4		
13-Oct	Moon	5	1	1
Subtotal		58.5 (1.0 hours)	1	1
TOTAL		860 (14.3 hours)	82	6

Appendix D. County map of West Virginia