Appendix E: Avian and Wildlife Resources Reports for Beech Ridge Wind Energy Project

Report E-1. Preliminary Report, Environmental Assessment – Wildlife Impacts, Proposed Wind Turbine Project in Greenbrier County, WV (Michael 1994)

Report E-2. Fall 1994 Raptor Migration Study in Greenbrier County, West Virginia (Lipton and White 1995)

Report E-3. Avian Phase I Assessment of Bird Populations on the MeadWestvaco Wind Power Project in Greenbrier County, West Virginia: Spring and Fall 2005 (Canterbury 2006)

Report E-4. Avian Fatal Flaw Analysis for Mead Westvaco Wind Farm Area, Greenbrier County, West Virginia (Curry and Kerlinger 2004)

Report E-5. Spring and Fall Eagle and Osprey Surveys for the Beech Ridge Wind Energy Center, Greenbrier and Nicholas Counties, West Virginia, March– May and September–October 2011 (Young et al. 2012a)

Report E-6. Avian Migration Studies for the Beech Ridge Wind Energy Project Expansion Area, Greenbrier and Nicholas Counties, West Virginia, March-May and September-November 2011. (Young et al. 2012c)

Report E-7. Avian and Bat Risk Assessment: Beech Ridge Wind Energy Project Expansion Area, Greenbrier and Nicholas Counties, West Virginia. (Young et al. 2012b)

Report E-8. Winter Raptor Surveys for the Beech Ridge Wind Energy Project, Greenbrier and Nicholas Counties, West Virginia, December 2011- March, 2012 (Young et al. 2013)

PRELIMINARY REPORT

ENVIRONMENTAL ASSESSMENT - WILDLIFE IMPACTS

PROPOSED WIND TURBINE PROJECT IN GREENBRIER COUNTY, WV

SUBMITTED TO:

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INTRODUCTION

Kenetech Windpower, Inc. has proposed to construct a 400 megawatt windplant, involving approximately 1,200 wind turbines, in Greenbrier County, WV. Initial construction (Phase I) is proposed for 1996 and will produce 50 megawatts from 150 wind turbines. Although Kenetech is concerned about the impact of this project on the total environment, one specific concern involves wildlife. Potential impacts on wildlife are: (1) disturbance during the construction phase, (2) disturbance and mortality during the operational phase, and (3) long-term habitat modification (both positive and negative).

The primary objective of this environmental study is to assess the impact of the proposed windplant on wildlife, with emphasis on avian populations. Surveys conducted during 1994 involved only the site to be impacted by Phase I (150 wind turbines).

PROJECT AREA

The proposed windplant will be located on property owned by forest products companies in Greenbrier County, West Virginia, between the towns of Rupert and Richwood. Phase I will be sited on the Gauley Woodlands of the Westvaco property (38° 5′ N, 80°

24′ W). Gauley Woodlands lies in the rugged and mountainous Appalachian Plateau Province. Clarkson (1966) described the area as greatly dissected high altitude plateaus interspersed with numerous rugged peaks that rise to elevations over 1220 m. Elevation of the proposed project area ranges from 976 to 1220 m.

Soils of the area are of the Dekalb stony loam series (U.S. Dept. Agric. 1941) with some large rock outcroppings interspersed throughout the area. The drainage pattern is typically dendritic, consisting of numerous winding streams fed by many convoluted branches.

In general, Gauley Woodlands are characterized by long cold winters and short warm summers. Precipitation is approximately 103-128 cm per year, including snowfall of 179-256 cm (Price and Heck 1939 and Chang and Lee 1975). Snow cover is usually continuous from late December to late March, depending on altitude. Temperatures range from a monthly mean of -0.6 C in January to a mean of 22.2 C in July (Price and Heck 1939).

Principal land uses of the proposed project area consist of hardwood timber production and coal strip-mining operations. Much of Gauley Woodlands was timbered in the 1910-1950 period by Meadow River and other lumber companies which resulted in extensive clearcut areas. These woodlands are now being systematically clearcut, in units approximately 16 ha in size.

Dominant tree species consist primarily of American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), yellow-poplar (*Liriodendron tulipifera*), black cherry (*Prunus serotina*), yellow birch (Betula lutea), red oak (Quercus rubra), and cucumber tree (Magnolia acuminata). Typical understory vegetation includes: striped maple (Acer pensylvanicum), mountain maple (Acer spicatum), mountain laurel (Kalmia latifolia), blackberry (Rubus allegheniensis), greenbrier (Smilax rotundifolia), stinging nettle (Urtica dioica), jewelweed (Impatiens pallida), and numerous species of ferns.

METHODS

Initial assessments of impacts on wildlife in 1994 focused on: (1) threatened and endangered species, (2) rare and unusual plant communities, (3) herptiles, (4) birds, and (5) mammals. Assessments for impacts on birds involved the following: (1) breeding songbirds, (2) migrating songbirds, (3) resident upland gamebirds, (4) resident crows, raptors, ravens, and vultures, and (5) migrating raptors.

The presence of threatened/endangered species and rare/unusual plant communities was determined by literature review, examination of historical records, computer search conducted by the West Virginia Division of Natural Resources Natural Heritage Program, and on-site examinations. Thomas K. Pauley (Biology Department, Marshall University) was responsible for assessments of herptiles (amphibians/salamanders), Edwin D. Michael (Division of Forestry, West Virginia University) was responsible for mammals, and William N. Grafton (Division of Forestry, West Virginia University) was responsible for assessments of plants and plant communities.

The areas to be impacted by the development of windplants in the Beech Ridge Project Area were examined for rare and unusual plant communities and for potential amphibian and reptile habitats in August, 1994.

Assessments of impacts of the proposed windplant project on birds involved breeding bird surveys along pre-established transect lines, drive routes along existing roads through the project area, and observations from selected vantage points within the project area. Dr. George A. Hall (West Virginia University, retired) was the technical advisor for bird surveys.

Breeding bird surveys were conducted from May 25 to June 6, 1994, to determine relative abundance of all avian species that breed in the Phase I construction area. Ten line transects were established parallel to the mountain ridges where wind turbines would be located if construction occurs (Fig. 1). Locations of transects were selected from topographic maps, followed by on-site delineation using plastic flagging and numbered aluminum tags. The length of each transect line depended on access and the length of the ridge where construction would occur. These 10 transect lines totaled 19,500 m (12.2 miles) in length and passed through a variety of habitat types, including, but not restricted to: reclaimed surface mines, mature hardwoods, immature hardwoods, recent clearcuts, and shrub/sapling areas.

Breeding bird surveys were conducted on foot from 30 minutes before sunrise until 4 hours past sunrise. Surveys were not conducted on mornings when rain or wind reduced the observer's ability to see/hear birds. All paired birds and/or males identified by sight or sound and detected within 33 meters of either side of the transect were recorded. Three different observers conducted these surveys on 7 different mornings from May 25 to June 6. Usually only 1 transect was surveyed per observer per morning, but 2 of the short transects were often surveyed by the same observer on the same morning.

Drive surveys to record resident birds were conducted on 10 different mornings from May 24 until June 23. Three different routes were driven: Beech Ridge-Pole Road (8.5 miles), K.P. Skyway (6.0 miles), and Richwood Road (5.0 miles) (see Fig. 1). Survey counts began 30 minutes before sunrise on dry, windless mornings, and ended approximately 4 hours later. Observers stopped their vehicles every 0.5 miles, listened for 5 minutes, and recorded all birds seen and/or heard. All raptors, ruffed grouse, and wild turkey seen while driving between stops were also recorded.

Migrating songbirds were surveyed from August 20 to October 15 along a 10-mile drive-route from Beech Knob to Cold Knob. Observers stopped every 0.5 mile at 20 different locations and recorded all birds seen and/or heard during a 10-minute observation period. Daytime surveys were conducted on 29 days and nighttime surveys were conducted on 10 nights. Nighttime observers used a parabolic reflector, microphone, and earphones to increase the likelihood of detecting migrating songbirds overhead.

Resident crows, raptors, ravens, and vultures were surveyed by driving the Beech Ridge-Pole Road from Cold Knob to Beech Knob monthly during June, July, and August and stopping at 10 selected vantage points. Observers recorded all crows, raptors, ravens, and vultures seen and/or heard during 10-minute stops at each observation point.

Migrant raptors were surveyed by Hawkwatch International observers from September 10 through November 29, 1994 from 6 observation points: Beech Knob (29 days), Job Knob (7 days), Joe Knob (2 days), Five-Points (3 days), Craters (9 days), and Cold Knob (36 days)(Fig. 2). Observers with binoculars recorded the following information: species, age (immature-vs-adult), height of flight, direction of flight, time sighted, wind direction, and wind speed. Surveys usually extended throughout most of the daylight hours, but were not conducted during inclement weather. Three different observers participated in these migrant-raptor surveys, and all 3 individuals typically observed on the same day at different sites.

Volunteers were recruited to conduct surveys of migrant birds on September 10 and 11, 1994. These individuals were all amateur ornithologists and possessed varying bird-identification skills. Volunteers observed from 7 vantage points and a crew of professionals observed from 3 additional vantage points. A total of 16 volunteers observed from 10 vantage points from 10 a.m. to 5 p.m. on September 10 and from 10 a.m. to 3 p.m. on September

11. They recorded all birds sighted and the direction of travel of migrating raptors.

To determine the mammal species present in the project area, a thorough literature search was conducted, biologists with the WV Division of Natural Resources were contacted, and the availability of suitable habitat for individual species was determined while conducting bird surveys.

RESULTS

Threatened and Endangered Species

A computer search by the West Virginia Division of Natural Resources Natural Heritage Program indicated that only 1 species listed as threatened or endangered by the U. S. Fish and Wildlife Service is known to occur in the vicinity of the proposed wind turbine project in Greenbrier County. The Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*) has been reported from 3 locations near the northeast border of the proposed project site. These locations are approximately 4 miles from the area proposed for Phase I. The northern flying squirrel in West Virginia is restricted to high elevations (usually over 3,500 feet: 1,067 m) and its preferred habitat is red spruce forests (*Picea rubens*). An extensive search of the project area was made to determine if suitable habitat for the northern flying squirrel is present. No red spruce forests occur within the project area and few stands of mature hardwood forest are present. It is highly unlikely that northern flying squirrels are present within the proposed project area.

The bald eagle, listed as endangered by the U.S. Fish and Wildlife Service, was recorded on only 1 occasion. A single bird was sighted flying past Cold Knob on October 16, 1994.

The eastern woodrat (Neotoma floridana) has been proposed for listing as a threatened and endangered species by the U. S. Fish and Wildlife Service. This species lives in caves or rock outcroppings having large boulders and associated crevices. Woodrats have not been previously reported from the proposed wind turbine site and an extensive search of the project area did not locate suitable woodrat habitat. It is highly unlikely that eastern woodrats occur within the proposed project area.

West Virginia does not have state legislation relating to endangered species, but has published a list of Vertebrate Species of Special Concern (WVDNR 1991). These vertebrate species are classified as: (1) Special Concern, (2) Scientific Interest, and (3) Status Undetermined. These classes are defined as follows:

Special Concern: "A species which was once more common or widespread in West Virginia and is now thought to be declining, becoming more restricted in range, or possibly extirpated."

Scientific Interest: "A species which has a unique scientific value (e.g. endemic, uncertain taxonomic status), or has probably always been uncommon in West Virginia because the State is on the periphery of its range."

Status Undetermined: "Species in this classification are believed to be uncommon in West Virginia, but supportive data are lacking."

No amphibian or reptile Species of Special Concern are known to occur in the proposed windplant project area.

Six bird species that are listed as Species of Concern by the WVDNR were observed in the proposed project area during 1994 surveys. One species (golden-winged warbler) apparently nested in the area (Tables 3 and 4) and the other 5 species (black vulture, osprey, golden eagle, Cooper's hawk, and northern harrier) were migrants (Tables 8, 10, and 12). Two sightings were made of the golden-winged warbler (Species of Special Concern) during May-June surveys.

Black vultures (Species of Scientific Interest) were sighted during September and October only. One sighting was during the volunteer weekend, 4 during drive surveys, and 52 during raptor surveys. Osprey (Species of Scientific Interest) also were sighted during only September and October: 2 during volunteer weekend, 1 during a drive survey, and 7 during raptor surveys. Cooper's hawks (Species of Special Concern) were sighted only during fall surveys: 9 during volunteer weekend, 12 during drive surveys, and 50 during raptor surveys. Golden eagles (Status Undetermined) were sighted on 7 occasions as they migrated through the project area. Northern harriers (Species of Scientific Interest) also were restricted to the fall migration period: 1 during the volunteer weekend, 4 during drive surveys, and 46 during raptor surveys.

The only mammalian species of Special Concern known to occur in the project area is the rock vole (Microtus chrotorrhinus). This small rodent, classified as a Species of Scientific Interest by the WVDNR, was trapped in clearcut and forested areas by Hahn (1980).

Plants and Plant Communities

No plant species listed as threatened or endangered by the U.S. Fish and Wildlife Service, nor plant species on the West Virginia "Watch List of Rare Plants" were identified from the project site. The area between Beech Knob and Cold Knob was surveyed for unique plant communities, with emphasis on rock outcrops, cliffs, natural "balds", and wetlands. Locations and elevations of sites where intensive surveys were conducted follows: (1) a knob 1.2 miles ESE of Beech Knob (3,960 feet), (2) a knob 1.75 miles ESE of Beech Knob, south of Beech Ridge Road (4,040 feet), (3) a knob 2.5 miles ESE of Beech Knob, north of Beech Ridge Road (4,040 feet), (4) the north slopes at head of Linn Branch near 5-Points (3,880 feet), (5) the northwest slopes of Job Knob (3,850-4,200 feet), (6) the east slopes of Job Knob (4,000-4,160 feet), (7) Old Field Mountain Road (4,050-4,360 feet), (8) Grassy Knob Fire Tower Road (4,160-4,360 feet), and (9) Cold Knob (4,160-4,280 feet).

The majority of the forested areas in the project area are typical of numerous other high-elevation, cold-climate ridges of the central Appalachians. The ridges have steep slopes and range from 3,800 to 4,360 feet in elevation. They are predominantly northern hardwood forest types, except where old agricultural fields have been recolonized by pioneer tree species such as red maple (Acer rubrum), hawthorn (Crataegus spp), and black birch (Betula lenta).

Some interesting plant species are present in the project area, but no truly rare plant species or plant communities are present. The most interesting botanical sites are seeps and their associated small streams on the northwest slopes between 5-Points and Job Knob. These seeps contain several interesting plant species, including Carex scabrata, lettuce saxifrage, purple-stem aster, closed gentian, and turtlehead.

A list of those herbaceous and woody plants identified in the August 1994 survey is presented in Table 1. This was an autumnal survey, and plants that bloom in spring and summer could not be identified.

Herptiles

The following habitats were identified as suitable habitat for amphibians/reptiles: (1) xeric forests, (2) temporary and permanent ponds, (3) roadside ditches, (4) road puddles, (5) old fields, and (6) strip mines with high walls. These habitats could potentially support 28 species of amphibians and 19 species of reptiles. While all potential species are listed and discussed, several may not occur in higher elevations. Previous studies in higher elevations in northeastern mountains of West

Virginia revealed that several of the species discussed in this report do not occur above 3,000 ft. Since studies have not yet been conducted to determine species of amphibians and reptiles that occur in higher elevations in the southern sections of the state, all potential species are considered. Three species of amphibians (Ambystoma jeffersonianum, Aneides aeneus, and Pseudacris triseriata feriarum) and 2 species of reptiles (Eumeces a anthracinus and Thamnophis s. sauritus) that could occur in the Beech Ridge Project Area are on the West Virginia Division of Natural Resources' list of species of concern.

Amphibians. Table 2 lists the amphibians that potentially occur in the Beech Ridge Project Area under consideration for construction of windplants. Eighteen species of salamanders could occur in the Beech Ridge Project area. Three species of ambystomatid salamanders, Ambystoma jeffersonianum, A. maculatum, and A. opacum, probably occur here. Ambystoma jeffersonianum is listed as a species of concern (undetermined status) by the West Virginia Division of Natural Resources (1990). Notophthalmus v. viridescens is a common species in West Virginia and probably occurs in all ponds in the area.

Three desmognathine species probably occur in the Beech Ridge Project Area. Two, Desmognathus f. fuscus and D. ochrophaeus, are possible residents in seeps and first/second order streams. The third species, D. monticola, has not been recorded in Greenbrier County but could inhabit first/second order streams in the higher elevations.

Four species of woodland salamanders (Plethodon) may inhabit this area. The forests in the impact areas are xeric, and this could restrict some Plethodon species. Plethodon cinereus and P. glutinosus are the 2 most likely species to occur here, but P. hoffmani and P. wehrlei could also be present.

Hemidactylium scutatum probably occurs in marsh habitats around ponds and roadside ditches that are moss-covered. Gyrinophilus p. porphyriticus and Pseudotriton r. ruber could be present in first/second order streams. Pseudotriton r. ruber is also known to use wet sites with Sphagnum moss. Pseudotriton montanus diastictus typically occurs in muddy bottom wetlands, and there are known populations in Greenbrier County. However, it is doubtful this species occurs at these elevations in the Beech Ridge Project Area.

Aneides aeneus typically occurs in crevices in emergent rocks and rock outcrops. While these habitats are apparently not present in the project area, additional surveys are needed to determine the status of this species in the impact sites. This species is listed by the West Virginia Division of Natural Resources as a species of special concern (1990).

Eurycea bislineata and E. l. longicauda are species that occur in seeps and first/second order streams. Both species also breed in ponds and could therefore be present in the impact area.

While 2 toad species are listed as potential, only Bufo a. americanus is likely to occur at these elevations. In previous studies in the New River Gorge (Pauley 1992), it was determined that, when in sympatry, B. a. americanus breeds in higher elevations and B. woodhouseii fowleri breeds in lower elevations. Bufo a. americanus could use any of the ponds and roadside ditches and road puddles in this area for breeding habitats.

Greenbrier County is in the zone of sympatry for the 2 species of gray tree frogs (Hyla chrysoscelis and H. versicolor) that occur in West Virginia and, as a result, either or both species could occur in the Beech Ridge Project Area. Ponds in strip mines and other areas and roadside ditches are possible breeding habitats.

The 3 species of Pseudacris that occur in West Virginia could breed in this area. Certainly P. c. crucifer would use the roadside ditches and ponds as breeding sites. Records show that P. brachyphona and P. triserata feriarum occur in Greenbrier County. Little is known about the habitat requirements of P. t. feriarum in West Virginia. While it probably occurs only in the lower elevations, it should be determined if this species occurs in the potential impact sites. Both species breed in roadside ditches and heavy vegetation (grasses) at the edges of ponds.

Four ranid species could occur in the Beech Ridge Project Area. While Rana catesbeiana is less likely to breed in the ponds than the other species, there is potential for this species. The other species, R. clamitans melanota, R. sylvatica, and R. palustris most likely occur in this area. Rana clamitans melanota and R. sylvatica will breed in the ponds in the potential impact sites. Although R. sylvatica has not been reported from Greenbrier County, it certainly occurs there.

Reptiles. Table 3 lists the 19 species of reptiles that likely occupy habitats in the Beech Ridge Project Area. Of these only 2 turtles, Terrapene c. carolina and Chelydra s. serpentina, probably occur here. Terrapene c. carolina occurs throughout the area, although it may be absent in the higher elevations. While C. s. serpentina is known to occupy almost any type of permanent water, it is not known if it occurs in ponds in the impact area.

Habitats of 3 species of lizards were observed in the Beech Ridge Project Area. Sceloporus undulatus hyacinthinus and Eumeces fasciatus are common throughout most of West Virginia. Eumeces a. anthracinus is a species of concern in West Virginia (WVDNR 1990). Although lizards have not been observed in the higher elevations in northeastern West Virginia (Pauley 1993), they may occur in higher elevations in the southern portions of the state.

Fourteen species of snakes could occur in this area. Nine of these have been observed in higher elevations in the northeastern mountains in West Virginia. These are indicated with an asterisk in Table 3. Most terrestrial species inhabit old field habitats such as strip mine sites.

Nerodia s. sipedon probably inhabits ponds in this area. Storeria o. occipitomaculata inhabits moist habitats and could be found in the strip mine areas. Storeria d. dekayi occurs in similar habitats but is less likely to be in the higher elevations. Thamnophis s. sirtalis is the most common snake in West Virginia's upland forests. It probably occurs throughout the Beech Ridge Project Area. Thamnophis s. sauritus is one of the 3 most uncommon snakes in West Virginia and is listed as a species of concern by the WVDNR (1990). It is known to occupy ponds and marshes in Greenbrier County. However, it may not occur at these high elevations.

Heterodon platirhinos is not common in West Virginia. It is usually found in sandy habitats where toads are abundant. Although it is doubtful that it occurs in higher elevations, it should be considered as a potential species. The status of Carphophis a. amoenus in the higher elevations of southern West Virginia is not known, but it could potentially occur here. Diadophis punctatus edwardsii and Opheodrys v. vernalis are common species in the higher elevations of the state and should occur in the Beech Ridge Project Area. Two of the 3 black snakes, Coluber c. constrictor and Elaphe o. obsoleta, that occur in West Virginia could occupy habitats in this area. Only E. o. obsoleta is known to occur in higher elevations. Lampropeltis t. triangulum is a common snake in the old field habitat and should occur in this area.

The 2 venomous snakes known to occur in West Virginia, Agkistrodon contortrix mokasen and Crotalus horridus, could be found throughout this area, particularly in the strip mine sites.

Birds

A total of 53 species of resident birds were recorded while conducting walk transects and 59 species were recorded during drive surveys (Table 4). The most abundant resident bird species in the project area were the red-eyed vireo, chestnut-sided warbler, veery, dark-eyed junco, and rufous-sided towhee. In addition to Beech Ridge/Pole Road, 2 additional road segments were surveyed with the objective of having one or both of them serve as a control for comparing future changes in bird populations within the project area. Results of 1994 surveys indicate that the K. P. Skyway is a more appropriate control road than is Richwood Road. A total of 52 bird species was recorded along Beech Ridge/Pole Road, compared to 47 along K. P. Skyway (Table 5). Number of individuals per mile was also quite similar; 103.9 for Beech Ridge/Pole Road and 104.2 for K. P. Skyway.

Relative abundance of resident birds recorded on the 2 types of surveys (walk and drive) was similar. A total of 825 individuals of 53 species was recorded along walk-transects, compared to 883 individuals of 52 species along the Beech Ridge Road/Pole Road drive route. A comparison of walk-transect data with Beech Ridge Road/Pole Road drive-survey data shows the 3 most abundant species (red-eyed vireo, veery, and chestnut-sided warbler) were the same for both drive- and walk-transects (Table 6). Certain species were more likely to be observed during walk-surveys than during drive-surveys, including: junco, black-throated green warbler, ovenbird, least flycatcher, and hermit thrush. Other species were more likely to be observed during drive-surveys than during walk-surveys, including: indigo bunting, crow, catbird, solitary vireo, and raven.

Bird abundance, as indicated by drive-surveys, was not equal along all sections of Beech Ridge/Pole Road (Fig. 3). Highest numbers were recorded at stops 9, 12, and 17.

As was expected both bird diversity and abundance differed among the various transects. Number of resident species varied from a low of 15 on the Old Field transect to 36 on the Les McClung Road/microwave towers transect (Table 7). Relative abundance varied from a low of 6.7 individual birds per 100 meters on the Grassy Knob transect to a high of 11.3 individuals per 100 meters on the Les McClung/reclaimed stripmine transect. The variation in relative density was due primarily to differential visibility on different transect lines. Visibility was better on the Les McClung/reclaimed stripmine transect than on any other transect.

Drive-surveys conducted along Beech Ridge/Pole Road during summer months detected few resident birds of prey. Only 7 species were recorded: turkey vulture, osprey, red-shouldered hawk, broad-winged hawk, red-tailed hawk, crow, and raven (Table 8). Numbers of resident raptors were quite low, including 3 red-shouldered hawks, 3 broad-winged hawks, and 4 red-tailed hawks.

Relative abundance of birds-of-prey along Beech Ridge Road/Pole Road is presented in Fig. 4, 5, 6, and 7. Due to low sample size it is not possible to identify areas of concentration.

Amateur ornithologists gathered some interesting and worthwhile data during the volunteer weekend of September 10-11. Although it was not possible to distinguish between resident and migrating birds, it was evident that several of the raptors recorded were migrating through the area. A total of 52 species representing 1,313 birds was recorded by the volunteers (Table 9). This total included 136 raptors, 138 turkey vultures, and 1 black vulture. The most numerous raptors recorded were broad-winged hawks and red-tailed hawks. The most numerous songbirds recorded were chimney swifts, cedar waxwings, and American goldfinches.

The weekend of September 10-11 was the peak concentration of songbird migration through the Appalachians as indicated by bird banding records from the Allegheny Front Migration Observatory in Grant County, WV (Table 10). A total of 1,007 songbirds were banded at the banding station on September 9-10-11, compared to the next highest 3-day total of 767 on September 15-17.

Drive-surveys conducted during August, September, and October indicated that species diversity was slightly higher during September than August, and was lowest in October (Table 11). Bird abundance was greatest during August (157.6/survey), due to higher numbers of goldfinch and unidentified songbirds. Although there were no obvious concentrations of songbirds along the Beech Ridge Road, the highest numbers recorded were at observation points 5, 6, and 7 (approximately 2-3 miles east of Beech Knob) and at Cold Knob (Fig. 8, 9, 10, 11). Areas of low numbers of birds were at observation points 8, 11, and 16-18.

Sample sizes for raptors, crows, ravens, and turkey vultures from the August-October drive surveys were too small to detect concentrations of birds-of-prey (Fig. 12, 13, 14, 15). Crows appear to be more numerous in the Beech Knob area (near agriculture fields), while ravens are more abundant in the Cold Knob area. Turkey vultures are more abundant in both the Beech Knob and Cold Knob areas than in the areas in between.

Only 201 birds were recorded during the 10 nighttime surveys in August, September, and October (Table 12). Most songbirds could not be identified by species because they were not seen and birds used call-notes rather than typical songs. There did not appear to be concentrations of birds at night at specific points along Beech Ridge Road (Fig. 16).

Raptor observations from select vantage points by Hawkwatch International personnel detected 974 migrating raptors during September, October, and November (Table 13) (Hawkwatch International 1995). The red-tailed hawk was the most abundant species (322 individuals), followed by sharp-shinned hawks (158), turkey vultures (155), and broad-winged hawks (118). Broad-winged hawks were recorded only in September and sharp-shinned hawks were most abundant in September and October. Red-tailed hawks were most abundant in the area in November. The greatest diversity of raptors migrating through the area occurred in

October (13 species), but raptors abundance was greatest in November due to the large numbers of red-tailed hawks migrating through the area. Red-tails comprised 67% of all migrating raptors recorded during November and 33% of all raptors recorded during September-November. The highest numbers were recorded at Cold Knob (112 raptors/100 hours) and Beech Knob (63/100 hours). The high numbers at Cold Knob were due primarily to the concentrations of red-tailed hawks migrating past the knob. Accipiters were slightly more abundant at Beech Knob (41/100 hours) than at Cold Knob (51/100 hours), whereas buteos were slightly more abundant at Cold Knob (131/100 hours) than at Beech Knob (112/100 hours).

Scientific names of all bird species known to occur or expected to occur in the project area are presented in Table 14.

Mammals

A list of mammal species known to occur or expected to occur in the project area is presented in Table 15. The only small mammal trapping previously conducted in or near the project area was by Hahn (1980). He conducted snap-trapping in mature forests and in clearcuts ranging from 1 to 6 years in age. Nine species of small mammals were captured in the mature forest cover type, including the deer mouse, woodland jumping mouse, boreal redback vole, meadow vole, rock vole, southern bog lemming, smoky shrew, masked shrew, and shorttail shrew (Table 15). The same 9 species were captured in clearcuts, and all except the southern bog lemming were captured in edge habitats where mature forests were adjacent to clearcuts (Hahn and Michael 1980). The most abundant small mammals (> 3.3 captures/100 trapnights) were the deer mouse and redback vole. Capture rates for all other small mammals were <1.0 capture/100 trap nights.

Other mammals known or expected to occur in the project area include: hairy-tailed mole, cottontail rabbit, snowshoe hare, chipmunk, woodchuck, gray squirrel, fox squirrel, southern flying squirrel, red fox, gray fox, black bear, raccoon, long-tailed weasel, spotted skunk, bobcat, and white-tailed deer (Table 15). Bats were observed feeding over roads on several nights, but it was not possible to identify them by species. Bat species most likely to occur in the project area are the little brown bat, eastern pipistrelle, and big brown bat.

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TABLES

Table 1. List of plant species known to occur in the proposed windplant project area, Greenbrier County, WV.

Herbaceous Plants	
Lycopodium lucidulum	Shining club moss
Lycopodium flabelliforme	Groundpine
Osmunda cinnamomea	Cinnamon fern
Thelypteris noveboracensis	New York fern
Dryopteris campyloptera	Mountain wood fern
Dryopteris spinulosa	Spinulose shield fern
Dennstaedtia punctilobula	Hay-scented fern
Athyrium angustum	Northeastern lady fern
Brachyelytrum erectrum	Grass
Danthonia spicata	Poverty oatgrass
Hystrix patula	Bottlebrush grass
Dulichium arundinaceum	Three-way sedge
Carex trisperma	Sedge
Carex scabrata	Sedge
Carex intumescens	Sedge
Amianthium muscaetoxicum	Fly poison
Veratrum viride	White hellebore
Uvularia pudica	Mountain bellwort
Allium tricoccum	Ramp
Clintonia borealis	Yellow clintonia
Clintonia umbellulata	White clintonia
Mianthemum canadense	Wild lily-of-the-valley
Disporum lanuginosum	Hairy disporum
Streptopus roseus	Twisted stalk
Medeola virginiana	Indian cucumber-root
Trillium undulatum	Painted trillium
Smilax rotundifolia	Common greenbrier
Dioscorea villosa	Wild yam
Laportea canadensis	Wood nettle
Cimicifuga americana	Mountain bugbane
Caulophyllum thalictroides	Blue cohosh
Saxifraga micranthidifolia	Lettuce saxifrage
Tiarella cordifolia	Foamflower
Rubus canadensis	Thornless blackberry
Amphicarpa bracteata	Hog-peanut
Oxalis montana	White wood sorrel
Impatiens capensis	Spotted touch-me-not
Viola papilionacea	Common blue violet
Viola blanda	Sweet white violet
Thaspium barbinode	Hairy-jointed meadow-parsnip
Angelica spp.	Angelica
Monotropa uniflora	Indian pipe
Gentiana clausa	Closed gentian
Cuscuta gronovii	Common dodder
Phlox divaricata	Wild blue phlox

Table 1. Continued.

Hydrophyllum virginianum	Virginia waterleaf
Hydrophyllum canadense	Broad-leaved waterleaf
Collinsonia canadensis	Richweed
Chelone glabra	Turtlehead
Pedicularis canadensis	Common lousewort
Epifagus virginiana	Beechdrops
Mitchella repens	Partridgeberry
Solidago puberula	Downy goldenrod
Solidago erecta	Slender goldenrod
Aster puniceus	Purple-stem aster
Uncommon Trees and Shrubs	
Magnolia acuminata	Cucumber tree
Magnolia fraseri	Mountain magnolia
Tsuga canadensis	Hemlock
Pyrus americana	Mountain-ash
Menziesia pilosa	Allegheny menziesia
Common Trees and Shrubs	
Quercus rubra	Red oak
Acer rubrum	Red maple
Acer saccharum	Sugar maple
Acer pensylvanicum	Striped maple
Fagus grandifolia	American beech
Prunus serotina	Wild black cherry
Hamamelis virginiana	Witch hazel
Betula lenta	Black birch
Betula alleghaniensis	Yellow birch
Prunus pensylvanica	Fire cherry
Fraxinus americana	White ash
Tilia americana	American basswood
Rhododendron calendulaceum	Flame azalea
Ilex montana	Mountain holly
Viburnum alnifolium	Hobblebush

Table 2. List of amphibian species known to occur or expected to occur in the proposed windplant project area, Greenbrier County, WV.

Salamanders	
Ambystoma jeffersonianum	Jefferson salamander
Ambystoma maculatum	Spotted salamander
Ambystoma opacum	Marbled salamander
Notophthalmus v. viridescens	Red-spotted newt, Red eft
Desmognathus f. fuscus	Northern dusky salamander
Desmognathus monticola	Seal salamander
Desmognathus ochrophaeus	Mountain dusky salamander
Plethodon cinereus	Redback salamander
Plethodon hoffmani	Valley and ridge salamander
Plethodon glutinosus	Slimy salamander
Plethodon wehrlei	Wehrle's salamander
Hemidactylium scutatum	Four-toed salamander
Gyrinophilus p. porphyriticus	Northern spring salamander
Pseudotriton montanus diastictus	Midland mud salamander
Pseudotriton r. ruber	Northern red salamander
Aneides aeneus	Green salamander
Eurycea bislineata	Northern two-lined salamander
Eurycea l. longicauda	Longtail salamander
Toads	
Bufo a. americanus	Eastern American toad
Bufo woodhouseii fowleri	Fowler's toad
Frogs	
Hyla versicolor/chrysoscelis	Gray treefrog (complex)
Pseudacris c. crucifer	Northern spring peeper
Pseudacris brachyphona	Mountain chorus frog
Pseudacris triserata feriarum	Upland chorus frog
Rana catesbeiana	Bullfrog
Rana clamitans melanota	Green frog
Rana sylvatica	Wood frog
Rana palustris	Pickerel frog

Table 3. List of reptile species known to occur or expected to occur in the proposed windplant project area, Greenbrier County, WV.

Turtles	
Chelydra s. serpentina	Common snapping turtle
Terrapene c. carolina	Eastern box turtle
Lizards	
Sceloporus undulatus hyacinthinus	Northern fence lizard
Eumeces fasciatus	Five-lined skink
Eumeces a. anthracinus	Northern coal skink
Snakes	
*Nerodia s. sipedon**	Northern water snake
*Storeria o. occipitomaculata**	Northern redbelly snake
Storeria d. dekayi	Northern brown snake
*Thamnophis s. sirtalis**	Eastern garter snake
Thamnophis s. sauritus	Eastern ribbon snake
Heterodon platirhinos	Eastern hognose snake
Carphophis a. amoenus	Eastern worm snake
*Diadophis punctatus edwardsii**	Northern ringneck snake
Coluber c. constrictor	Northern black racer
*Opheodrys v. vernalis**	Eastern smooth green snake
*Elaphe o. obsoleta**	Black rat snake
*Lampropeltis t. triangulum**	Eastern milk snake
*Agkistrodon contortrix mokasen**	Northern copperhead
*Crotalus horridus**	Timber rattlesnake

*Species known to occur in the higher elevations of the northeastern section of the state.

Table 4. Total numbers of resident birds recorded during breeding bird surveys along transect lines and drive routes, May-June, 1994. N = number of different days surveyed.

Species	Numbers of Individuals Sighted: Walk Transects (N=29)	Drive Routes (N=10)
Mallard	-	2
Turkey vulture	2	10
Red-shouldered hawk	2	-
Broad-winged hawk	-	2
Ruffed grouse	2	2
Wild turkey	1	1
Mourning dove	2	3
Yellow-billed cuckoo	2	8
Barred owl	2	-
Chimney swift	-	1
Ruby-throated hummingbird	-	1
Northern flicker	2	8
Pileated woodpecker	2	5
Downy woodpecker	7	1
Hairy woodpecker	1	2
Unidentified woodpecker	2	17
Acadian flycatcher	-	1
Willow flycatcher	2	6
Least flycatcher	19	23
Eastern wood peewee	5	9
Tree swallow	1	1
Blue jay	3	11
Common raven	2	18
Common crow	12	52
Black-capped chickadee	11	16
White-breasted nuthatch	3	7
House wren	3	1
Winter wren	-	2
Gray catbird	8	49
Brown thrasher	2	10
American robin	31	51
Wood thrush	4	29
Hermit thrush	18	15
Veery	84	215
Cedar waxwing	14	30
Solitary vireo	8	51
Red-eyed vireo	126	264
Black and white warbler	1	2
Golden-winged warbler	1	1
Magnolia warbler	-	2
Black-throated blue warbler	4	23
Black-throated green warbler	57	73
Chestnut-sided warbler	81	247
Ovenbird	41	27

Table 4. Continued.

Species	Numbers of Individuals Sighted: Walk Transects (N=29)	Numbers of Individuals Sighted: Drive Routes (N=10)
Kentucky warbler	3	1
Mourning warbler	19	39
Common yellowthroat	9	27
Hooded warbler	5	16
Canada warbler	5	8
American redstart	1	11
Brown-headed cowbird	26	59
Scarlet tanager	2	19
Rose-breasted grosbeak	14	46
Indigo bunting	12	65
American goldfinch	25	65
Rufous-sided towhee	40	100
Dark-eyed junco	65	101
Vesper sparrow	-	3
Chipping sparrow	5	13
Field sparrow	5	16
Song sparrow	21	22
Total # species	53	59

Table 5. Total numbers of resident birds recorded during 10 drive routes, May-June, 1994.

	K.P. Skyway (6 miles)	Richwood Road (5 miles)	Beech Ridge/ Pole Road (8.5 miles)
Mallard	-	-	2
Turkey vulture	3	3	4
Broad-winged hawk	1	-	1
Ruffed grouse	1	-	1
Wild turkey	-	-	1
Mourning dove	-	-	3
Yellow-billed cuckoo	4	2	2
Chimney swift	1	-	-
Ruby-throated hummingbird	-	-	1
Northern flicker	4	1	3
Pileated woodpecker	-	3	2
Downy woodpecker	1	-	-
Hairy woodpecker	2	-	-
Unidentified woodpecker	11	3	3
Acadian flycatcher	-	1	-
Willow flycatcher	2	1	3
Least flycatcher	12	5	6
Eastern wood peewee	6	-	3
Tree swallow	-	-	1
Blue jay	5	3	3
Common raven	4	4	10
Common crow	7	11	34
Black-capped chickadee	8	2	6
White-breasted nuthatch	2	3	2
House wren	-	-	1
Winter wren	2	-	-
Gray catbird	10	9	30
Brown thrasher	4	1	5
American robin	12	13	26
Wood thrush	22	3	4
Hermit thrush	10	3	2
Veery	63	53	99
Cedar waxwing	4	5	21
Solitary vireo	7	23	21
Red-eyed vireo	112	55	97
Black and white warbler	-	-	2
Golden-winged warbler	1	-	-
Magnolia warbler	1	-	1
Black-throated blue warbler	18	2	3
Black-throated green warbler	34	14	25
Chestnut-sided warbler	62	60	125
Ovenbird	6	4	17
Kentucky warbler	-	1	-
Mourning warbler	14	10	15
Common yellowthroat	8	2	17

Table 5. Continued.

	K.P. Skyway (6 miles)	Richwood Road (5 miles)	Beech Ridge/ Pole Road (8.5 miles)
Hooded warbler	2	2	12
Canada warbler	2	2	4
American redstart	4	-	7
Brown-headed cowbird	13	5	41
Scarlet tanager	6	5	8
Rose-breasted grosbeak	14	16	16
Indigo bunting	11	8	46
American goldfinch	33	6	26
Rufous-sided towhee	32	20	48
Dark-eyed junco	39	32	30
Vesper sparrow	-	-	3
Chipping sparrow	1	3	9
Field sparrow	4	2	10
Song sparrow	-	1	21
Total # individuals	625	402	883
Total # species	47	41	52
# individuals/mile	104.2	80.4	103.9

Table 6. Relative abundance of resident birds recorded during breeding bird surveys along transect lines and the Beech Ridge/Pole Road drive routes, May-June, 1994. N = number of different days surveyed.

Species	Numbers of Individuals Sighted	
	Walk Transects (N=29)	Drive Routes (N=10)
Red-eyed vireo	126	97
Veery	84	99
Chestnut-sided warbler	81	125
Dark-eyed junco	65	30
Black-throated green warbler	57	25
Ovenbird	41	17
Rufous-sided towhee	40	48
American robin	31	26
Brown-headed cowbird	26	41
American goldfinch	25	26
Song sparrow	21	21
Mourning warbler	19	15
Least flycatcher	19	6
Hermit thrush	18	2
Cedar waxwing	14	21
Rose-breasted grosbeak	14	16
Indigo bunting	12	46
Common crow	12	34
Black-capped chickadee	11	6
Common yellowthroat	9	17
Gray catbird	8	30
Solitary vireo	8	21
Downy woodpecker	7	0
Hooded warbler	5	12
Field sparrow	5	10
Chipping sparrow	5	9
Canada warbler	5	4
Eastern wood pewee	5	3
Wood thrush	4	4
Black-throated blue warbler	4	3
Blue jay	3	3
White-breasted nuthatch	3	2
House wren	3	1
Kentucky warbler	3	0
Common raven	2	10
Scarlet tanager	2	8
Brown thrasher	2	5
Turkey vulture	2	4
Willow flycatcher	2	3
Northern flicker	2	3
Unidentified woodpecker	2	3
Mourning dove	2	3

Table 6. Continued

Species	Numbers of Individuals Sighted Walk Transects (N=29)	Drive Routes (N=10)
Pileated woodpecker	2	2
Yellow-billed cuckoo	2	2
Ruffed grouse	2	1
Barred owl	2	0
Red-shouldered hawk	2	0
American redstart	1	7
Black and white warbler	1	2
Wild turkey	1	1
Tree swallow	1	1
Hairy woodpecker	1	0
Golden-winged warbler	1	0
Vesper sparrow	0	3
Mallard	0	2
Broad-winged hawk	0	1
Ruby-throated hummingbird	0	1
Magnolia warbler	0	1
Total # individuals	825	883
Total # species	53	52

Table 7. Total numbers of resident birds recorded during transect line surveys, May-June, 1994. N = number different days surveyed.

	Transect Line							
	A* N=4	B N=5	C N=3	D N=3	E N=4	F N=3	G N=3	H N=4
Turkey vulture	1	-	-	-	-	-	-	-
Red-shouldered hawk	-	1	-	-	-	-	-	-
Ruffed grouse	1	-	-	1	-	-	-	-
Mourning dove	-	-	-	-	-	-	-	6
Chimney swift	-	-	-	1	-	-	-	-
Northern flicker	2	-	-	3	-	-	-	-
Pileated woodpecker	-	-	-	1	-	-	-	-
Downy woodpecker	1	1	1	1	-	-	2	-
Unidentified woodpecker	1	1	-	-	-	-	-	-
Acadian flycatcher	-	-	-	1	-	-	-	-
Willow flycatcher	-	-	1	-	-	-	-	2
Least flycatcher	-	-	1	8	-	7	12	1
Eastern wood-pewee	1	-	-	1	-	-	6	-
Tree swallow	-	-	-	-	1	-	-	-
Blue jay	-	-	1	-	-	-	1	-
Common raven	-	-	-	-	-	-	2	-
American crow	3	-	2	4	5	-	-	-
Black-capped chickadee	-	-	-	7	-	-	4	2
White-breasted nuthatch	-	-	-	4	-	-	-	-
Gray catbird	-	-	2	5	1	-	2	2
Brown thrasher	-	-	2	-	-	-	-	1
American robin	4	8	3	10	15	2	8	6
Wood thrush	-	-	-	2	-	2	1	-
Hermit thrush	2	2	2	9	-	6	9	1
Veery	28	36	19	52	2	8	26	10
Cedar waxwing	-	-	-	2	-	1	9	2
Solitary vireo	1	1	1	4	-	-	3	-
Red-eyed vireo	44	26	19	77	4	9	49	6
Black and white warbler	-	-	-	1	-	-	-	-
Golden-winged warbler	-	-	2	-	-	-	-	-
Bl-throated blue warbler	1	-	-	1	1	-	1	-
Bl-throated green warbler	25	21	3	28	3	3	19	-
Chestnut-sided warbler	11	22	24	44	4	10	38	15
Ovenbird	28	10	2	25	1	5	18	2
Kentucky warbler	-	-	-	2	-	1	2	-
Mourning warbler	3	9	4	1	-	2	9	2
Yellowthroat	2	1	4	1	2	-	3	2
Hooded warbler	3	-	-	2	-	-	-	-
Canada warbler	-	4	-	-	-	-	2	-
American redstart	-	-	-	-	-	-	1	-
Northern oriole	-	-	-	-	-	-	1	-
Brown-headed cowbird	-	1	1	7	44	-	6	-

Table 7. Continued.

	Transect Line							
	A* N=4	B N=5	C N=3	D N=3	E N=4	F N=3	G N=3	H N=4
Scarlet tanager	-	2	-	-	-	-	1	-
Rose-breasted grosbeak	1	2	1	9	-	-	5	-
Indigo bunting	-	2	6	2	2	-	1	4
American goldfinch	-	-	1	-	18	7	8	1
Rufous-sided towhee	4	14	11	13	5	3	24	13
Dark-eyed junco	12	14	6	35	-	12	45	11
Chipping sparrow	-	-	2	1	2	-	2	1
Field sparrow	-	-	1	2	-	-	-	3
Song sparrow	-	-	2	4	25	-	1	4
Total # individuals	179	178	124	371	135	78	321	97
Total # species	22	20	20	36	17	15	33	22
Transect length (meters)	2600	1700	1700	5400	1200	1000	4800	1100
# individuals/100 meters	6.9	10.5	7.3	6.9	11.3	7.8	6.7	8.8

*A = Beech Ridge Road: 3.2 miles east of Anjean Road junction.
B = Job Knob: 4.0 miles east of Anjean Road junction.
C = Five-points: 4.1 miles east of Anjean Road junction.
D = Les McClung Road/microwave towers: 6.1 miles east of Anjean Road junction.
E = Les McClung Road/reclaimed stripmine: 6.2 miles east of Anjean Road junction.
F = Old Field Road: 8.0 miles east of Anjean Road junction.
G = Grassy Knob: 8.2 miles east of Anjean Road junction.
H = Cold Knob: 10.0 miles east of Anjean Road junction.

Table 8. Total numbers of resident turkey vultures, raptors, crows, and ravens sighted during drive surveys along Beech Ridge-Pole Road, June-August 1994. N = number of surveys conducted.

	June (N=1)	July (N=3)	August (N=2)
Turkey vulture	22	9	10
Osprey	-	-	1
Red-shouldered hawk	-	3	-
Broad-winged hawk	2	-	1
Red-tailed hawk	-	-	4
American crow	-	19	9
Common raven	1	4	8

Table 9. Total numbers of birds (resident and migratory) sighted from 7 observation points between Beech Knob and Cold Knob during "volunteer weekend", September 10-11, 1994.

	Observation Points						
	A*	B	C	D	E	F	G
Turkey vulture	15	19	-	33	3	43	25
Black vulture	-	1	-	-	-	-	-
Osprey	-	1	-	1	-	-	-
Northern harrier	-	-	-	-	1	-	-
Sharp-shinned hawk	2	4	-	-	1	3	1
Cooper's hawk	1	4	-	2	-	-	2
Unidentified accipiter	-	-	-	1	1	6	1
Red-shouldered hawk	2	2	-	2	2	-	3
Broad-winged hawk	2	13	-	2	1	20	2
Red-tailed hawk	4	3	-	1	3	1	5
Unidentified buteo	1	-	-	1	-	13	-
American kestrel	-	2	-	-	1	3	1
Merlin	-	1	-	-	-	-	-
Unidentified hawk	2	1	6	1	-	-	3
Ruffed grouse	-	-	-	1	-	-	-
Wild turkey	-	-	-	4	-	1	-
Mourning dove	-	-	-	1	-	-	1
Barred owl	-	-	-	1	-	-	-
Common nighthawk	-	-	-	4	-	-	-
Chimney swift	-	60	-	40	-	3	5
Hummingbird	1	1	-	-	-	-	-
Northern flicker	-	-	-	4	-	-	2
Pileated woodpecker	-	-	-	3	-	-	-
Downy woodpecker	-	-	-	1	-	-	-
Unidentified woodpecker	1	-	-	-	-	-	-
Eastern wood-pewee	-	-	-	3	-	-	-
Eastern phoebe	-	-	-	7	-	3	-
Eastern kingbird	-	-	-	1	-	-	-
Tree swallow	-	35	-	-	-	-	-
Barn swallow	-	2	-	1	3	2	-
Unidentified swallow	-	6	1	-	-	-	-
Blue jay	-	-	-	3	1	-	-
Common raven	5	2	-	13	2	-	2
American crow	10	6	-	16	7	10	1
Black-capped chickadee	1	2	-	5	-	1	-
White-breasted nuthatch	-	15	-	3	-	-	-
Golden-crowned kinglet	-	-	-	2	-	-	-
Gray catbird	7	1	-	3	-	-	-
Wood thrush	-	-	-	-	-	-	1
Cedar waxwing	12	46	-	11	94	-	9
Red-eyed vireo	1	-	-	8	-	-	-
Magnolia warbler	-	-	-	3	-	-	-
Black-throated green warbler	-	-	-	6	-	-	-

Table 9. Continued.

	Observation Points						
	A*	B	C	D	E	F	G
Chestnut-sided warbler	-	-	-	6	-	-	-
Yellow-throated warbler	-	2	-	-	-	-	-
Yellowthroat	-	-	-	1	-	-	-
Blackpoll warbler	-	-	-	-	-	-	1
Yellow-breasted chat	1	1	-	1	-	-	-
Unidentified warbler	1	31	-	3	-	-	2
Rose-breasted grosbeak	-	2	-	-	-	-	-
Indigo bunting	1	-	-	-	-	-	-
American goldfinch	10	9	-	28	-	13	50
Rufous-sided towhee	-	2	-	4	-	4	-
Dark-eyed junco	1	3	-	-	-	5	1
Field sparrow	-	-	-	2	-	1	1
Grasshopper sparrow	-	-	-	-	-	-	1
Savannah sparrow	-	-	-	1	-	-	-
Unidentified sparrow	1	4	-	14	-	-	-
Unidentified songbird	27	78	2	55	-	17	125
Total # individuals	109	358	9	303	120	149	265

*A = Westvaco tree sign (2.5 miles east of Anjean Road junction): 9/10/94 - 2 observers and 9/11/94 - 2 observers.

B = Powerline crossing/Kiosk overlook (3.1 miles east of Anjean Road junction): 9/10/94 - 2 observers and 9/11/94 - 3 observers.

C = Five-points (4.0 miles east of Anjean Road junction): 9/10/94 - 2 observers.

D = Les McClung/South Laurel (6.0 miles east of Anjean Road junction): 9/10/94 - 4 observers and 9/11/94 - 3 observers.

E = Joe Knob (2 miles east of Anjean): 9/10/94 - 1 observer.

F = Grassy Knob/Cut-off Road (8.0 miles east of Anjean Road junction): 9/10/94 - 3 observers and 9/11/94 - 3 observers).

G = Cold Knob (10.0 miles east of Anjean Road junction): 9/10/94 - 3 observers and 9/11/94 - 3 observers.

Table 10. Number of songbirds banded at the Allegheny Front Migration Observatory, August-October, 1994 (from George Hall).

Date	# Birds Banded		# Birds Banded
August		September	
13	3	25	209
14	16	26	39
15	16	27	57
16	8	28	12
17	rain	29	37
18	rain	30	94
19	22	October	
20	24	1	156
21	19	2	11
22	5	3	19
23	6	4	40
24	13	5	29
25	32	6	73
26	68	7	35
27	14	8	47
28	58	9	24
29	16		
30	58		
31	78		
September			
1	6		
2	13		
3	19		
4	5		
5	22		
6	33		
7	46		
8	111		
9	185		
10	542		
11	280		
12	92		
13	65		
14	99		
15	256		
16	230		
17	281		
18	66		
19	117		
20	59		
21	49		
22	12		
23	21		
24	76		

Table 11. Total numbers of birds (resident and migratory) sighted during 29 daytime drive routes along Beech Ridge-Pole Road (10 miles), August-October, 1994. N = number of surveys conducted.

Species	August (N=7)	September (N=16)	October (N=6)
Black vulture	-	4	-
Turkey vulture	14	35	40
Osprey	-	1	-
Northern harrier	-	3	1
Sharp-shinned hawk	-	3	6
Cooper's hawk	2	6	4
Red-shouldered hawk	-	6	2
Broad-winged hawk	6	5	1
Red-tailed hawk	1	4	7
Unidentified buteo	-	2	-
Kestrel	1	1	1
Unidentified hawk	-	1	2
Ruffed grouse	-	1	2
Wild turkey	-	-	9
Mourning dove	-	1	-
Yellow-billed cuckoo	2	3	1
Chimney swift	3	5	-
Hummingbird	11	-	-
Northern flicker	2	7	2
Pileated woodpecker	-	3	3
Downy woodpecker	3	8	6
Hairy woodpecker	-	1	-
Unidentified woodpecker	1	1	5
Acadian flycatcher	3	-	-
Eastern wood-pewee	3	-	-
Eastern phoebe	1	5	-
Unidentified flycatcher	-	2	1
Eastern kingbird	1	-	-
Tree swallow	13	-	-
Blue jay	4	12	12
Common raven	5	44	45
Common crow	48	123	71
Chickadee	52	123	35
White-breasted nuthatch	2	4	-
Carolina wren	2	-	-
Ruby-crowned kinglet	-	-	10
Gray catbird	42	81	-
American robin	10	29	21
Northern mockingbird	-	2	-
Veery	8	-	2
Cedar waxwing	111	246	50
Solitary vireo	2	2	7
Red-eyed vireo	37	16	4

Table 11. Continued.

Species	August (N=7)	September (N=16)	October (N=6)
Black & white warbler	3	1	-
Worm-eating warbler	1	-	-
Black-throated blue warbler	-	19	2
Black-throated green warbler	2	7	4
Palm warbler	-	1	2
Chestnut-sided warbler	6	9	-
Ovenbird	2	6	-
Yellowthroat	19	44	1
Hooded warbler	3	1	-
Canada warbler	-	1	-
American redstart	-	2	-
Unidentified warbler	15	125	21
Red-winged blackbird	1	-	-
Brown-headed cowbird	1	-	-
Scarlet tanager	1	-	-
Rose-breasted grosbeak	1	6	-
Indigo bunting	5	-	-
American goldfinch	148	132	29
Rufous-sided towhee	36	70	23
Dark-eyed junco	25	30	17
Chipping sparrow	2	9	-
Field sparrow	6	12	3
Song sparrow	20	9	11
White-throated sparrow	-	-	5
Unidentified songbird	416	550	112
Total # individuals	1,103	1,824	580
Total # species	48	53	39
Ave. # individuals/survey	157.6	114.0	96.7

Table 12. Numbers of birds (resident and migratory) recorded during 10 nightime drive routes along Beech Ridge-Pole Road (10 miles), August-October, 1994.

Species	Number Recorded
Screech owl	1
Barred owl	9
Unidentified owl	1
Common nighthawk	2
Great-crested flycatcher	1
American robin	1
Red-eyed vireo	1
Yellowthroat	1
Unidentified songbird	184
Total # individuals	201

Table 13. Total numbers of migrating birds-of-prey recorded at 6 observation points from Beech Knob to Cold Knob, September-November, 1994. N = number of surveys conducted.

	Observation Point						
	Beech Knob N=10	Five Points N=3	Job Knob N=4	Joe Knob N=2	Craters N=2	Cold Knob N=7	TOTAL N=28
September							
Turkey vulture	-	-	-	-	-	-	0
Black vulture	-	-	-	-	-	-	0
Osprey	2	-	-	-	-	3	5
Bald eagle	-	-	-	-	-	-	0
Golden eagle	-	-	-	-	-	-	0
Harrier	2	-	1	-	-	1	4
Sharp-shinned	25	4	2	1	-	27	59
Cooper's	3	1	2	-	-	5	11
Northern goshawk	-	-	-	-	-	-	0
Red-shouldered	2	-	-	-	-	1	3
Broad-winged	58	10	28	3	3	16	118
Red-tailed	7	3	-	-	-	2	12
Kestrel	14	-	2	1	-	5	22
Merlin	-	-	-	-	-	-	0
Unid. Accipiter	1	1	3	1	-	1	7
Unid. Buteo	12	1	-	-	-	6	19
Unid. Raptor	5	5	1	1	-	15	27
Total	131	25	39	27	3	82	287

	Observation Point						
	Beech Knob N=10	Five Points N=0	Job Knob N=5	Joe Knob N=0	Craters N=7	Cold Knob N=13	TOTAL N=35
October							
Turkey vulture	11		5		-	57	73
Black vulture	-		-		-	7	7
Osprey	1		-		-	1	2
Bald eagle	-		-		-	1	1
Golden eagle	-		-		-	1	1
Harrier	-		-		-	2	2
Sharp-shinned	22		29		14	27	92
Cooper's	6		-		1	20	27
Northern goshawk	-		-		-	3	3
Red-shouldered	-		-		1	1	2
Broad-winged	-		-		-	-	0
Red-tailed	5		-		1	43	49
Kestrel	1		-		1	5	7
Merlin	1		-		-	-	1
Unid. Accipiter	6		1		3	4	14
Unid. Buteo	-		-		-	4	4
Unid. Raptor	1		5		1	5	12
Total	54	-	40	-	22	181	297

Table 13. Continued

	Observation Point						
	Beech Knob N=9	Five Points N=0	Job Knob N=0	Joe Knob N=0	Craters N=0	Cold Knob N=16	TOTAL N=25
November							
Turkey vulture	38					44	82
Black vulture	-					-	0
Osprey	-					-	0
Golden eagle	1					5	6
Harrier	2					7	9
Sharp-shinned	-					7	7
Cooper's	3					4	7
Northern goshawk	-					-	0
Red-shouldered	2					1	3
Broad-winged	-					-	0
Red-tailed	90					171	261
Kestrel	-					1	1
Merlin	-					-	0
Unid. Accipiter	-					-	0
Unid. Buteo	6					8	14
Unid. Raptor	-					-	0
Total	142	-	-	-	-	248	390

	Observation Point						
	Beech Knob N=29	Five Points N=3	Job Knob N=9	Joe Knob N=2	Craters N=9	Cold Knob N=36	TOTAL N=88
Sept.-Oct.-Nov.							
Turkey vulture	49	-	5	-	-	101	155
Black vulture	-	-	-	-	-	7	7
Osprey	3	-	-	-	-	4	7
Bald eagle	-	-	-	-	-	1	1
Golden eagle	1	-	-	-	-	6	7
Harrier	4	-	1	-	-	10	15
Sharp-shinned	47	4	31	1	14	61	158
Cooper's	12	1	2	-	1	29	45
Northern goshawk	-	-	-	-	-	3	3
Red-shouldered	4	-	-	-		3	7
Broad-winged	58	10	28	3	3	16	118
Red-tailed	102	3	-	-	1	216	322
Kestrel	15	-	2	1	1	12	31
Merlin	1	-	-	-	-	-	1
Unid. Accipiter	7	1	4	1	3	5	21
Unid. Buteo	18	1	-	-	-	18	37
Unid. Raptor	6	5	6	1	1	20	39
Total	327	25	79	7	24	512	974

Table 14. Scientific names of birds known to occur or expected to occur in the proposed windplant project area, Greenbrier County, WV.

Anas platyrhynchos	Mallard
Coragyps atratus	Black vulture
Cathartes aura	Turkey vulture
Accipiter striatus	Sharp-shinned hawk
Accipiter cooperi	Cooper's hawk
Buteo jamaicensis	Red-tailed hawk
Buteo lineatus	Red-shouldered hawk
Buteo platypterus	Broad-winged hawk
Circus cyaneus	Northern harrier
Pandion haliaetus	Osprey
Aquila chrysaetos	Golden eagle
Falco sparverius	Kestrel
Falco columbarius	Merlin
Bonasa umbellus	Ruffed grouse
Meleagris gallopavo	Wild turkey
Charadrius vociferus	Killdeer
Philohela minor	American woodcock
Coccyuzus americanus	Yellow-billed cuckoo
Otus asio	Screech owl
Strix varia	Barred owl
Chordeiles minor	Common nighthawk
Chaetura pelagica	Chimney swift
Archilochus colubris	Ruby-throated hummingbird
Colaptes auratus	Northern flicker
Dryocopus pileatus	Pileated woodpecker
Sphyapicus varius	Yellow-bellied sapsucker
Dendrocopos villosus	Hairy woodpecker
Dendrocopos pubescens	Downy woodpecker
Tyrannus tyrannus	Eastern kingbird
Sayornis phoebe	Eastern phoebe
Myiarchus crinitus	Great-crested flycatcher
Empidonax trailli	Willow flycatcher
Empidonax virescens	Acadian flycatcher
Empidonax alnorum	Alder flycatcher
Empidonax minimus	Least flycatcher
Contopus virens	Eastern wood pewee
Iridoprocne bicolor	Tree swallow
Hirundo rustica	Barn swallow
Cyanocitta cristata	Blue jay
Corvus corax	Common raven
Corvus brachyrhynchos	Common crow
Parus atricapillus	Black-capped chickadee
Parus bicolor	Tufted titmouse
Sitta carolinenis	White-breasted nuthatch
Certhia familiaris	Brown creeper
Troglodytes aedon	House wren

Table 14. Continued.

Troglodytes troglodytes	Winter wren
Dumetella carolinensis	Gray catbird
Toxostoma rufum	Brown thrasher
Turdus migratorius	American robin
Hylocichla mustelina	Wood thrush
Catharus guttata	Hermit thrush
Catharus fuscescens	Veery
Sialia sialis	Eastern bluebird
Polioptila caerulea	Blue-grey gnatcatcher
Regulus satrapa	Golden-crowned kinglet
Regulus calendula	Ruby-crowned kinglet
Bombycilla cedrorum	Cedar waxwing
Sturnus vulgaris	Starling
Vireo solitarius	Solitary vireo
Vireo olivaceus	Red-eyed vireo
Mniotilta varia	Black and white warbler
Vermivora chrysoptera	Golden-winged warbler
Vermivora peregrina	Tennessee warbler
Vermivora ruficapilla	Nashville warbler
Parula americana	Northern parula
Dendroica magnolia	Magnolia warbler
Dendroica caerulescens	Black-throated blue warbler
Dendroica coronata	Yellow-rumped warbler
Dendroica virens	Black-throated green warbler
Dendroica pensylvanica	Chestnut-sided warbler
Dendroica fusca	Blackburnian warbler
Seiurus aurocapillus	Ovenbird
Geothlypis trichas	Common yellowthroat
Oporornis formosus	Kentucky warbler
Oporornis philadelphia	Mourning warbler
Wilsonia citrini	Hooded warbler
Wilsonia canadensis	Canada warbler
Setophaga ruticilla	American redstart
Sturnella magna	Eastern meadowlark
Agelaius phoeniceus	Red-winged blackbird
Quiscalus quiscula	Common grackle
Molothrus ater	Brown-headed cowbird
Piranga olivacea	Scarlet tanager
Pheucticus ludovicianus	Rose-breasted grosbeak
Passerina cyanea	Indigo bunting
Carpodacus purpureus	Purple finch
Spinus tristis	American goldfinch
Pipilo erythrophthalmus	Rufous-sided towhee
Junco hyemalis	Dark-eyed junco
Pooecetes gramineus	Vesper sparrow
Spizella passerina	Chipping sparrow
Spizella pusilla	Field sparrow
Ammodramus savannarum	Grasshopper sparrow
Passerculus sandwichensis	Savannah sparrow
Melospiza melodia	Song sparrow

Table 15. List of mammal species known to occur or expected to occur in the proposed windplant project area, Greenbrier County, WV.

Didelphis virginiana	Opossum
Sorex fumeus*	Smoky shrew
Sorex cinereus*	Masked shrew
Blarina brevicauda*	Short-tailed shrew
Parascalops breweri	Hairy-tailed mole
Myotis lucifugus	Little brown bat
Pipistrellus subflavus	Eastern pipistrelle
Eptesicus fuscus	Big brown bat
Lepus americanus	Snowshoe hare
Sylvilagus floridanus	Eastern cottontail
Tamias striatus	Eastern chipmunk
Marmota monax	Woodchuck
Sciurus carolinensis	Eastern gray squirrel
Sciurus niger	Fox squirrel
Glaucomys volans	Southern flying squirrel
Peromyscus maniculatus*	Deer mouse
Clethrionomys gapperi*	Southern red-backed vole
Microtus pennsylvanicus*	Meadow vole
Microtus chrotorrhinus*	Rock vole
Synaptomys cooperi*	Southern bog lemming
Napaeozapus insignis*	Woodland jumping mouse
Vulpes vulpes	Red fox
Urocyon cinereoargenteus	Gray fox
Ursus americanus	Black bear
Procyon lotor	Raccoon
Mustela frenata	Long-tailed weasel
Mephitis mephitis	Striped skunk
Felis rufus	Bobcat
Odocoileus virginianus	White-tailed deer

* = Trapped by Hahn (1980) in project area.

FIGURES

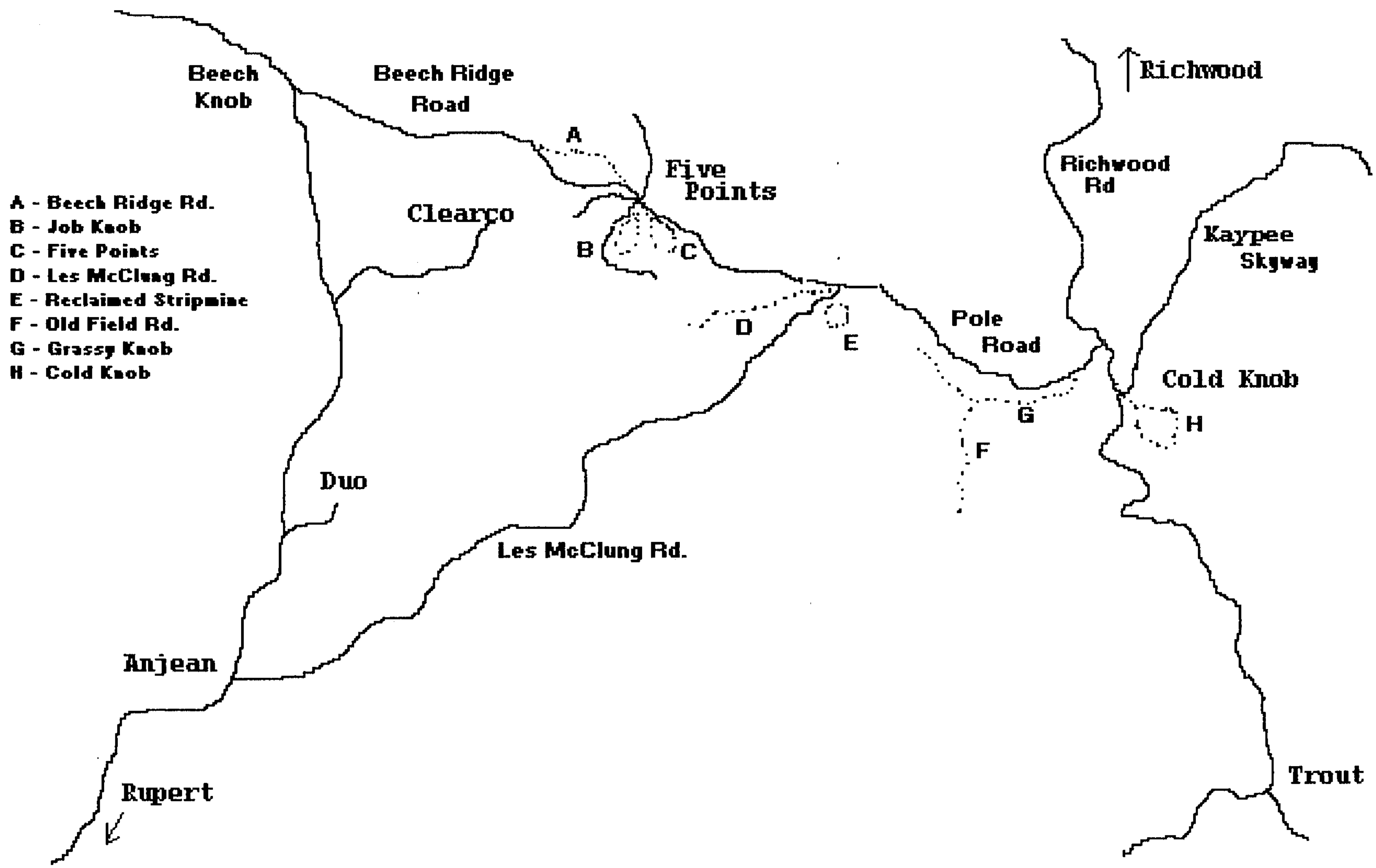

Fig. 1. Map of project area showing locations of line transects and drive routes.

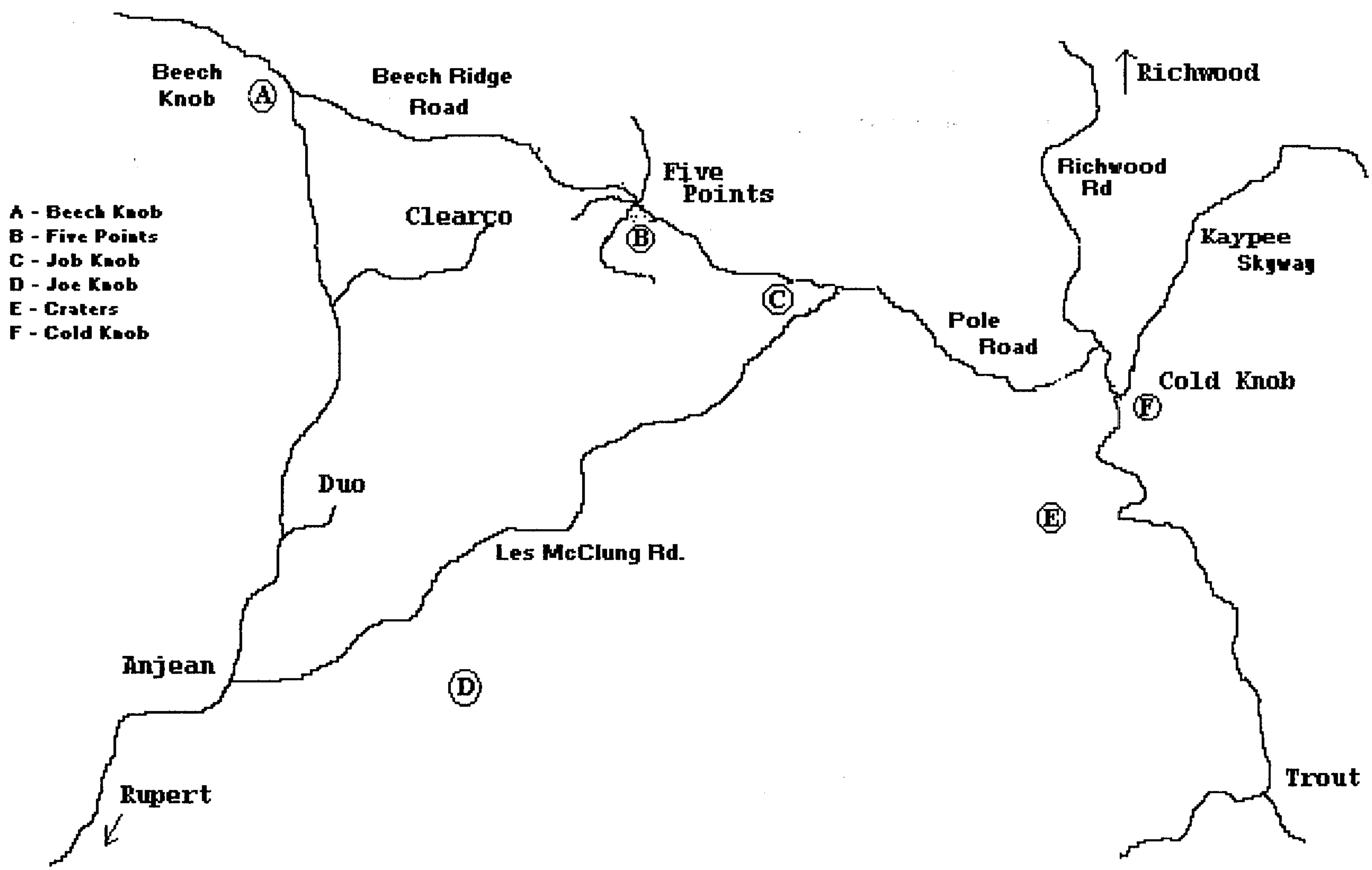

Fig. 2. Map of project area showing locations of line transects and drive routes.

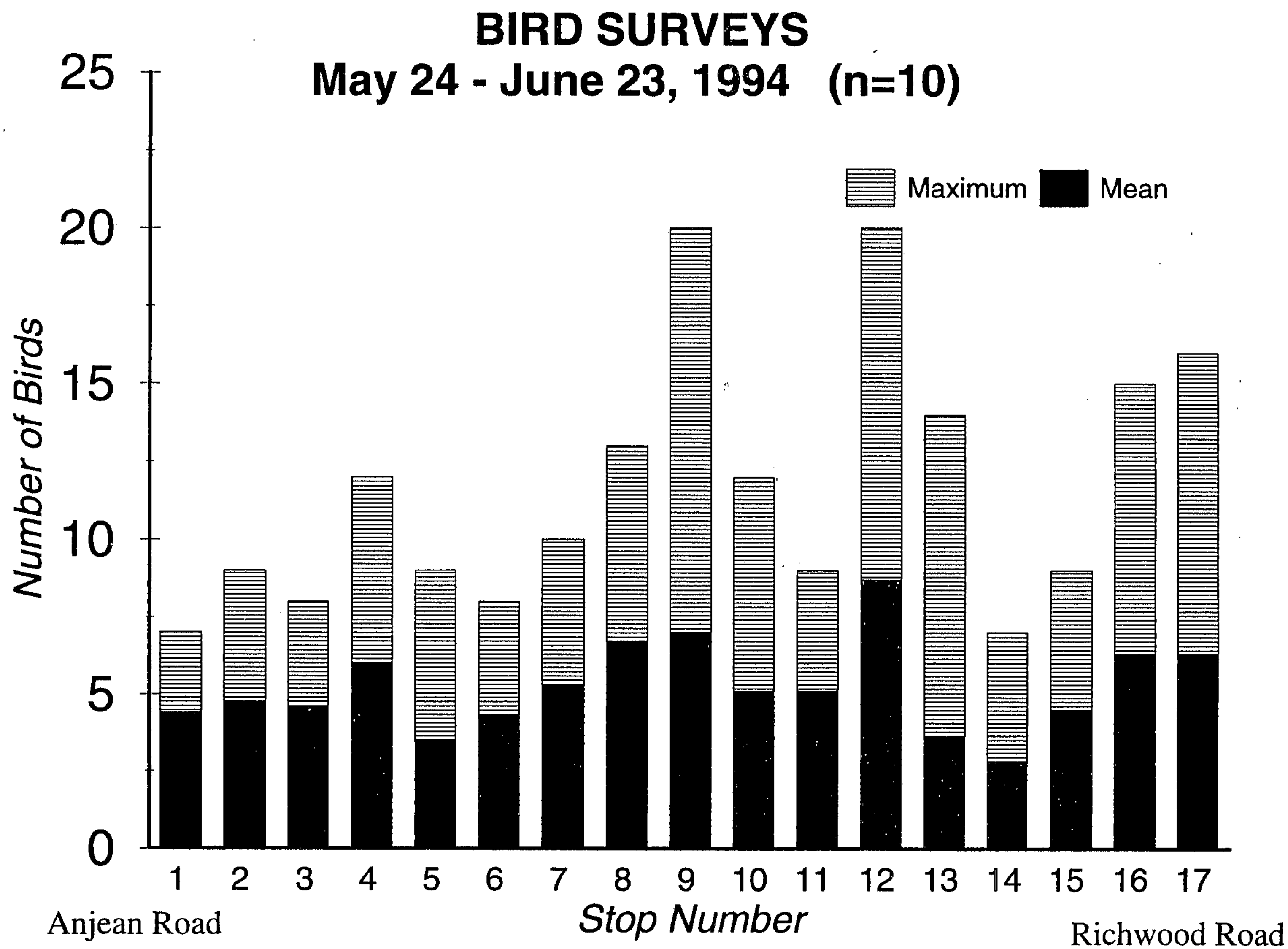

Fig. 3. Number of birds recorded during drive surveys along Beech Ridge/Pole Road.

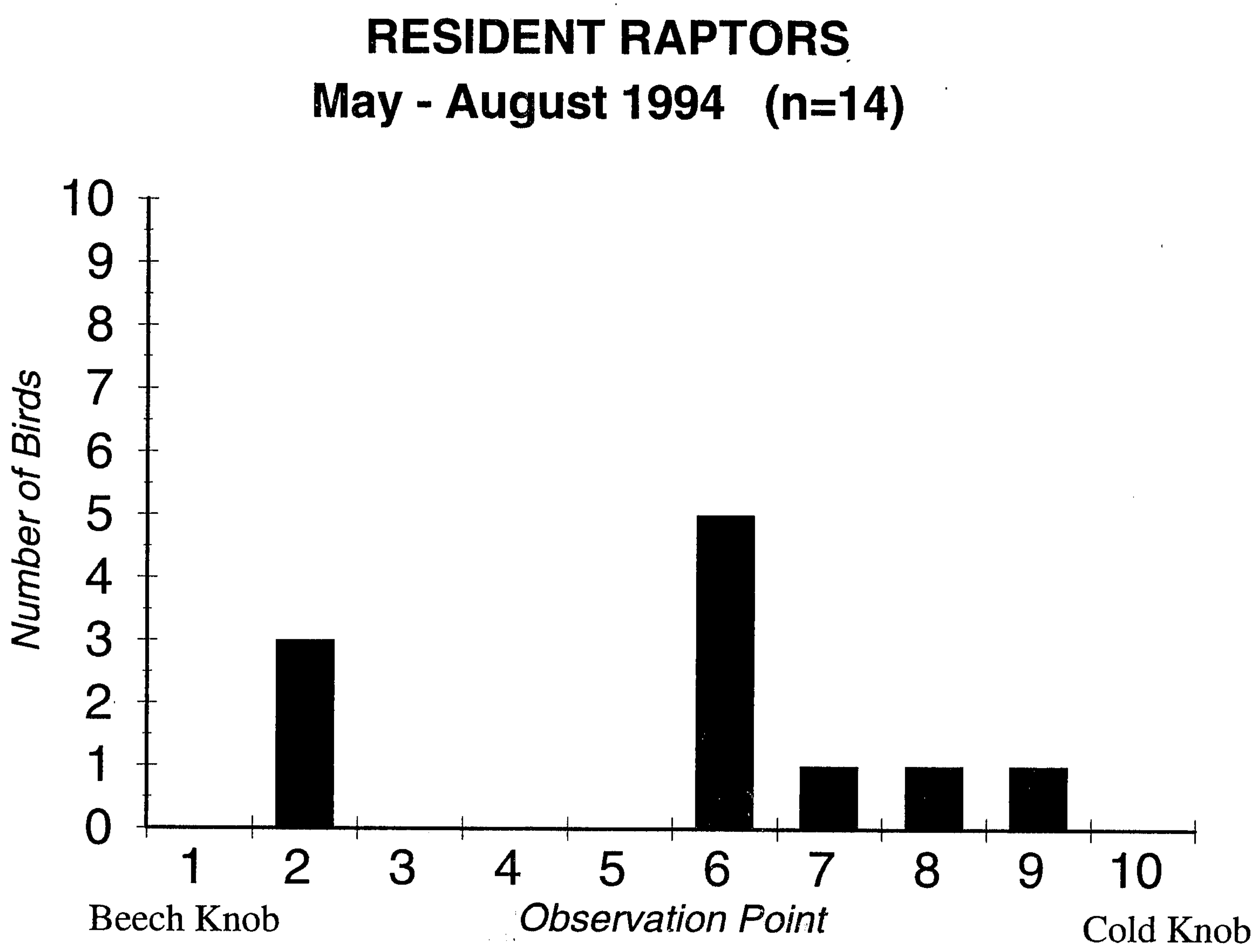

Fig. 4. Total number of resident raptors observed during 14 surveys along Beech Ridge Road.

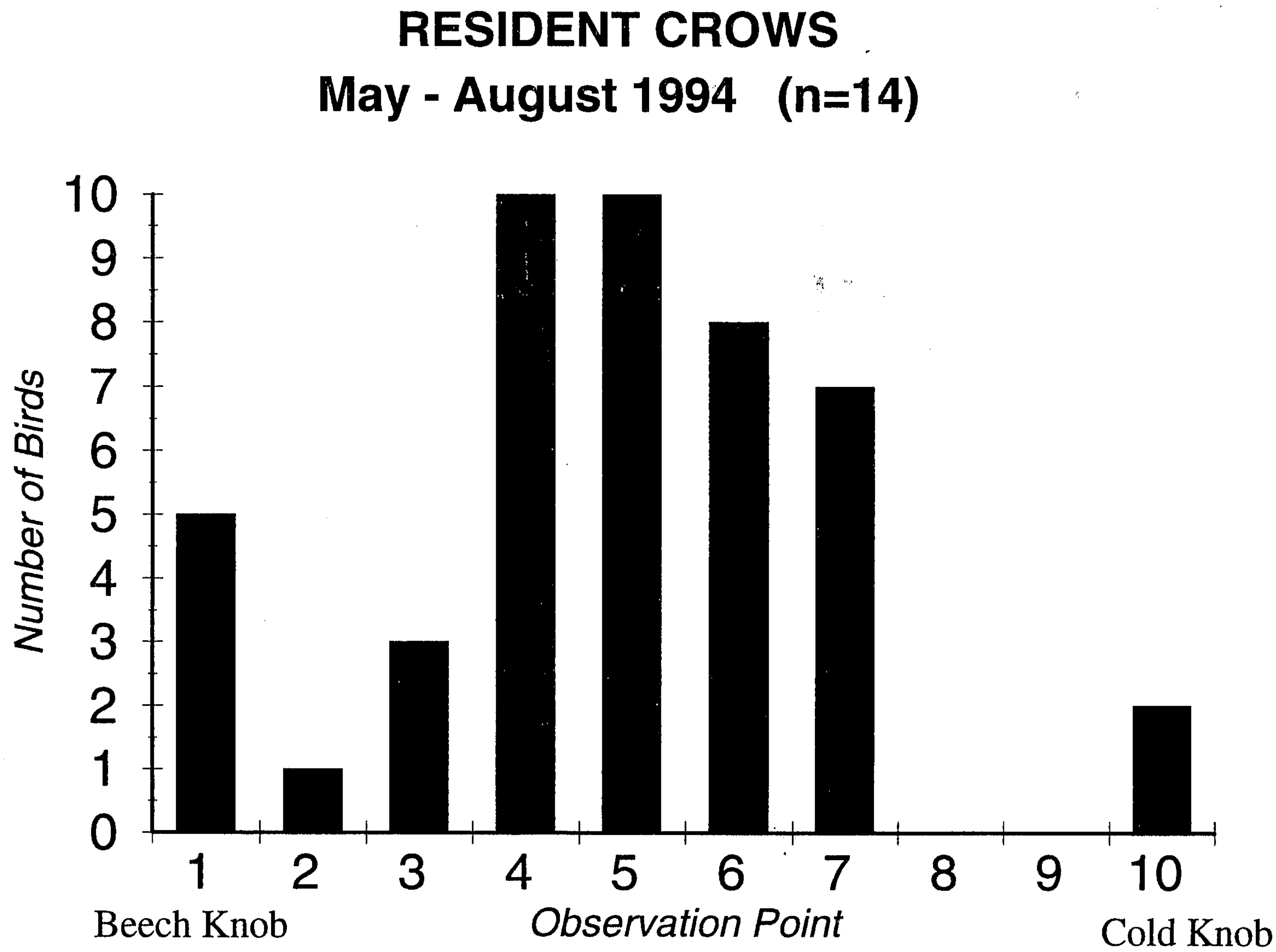

Fig. 5. Total number of resident crows observed during 14 surveys along Beech Ridge Road.

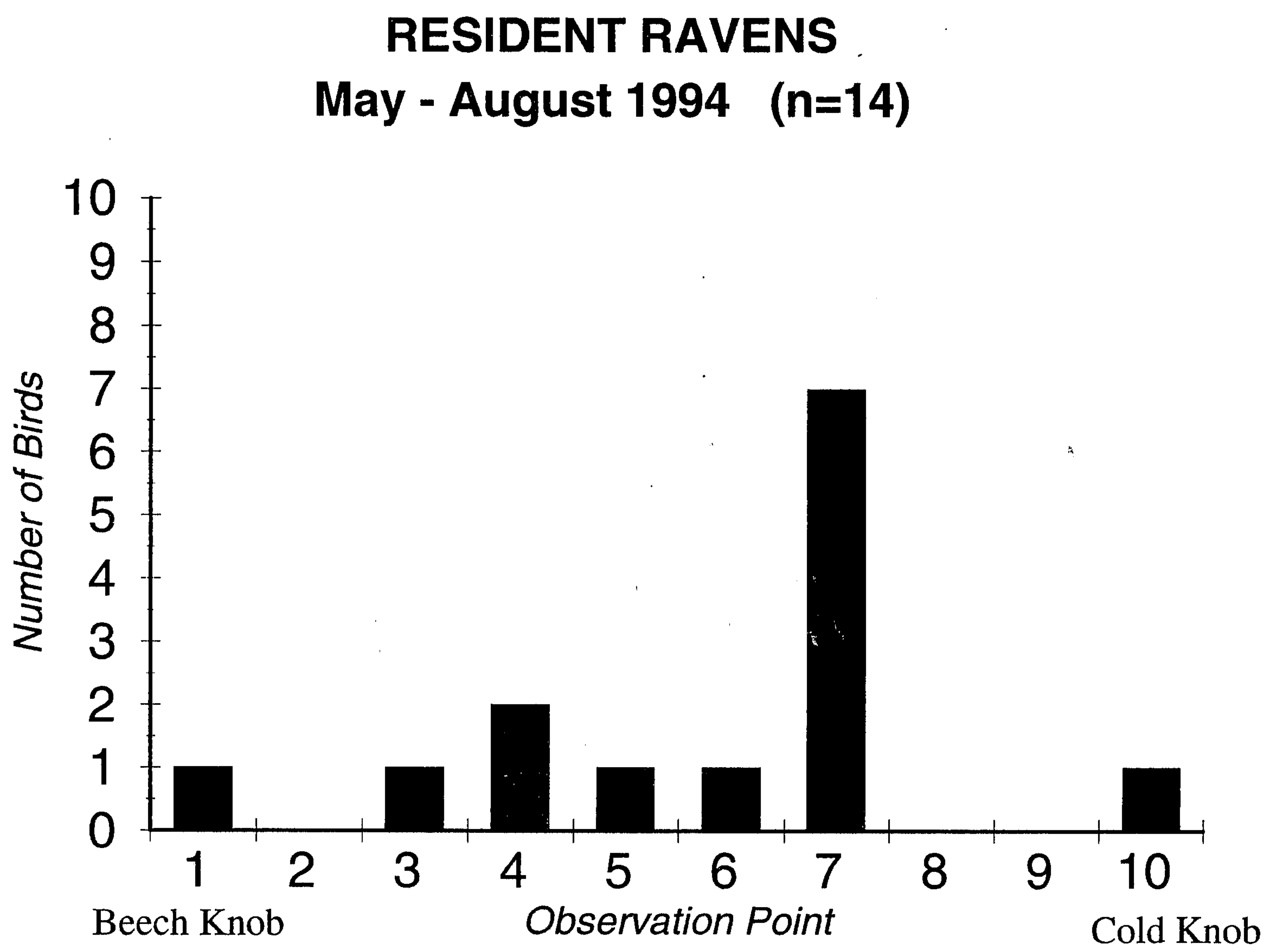

Fig. 6. Total number of resident ravens observed during 14 surveys along Beech Ridge Road.

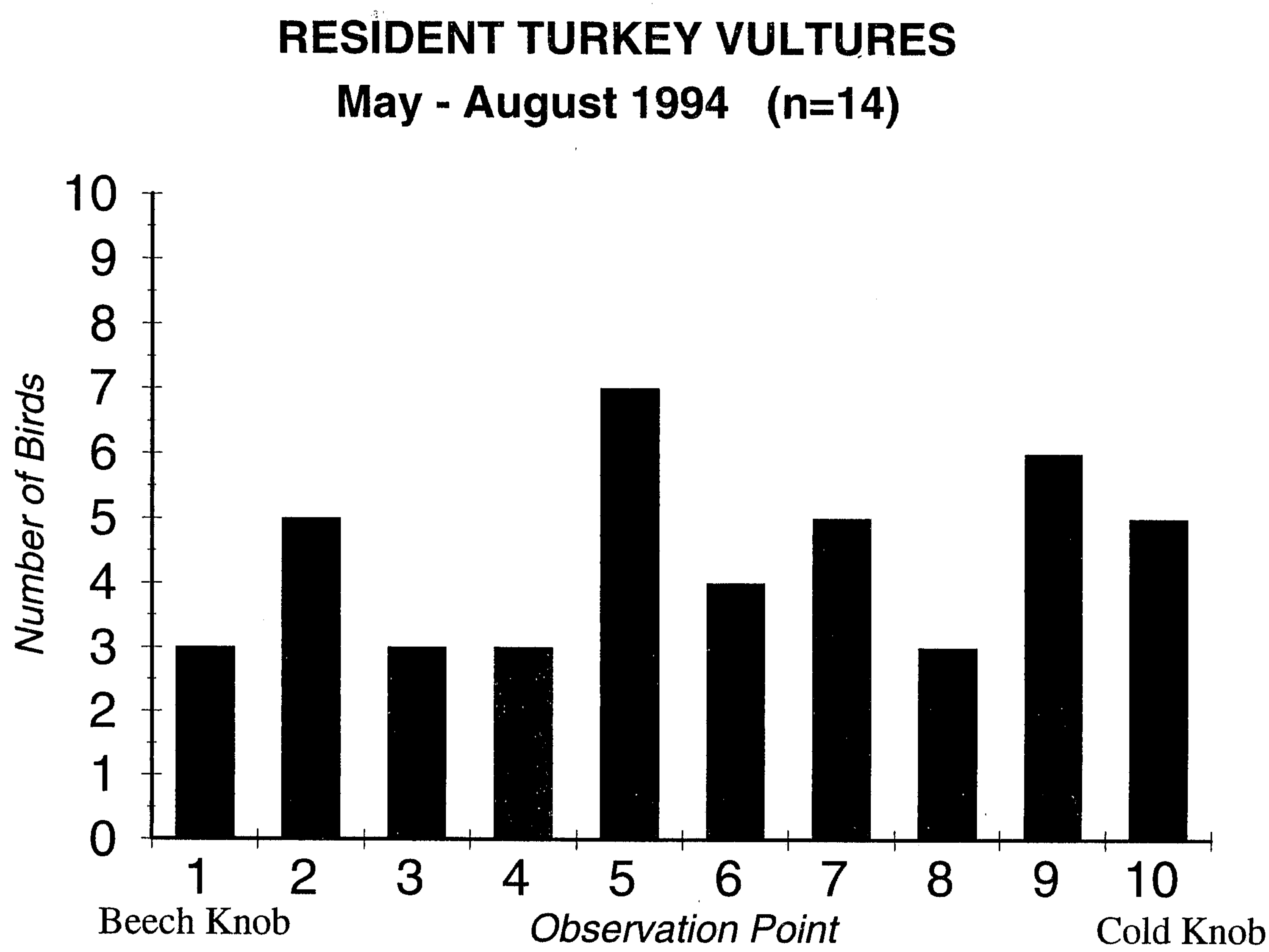

Fig. 7. Total number of resident turkey vultures observed during 14 surveys along Beech Ridge Road.

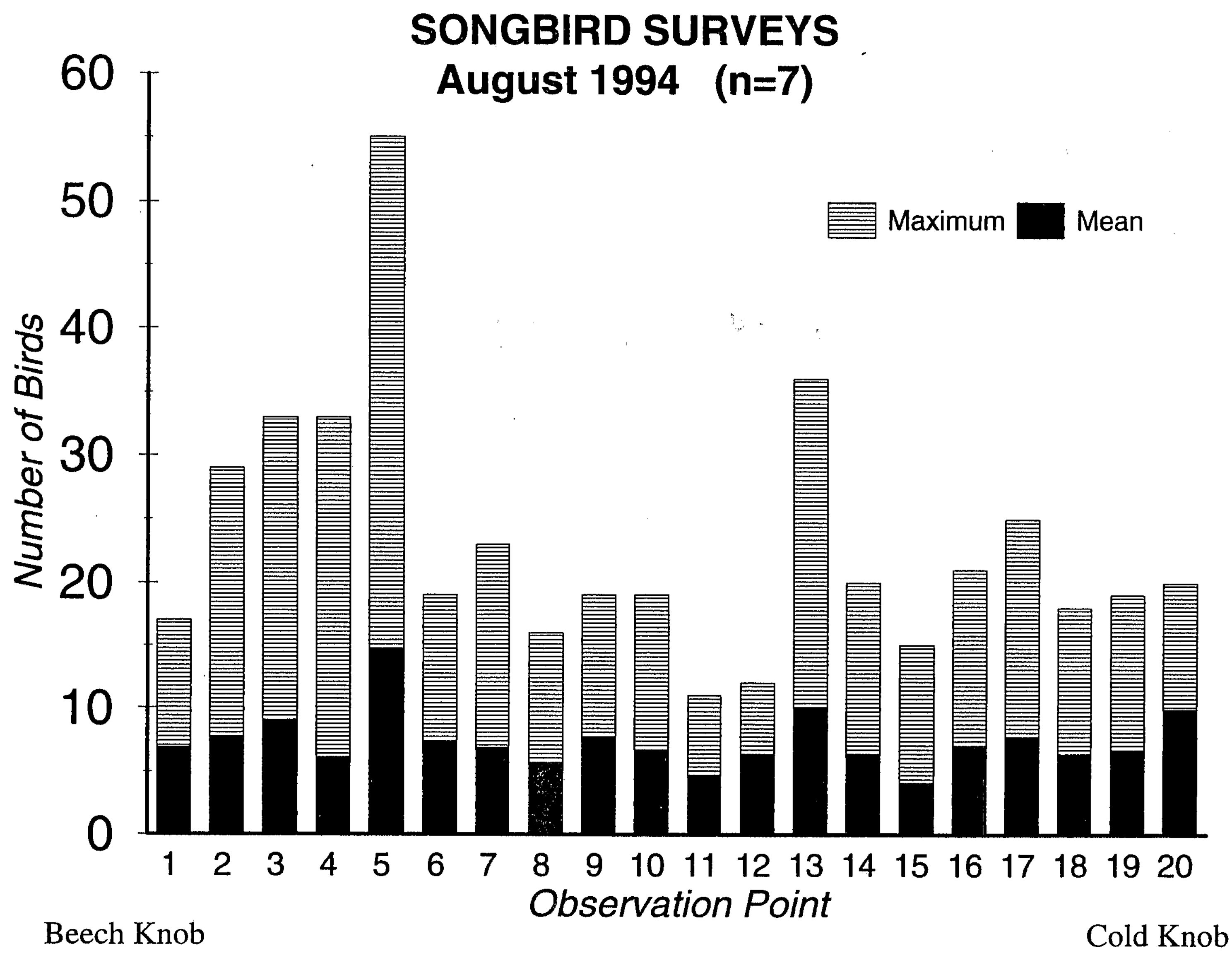

Fig. 8. Number of songbirds observed during 10 minute counts at 0.5 mile intervals along Beech Ridge Road, August 1994..

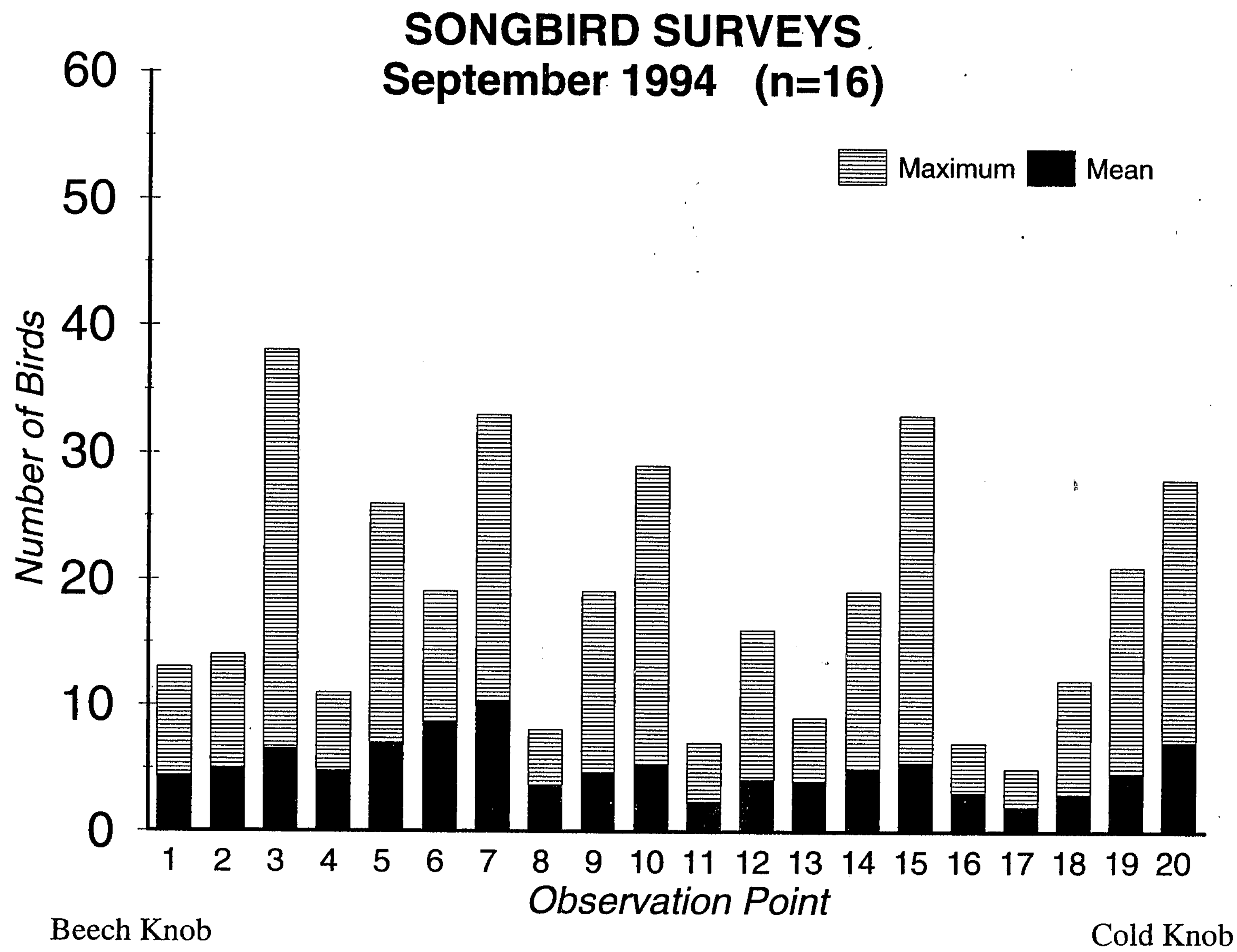

Fig. 9. Number of songbirds observed during 10 minute counts at 0.5 mile intervals along Beech Ridge Road, Sept. 1994.

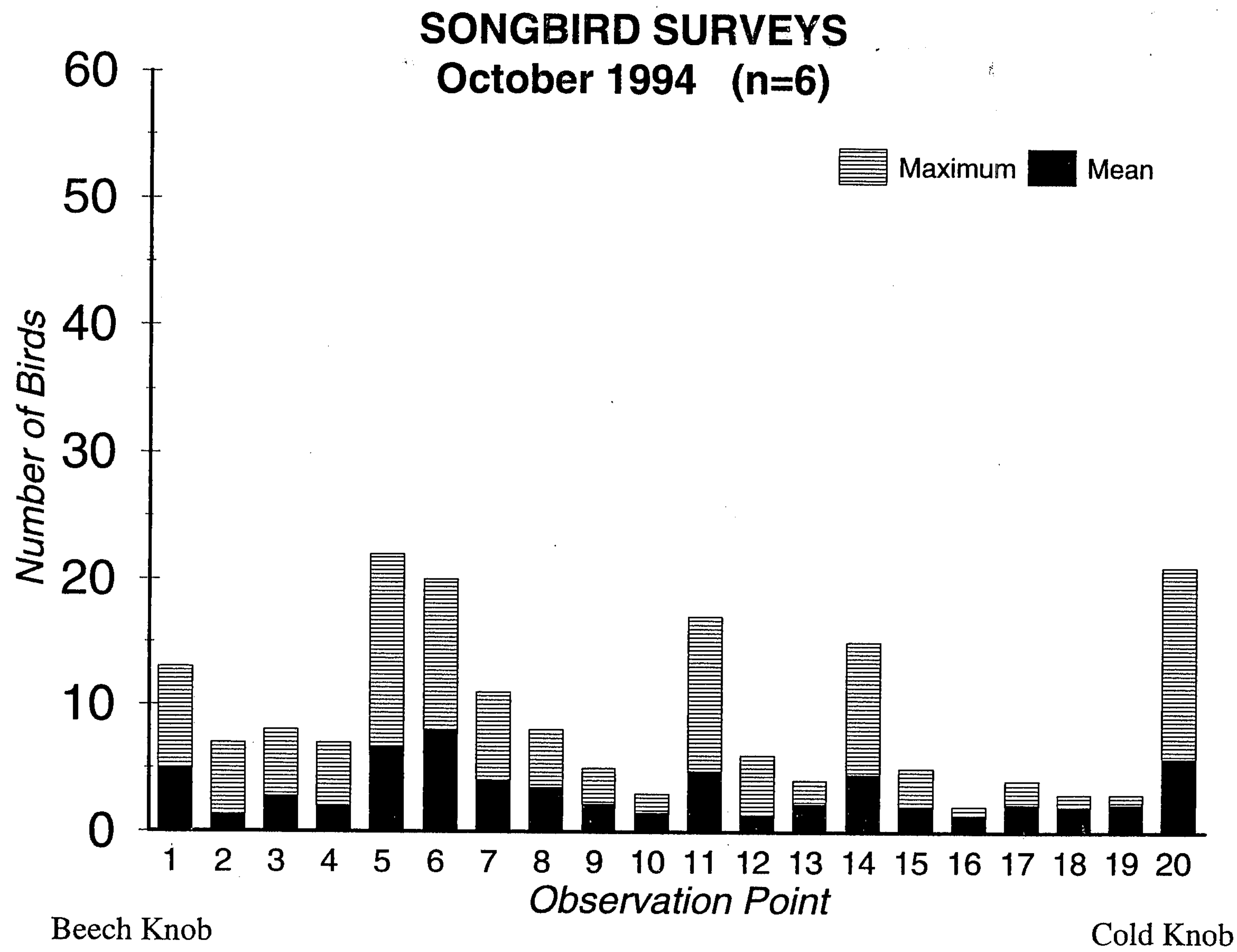

Fig. 10. Number of songbirds observed during 10 minute counts at 0.5 mile intervals along Beech Ridge Road, Oct. 1994.

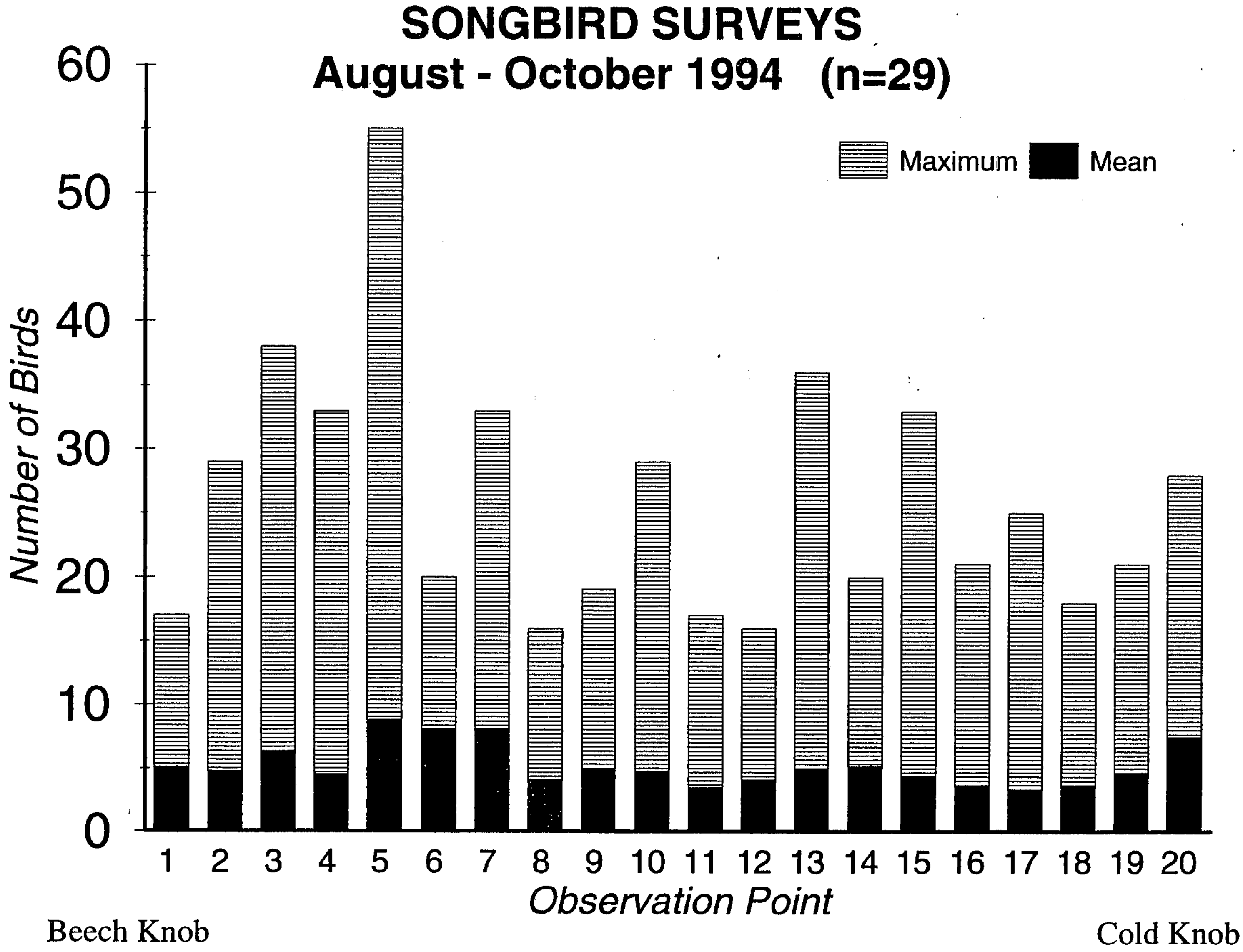

Fig. 11. Number of songbirds observed during 10 minute counts at 0.5 mile intervals along Beech Ridge Road, Aug.- Oct. 1994.

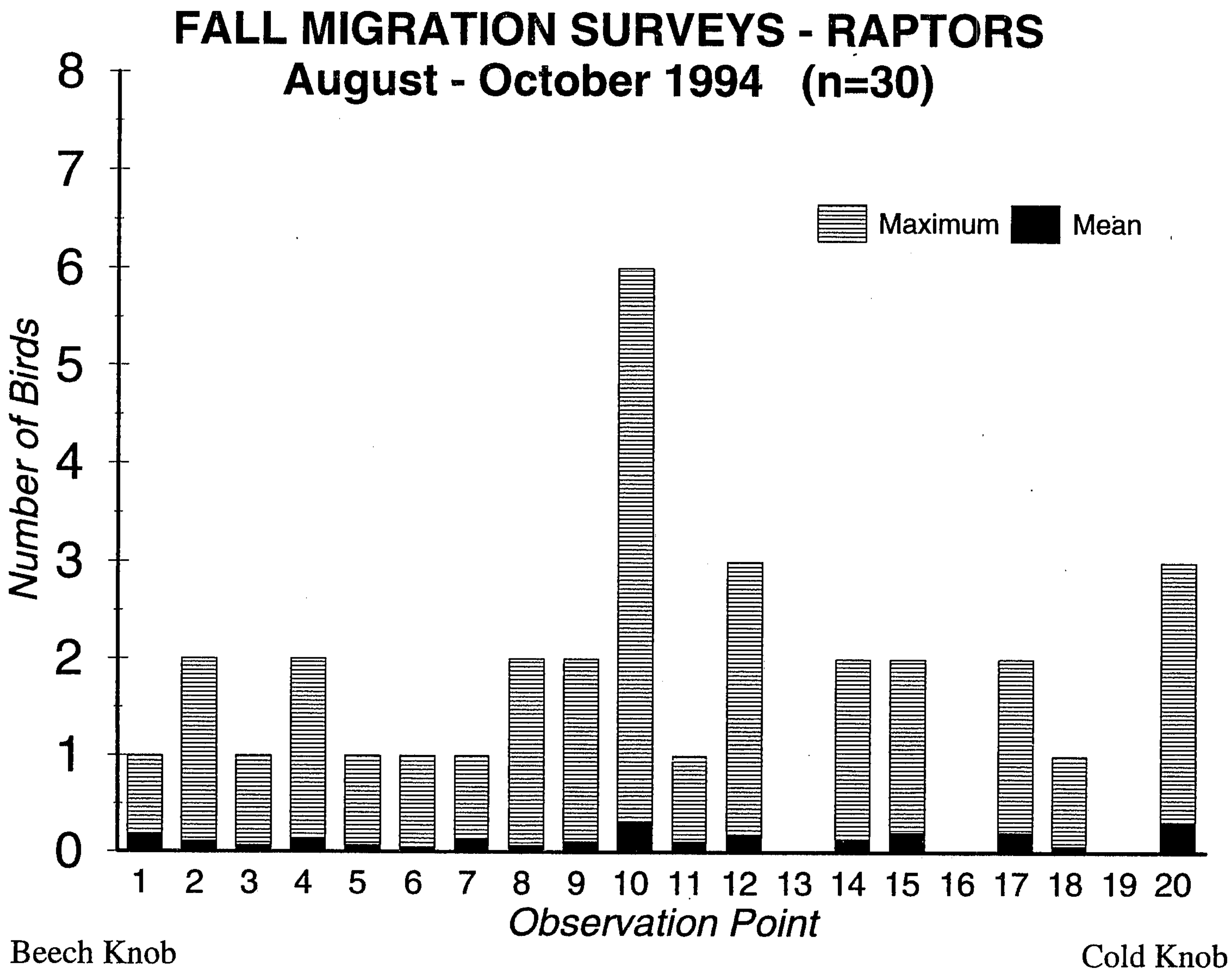

Fig. 12. Number of raptors observed during 10 min. counts at 0.5 mile intervals along Beech Ridge Road.

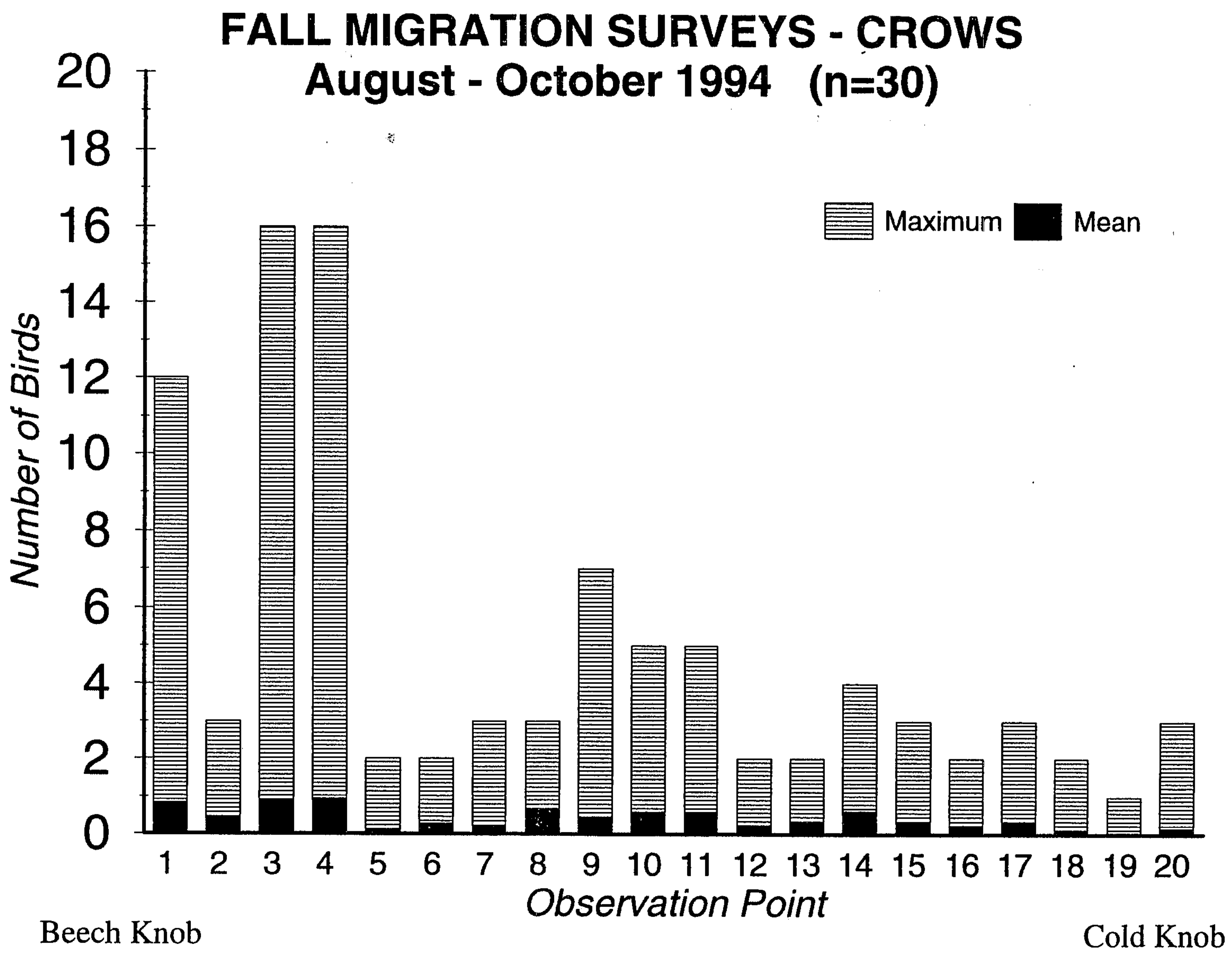

Fig. 13. Number of crows observed during 10 min. counts at 0.5 mile intervals along Beech Ridge Road.

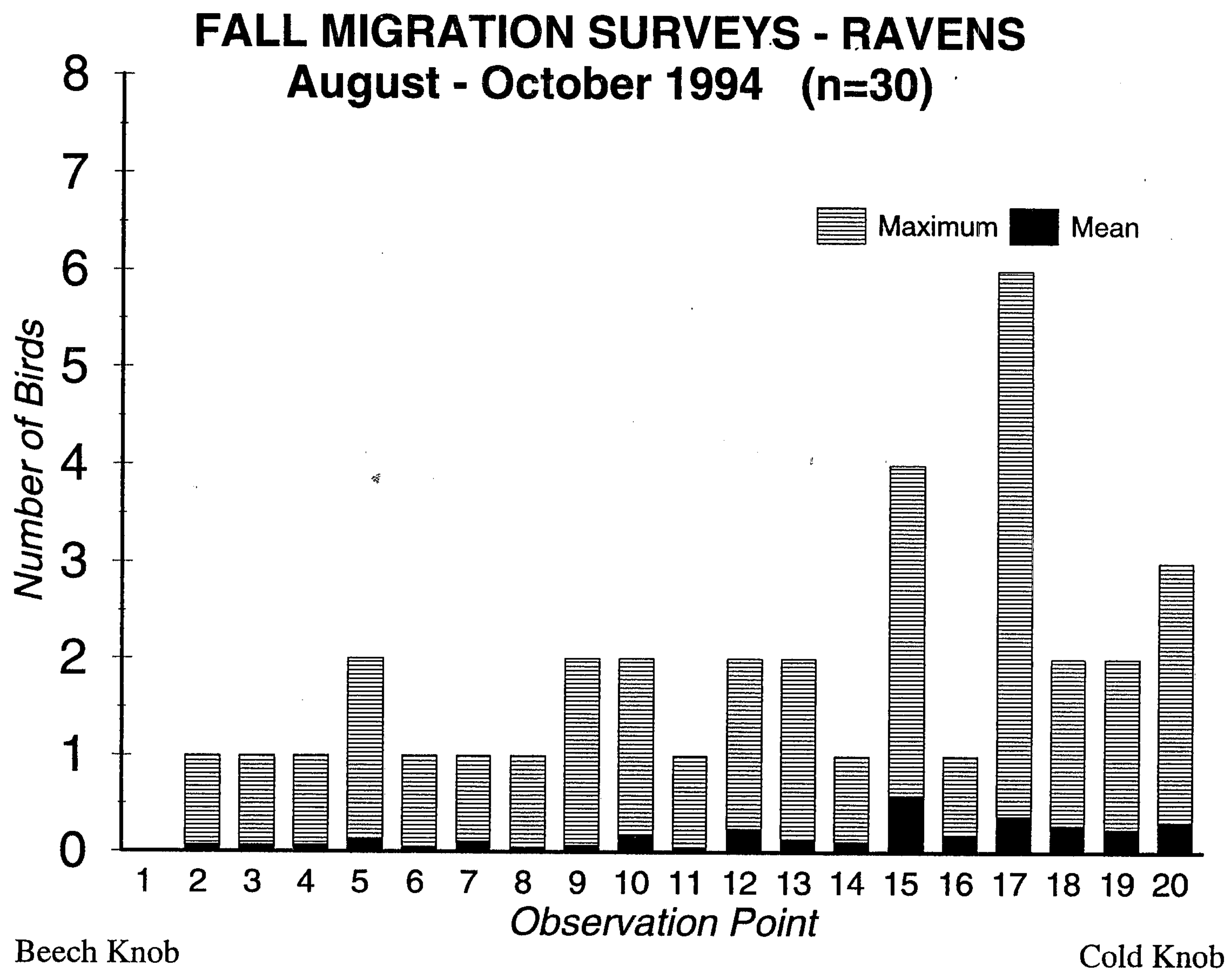

Fig. 14. Number of ravens observed during 10 min. counts at 0.5 mile intervals along Beech Ridge Road.

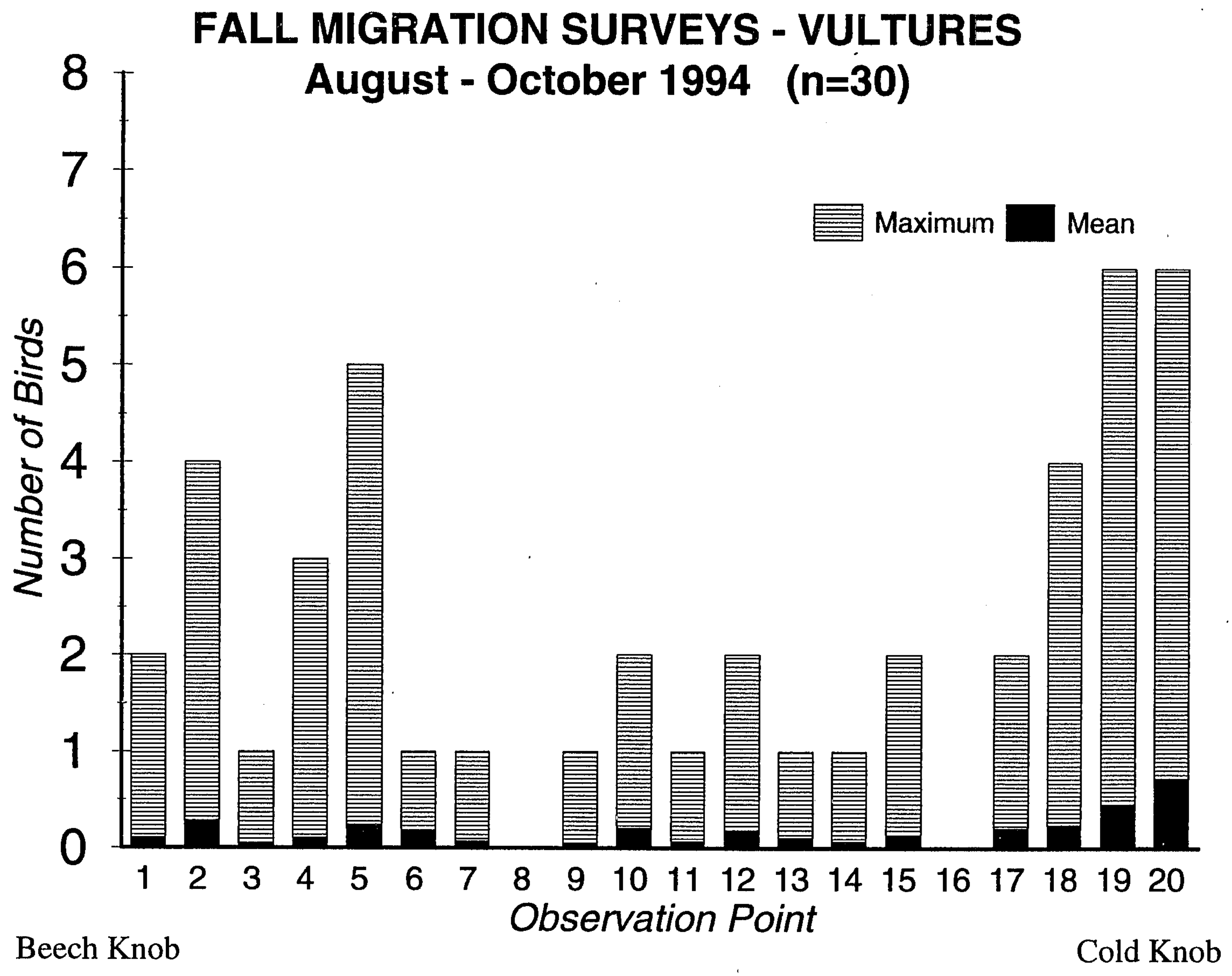

Fig. 15. Number of turkey vultures observed during 10 min. counts at 0.5 mile intervals along Beech Ridge Road.

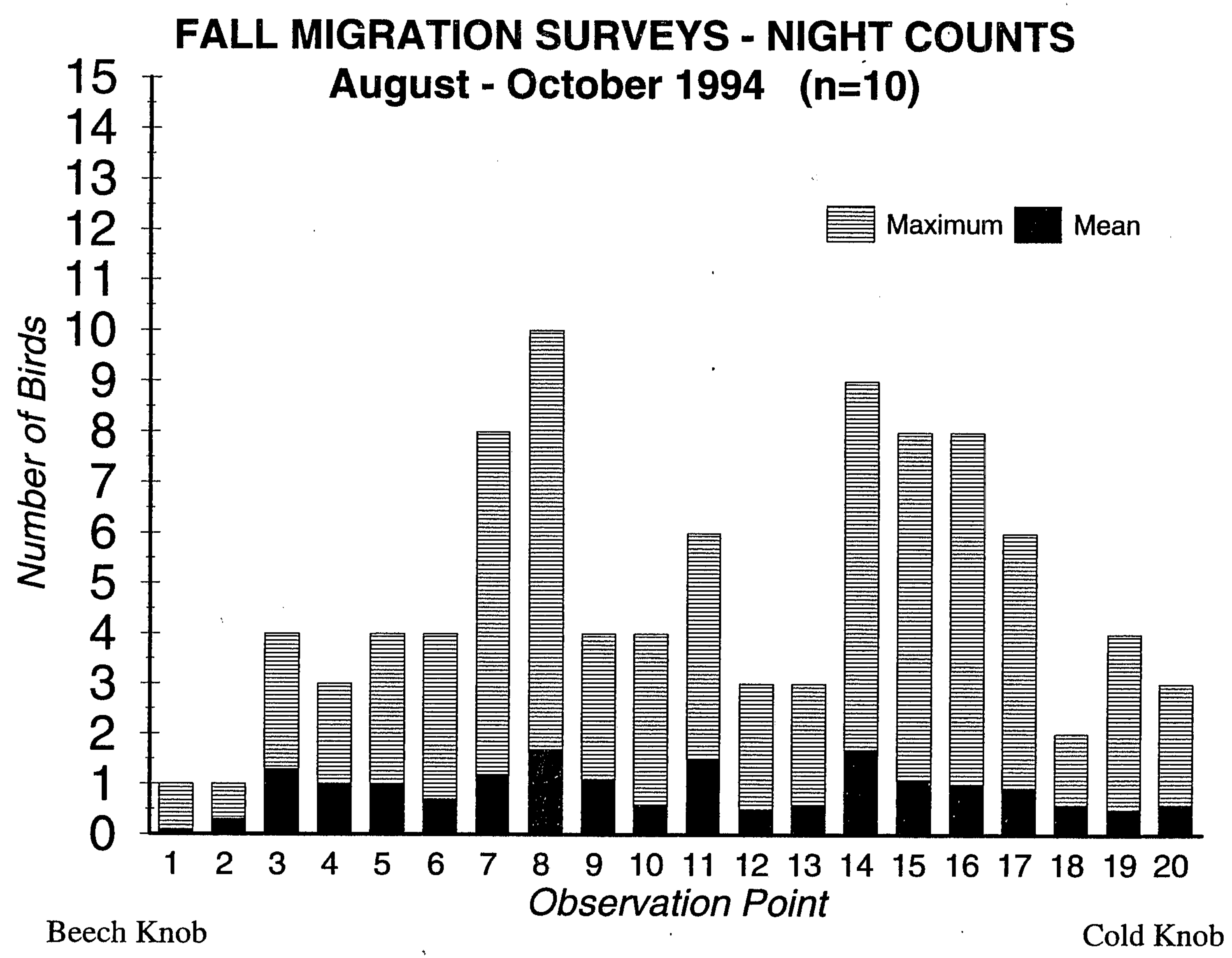

Fig. 16. Number of songbirds recorded during 10 min. counts at 0.5 mile intervals along Beech Ridge Road.

CONFIDENTIAL

Fall 1994 Raptor Migration Study in Greenbrier County, West Virginia

Prepared for:

Kenetech/Windpower
Washington, DC

Submitted by:

HawkWatch International
Salt Lake City, UT

February 1995

CONFIDENTIAL

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Executive Summary

In fall 1994, a survey was conducted to describe the raptor migration in the Allegheny Mountains in Greenbrier County, West Virginia, at the site of a proposed wind-generating facility. Six sites along and adjacent to Beech Ridge were monitored during the study.

Although migrant raptors were observed, no large concentrations were documented. A total count of 974 raptors was observed during 476.5 hours on selected days from September 10th through November 29th, yielding an overall passage rate of 204 raptors per 100 hours. (At established lookouts, passage rates are typically many thousands of raptors per 100 hours.) Migration appears to be dispersed throughout the area, with local concentrations around Cold Knob and Beech Knob. The principal fall migration season is from late August to late November.

Seasonality of the overall migration was relatively uniform, although different species migrated at different times. Broad-winged Hawks were observed only in early to mid-September; Red-tailed Hawks were concentrated in November. The flight rhythm showed a daily peak between 1100 and 1300 hours, with variations among species.

At a regular hawk migration lookout 30 miles southwest of the study area, Peter's Mountain, overall migration in fall 1994 was 59% of the previous four-year average. This may reflect poor conditions for observation throughout the region, as calm weather probably caused many raptors to fly too high to be counted. At the Beech Ridge study area, 91% of all migrants observed were greater than 50 meters above the observation sites. The unusual conditions this season suggest the flight over the study area is likely to be more numerous during most other years.

Weather conditions appeared to be the primary factor affecting passage rates, flight altitudes, and flight paths of raptors during the study. Increased counts occurred just before and after the passage of fronts, and higher counts were associated with winds out of the south or southwest. During inclement weather, migration slowed. These effects were not pronounced, as unseasonably mild conditions prevailed throughout the study.

This area also serves as habitat for many raptors and a stopover for substantial numbers of migrating birds. Raptors that move into and remain in the area for a period of time may be most at risk around wind generators. Resident activity averaged 2 sightings per hour in September, 2.8 sightings per hour in October, and 0.7 sightings per hour in November.

A short-term study was conducted by volunteers on September 10th and 11th, during which 278 raptors were recorded in the area. Most (49%) were Turkey Vultures; the greatest numbers for all species were recorded in areas near Cold Knob at the southern end of the study area.

Acknowledgments

Many people were responsible for making this study possible. First of all I would like to thank the observers who worked with me on this project, especially Gwen Powell Balogh. Her husband Alen and son Warren often assisted in the field. Ron Perrone and his wife Wendy, and The Three Rivers Raptor Center, also assisted in the field, helped recruit volunteers, and graciously provided the use of their home office and equipment.

I wish to thank Kenetech and Dr.Edward Michaels for organizing the volunteer weekend, and for their cooperation and support.

I would like to thank land owners Lowell Gwinn for his hospitality and excellent geography lessons, and Westvaco Corporation for their cooperation and help providing the right keys for the right gates.

A special thanks goes to George Hurley and Jerry Davis for supplying me with information gathered at the Hanging Rocks Firetower on raptor migration.

Finally, I would like to thank Sheila McEntee, the Vandalia Chapter of the Audubon Society, and all of the volunteers who turned out for the volunteer weekend.

Introduction

The study of the Beech Ridge area was conducted to provide data relevant to a proposed wind power development project, in order that potential impacts with migrating raptors could be minimized. The effort began in April of 1994 with a reconnaissance for observation sites. On September 10th, observations began at three sites in the study area. Observations continued at these and additional sites through November 29th, which concluded the first fall observation period. Further study is planned for the spring of 1995.

The objective of this project is to describe the raptor migration within the study area with respect to species composition, seasonal timing, daily timing, meteorological influences, flight directions and altitude, and topography. Resident raptors activities in the area were also recorded.

This report presents observations from each observation site and evaluates the study area for raptor migration potential. Data from two nearby established hawk migration lookouts are compared with our study area observations. The latter part of this report provides detailed species-specific data. Daily weather and raptor count data are presented in the Appendix (Tables A1 and A2).

Study Sites

The study was conducted in Greenbrier County, West Virginia, north of Williamsburg WV, east of Rupert WV, and south of Richwood WV (Figure 1). The region is utilized primarily for timber production. Forest land is mixed deciduous and northern hardwood with occasional plantations of pine. Timber is harvested primarily by clear-cutting and tracts of timber are at various stages of regrowth. In addition, the region has a history of coal mining. The forest is interrupted by stripmines that are mostly inactive and reclaimed into grassland. Seepage ponds, which provide some wetland habitat, are often a feature of reclaimed mines.

The area's topography is mountainous, with the highest ridges reaching 3500 to 4000 feet above sea level. The 200-sq-kilometer (75-sq-mi) study area is within the Allegheny Plateau Province, with drainage typically dendritic and of an irregular nature. Ridgelines formed by this type of drainage extend in all directions. Approximately 48 kilometers to the east lies the Ridge and Valley Province. The Allegheny Front forms the western edge of this province, where drainage is of the trellis type and ridgelines run NNE to SSW in a more or less continuous fashion. It is well documented that raptors follow these ridges during migration. In West Virginia there are three hawk-watching sites along this flyway; Hanging Rocks (Peter's Mountain) is the closest one to the study area; more complete observations are made at Harvey's Knob, Virginia, which is east of Hanging Rocks. These two sites were used to provide long-term data for comparison.

A dominant feature of the study area is Beech Ridge, which bisects the area on a northwest to southeast line for 13.5 kilometers. A road follows the ridge for 15.5 kilometers, and most of the observation sites are on or near this ridge (Figures 1 and 2). The two primary sites are at either end of this transect, Cold Knob at the southern end and Beech Knob at the northern end.

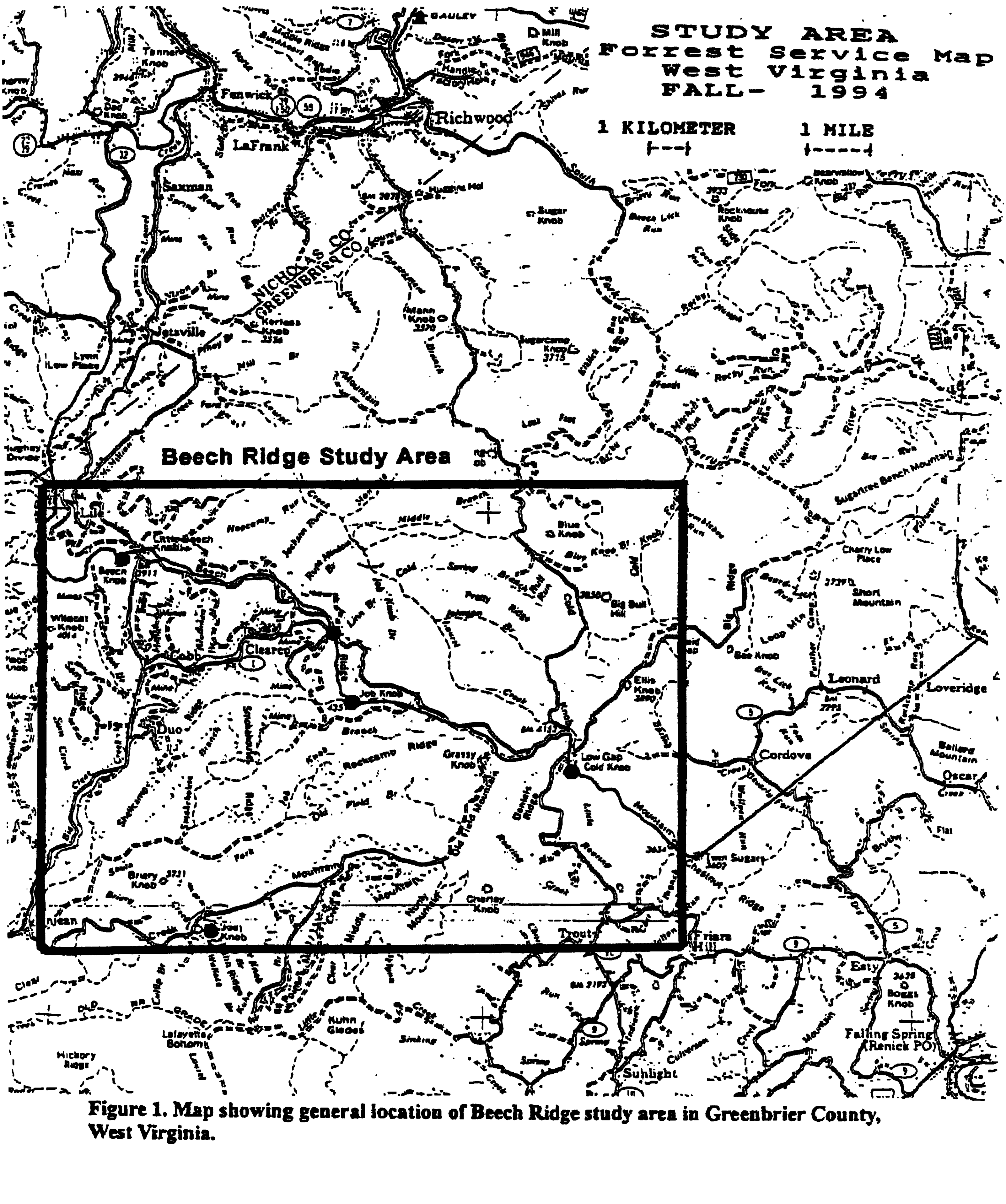


Figure 1. Map showing general location of Beech Ridge study area in Greenbrier County, West Virginia.

Methods

Site Selection

Raptor migration observations were made at six different sites within the study area between September 10th and November 29th, 1994. Sites were selected for their view and geographic position. Lookouts were generally prominent high points; locations were also chosen to provide broad geographic distribution throughout the study area and to correspond to proposed wind tower locations.

Data Collection

Data were collected at one or more sites during each sample day. When observations were conducted at more than one site on a given day, additional observers were used at the supplemental sites. Observations at a single site took place on 25 days; observations were conducted at multiple sites on 26 days. In all, observations were made on 51 days, for a total of 476.5 observation hours.

Migrations were generally monitored between 08:00 and 17:00 Eastern Standard Time. Observation periods ranged from 2 to 9 hours on selected days during the study (see Appendix, Table A2). Current and projected weather patterns were monitored to determine the best times and locations for conducting observations during that period.

Data were recorded on three separate data sheets: weather, migrant raptors, and resident raptors. Entries were made for weather every hour and included time, cloud cover, cloud type, thermal lift rating, wind velocity, wind direction, temperature, and visibility. Wind speed, cloud type, and cloud cover were evaluated following the guidelines published by the Hawk Migration Association of North America (HMANA). Thermal lift was estimated as poor, fair, good, or excellent based on wind and cloud cover conditions, temperature, and migrants' behavior. Information on storm fronts was compiled from weather records in local newspapers. All other weather variables were recorded on site. The starting and ending times for each observer were also recorded.

Field observations were conducted using 8.5 x 44 Swift binoculars and a 15-60 x 60mm scope. To detect as many passing migrants as possible, a consistent scanning technique was employed. Scanning efforts were concentrated on the windward side, along the tops and slopes of ridges, and wherever raptors were often observed. Notes were also taken on other avian species observed.

Raptors were considered migrants when flying directly south or southwest. Data recorded for migrants included time observed (in 1/2 hour periods), species, sex, age, distance from observer, altitude, and flight direction. Identifications of species, sex, and age were based on criteria provided in **Hawks in Flight** (Dunne *et al.* 1988) and **Hawks, The Peterson Field Guide Series** (Clark and Wheeler 1987). Flight altitudes were recorded as an hourly average and were estimated in relation to the observation site. As raptors crossed sites or adjacent ridges their approximate altitude was noted and an hourly flight altitude code recorded. Altitudes were grouped by categories of less than 50 m (including birds below eye level), 50 to 200 m, and above 200 m.

While this study was organized primarily to document migration of raptors through the study area, attention was also given to resident birds. Two forms were used in the field to collect data; one to record migrating raptors, the other to record resident birds. Distinction was made by observation of behavior. For the purpose of this study, any raptor observed hunting, kiting, perching, or not flying directly to the south or southwest was considered a "resident" raptor. No attempt to differentiate birds using the area briefly to rest or hunt during migration and raptors regularly seen using the area throughout the season was made.

Information concerning behavior and location of resident raptors was recorded on separate data forms from those used for migrants. Resident activity was tallied hourly, with data on species, sex, age, distance, and behavior, and summarized on an hourly basis to provide an average hourly resident activity rate. Resident raptors were listed as sightings, because it is likely that individual birds were sighted repeatedly throughout the period. Therefore numbers for residents refer to "resident activity."

Data Analysis

Raptor migration results for this study are standardized and expressed in this report as passage rates (numbers of raptors per hour or per 100 hours). Because observations at each site varied, passage rate calculations are used to generate comparable values. Passage rates were also used in comparisons with more complete migration data collected at Hanging Rocks, WV, and at Harvey's Knob, VA. In most cases, hours of observation are included to indicate the sample size on which the passage rate calculation is based. For site-to-site comparisons, all observations are combined to calculate passage rates unless otherwise noted.

Daily and seasonal flight patterns of migrating raptors were calculated based on a subsample of the data. Daily rhythms for all species combined were calculated using data collected on days having a minimum 7-hour observation period; for individual species, a minimum 5-hour day was used. Data are summarized in hourly intervals (0900-1000, 1000-1100, . . .) and expressed as the hourly passage rate for each interval (number observed during the hour interval divided by total hours observed for that interval). The days used for each species and hours for each time period are provided in the Appendix, Table A3.

To obtain adequate representation for seasonal migration patterns, data from the "best site" each day were used for each species. Best site was the site at which the greatest number of migrants of that species was recorded; no more than one site was used for each day. Best site for all species was the site that had the highest total numbers of migrating raptors. Thus, dates and total hours vary by species, but the overall migration pattern recorded compensates for daily shifts in the locations where the most raptors were migrating. Seasonal passage rates are expressed as numbers of raptors per 100 hours. Dates and locations used for calculating seasonal migration patterns are recorded in Table A4.

An effort was made to determine the effects of weather on raptor migration, especially on the number and flight patterns of observed raptors. Sightings were summarized according to wind direction and velocity, passage of fronts, and altitude and direction of flight in order to determine any apparent relationships.

Volunteer Weekend

On September 10th and 11th, a volunteer weekend was held. The research was organized by Dr. Edward Michaels. On two consecutive days, volunteers were spread out along the study transect from Cold Knob to Beech Knob, where they collected data on raptors and passerine species. These data are presented in a separate report to Kenetech. These data were particularly helpful by identifying an additional observation site for the study. Observations were continued at one of these sites during the study.

Results

Weather Conditions

Conditions were unusually mild for the time of year. Clear to partly cloudy skies dominated the fall weather and represented 71% of all observation days. These conditions yielded 89% of the flight. Other studies have shown that most migrating raptors are observed during clear to partly cloudy skies and south to west winds of 10-30 mph (Hall *et al.* 1992, Heintzelman 1986, Kerlinger 1989).

Fifteen fronts passed through the area during the observation period; 12 were associated with rainy periods and the last one brought snow. Weather associated with these cold fronts was characterized by light rain and cloudy skies (Appendix, Table A1). None of these fronts brought severe weather.

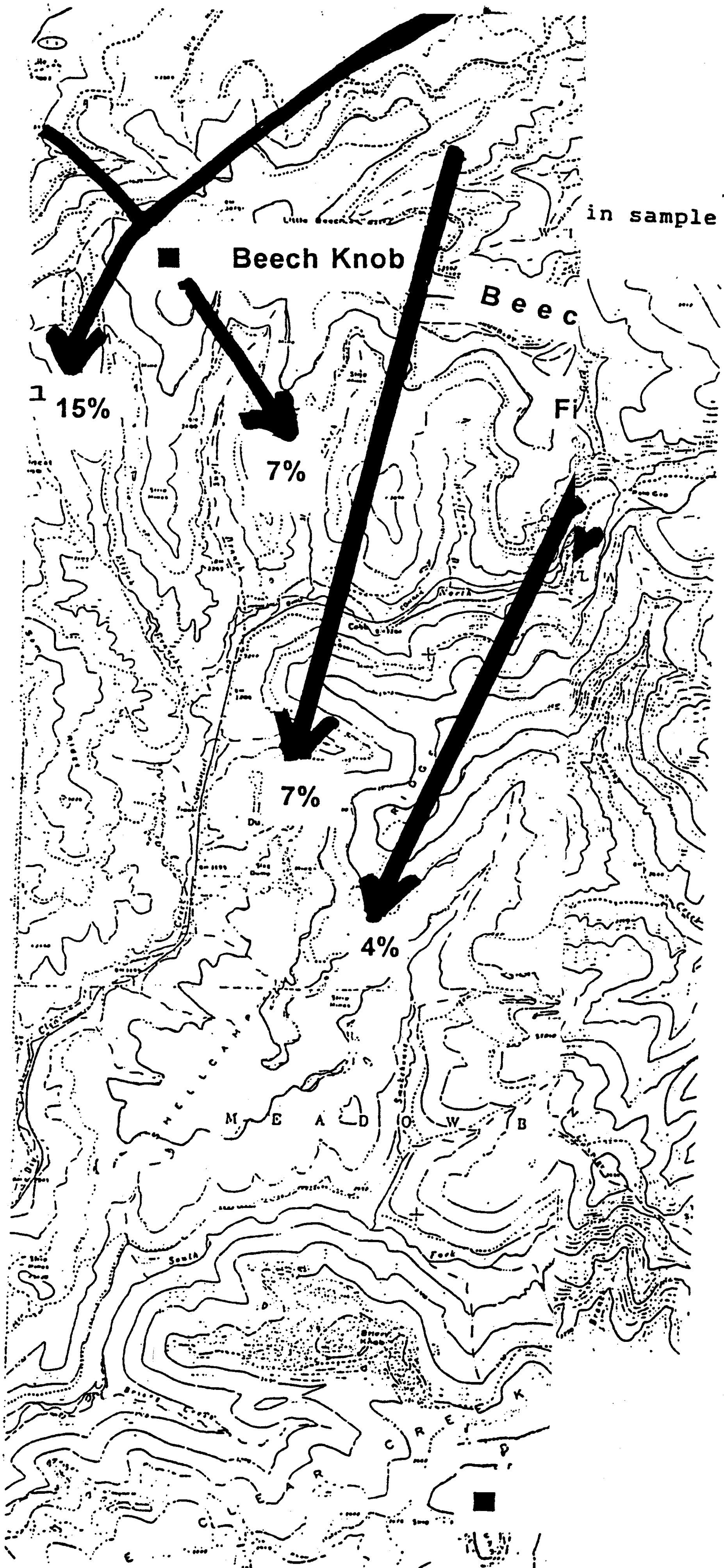
Site Summary

Observations were made from six different sites throughout the study (Figure 2). Four of these sites are located along a transect which follows Beech Ridge and runs northwest to southeast for a distance of approximately 13.5 kilometers. Cold Knob is located at the southern extreme and Beech Knob at the northern extreme of this transect. These two sites proved to be the most useful for our fall observations, and were most intensively monitored. Two additional sites, Craters and Joe Knob, are located off Beech Ridge to the southwest of Cold Knob and were monitored briefly for comparison purposes.

Raptors migrating through the study area are generally dispersed over the entire area, but do seem to favor certain flight paths under certain conditions (Figure 2). Conditions this fall caused raptors to favor the southern range around Cold Knob, with a total of 511 raptors in 13 species recorded there (Table 1). To the north around Beech Knob, migration was heavy at times, and 326 raptors in 11 species were observed. Although less time was spent at Beech Knob, passage rates (number of raptors per 100 hours) were close to those recorded at Cold Knob (Figure 3).

The other sites yielded fewer raptors, fewer species, and lower overall passage rates (Figure 3). Five Points and Job Knob, in particular, showed reasonably high passage rates (about 155 raptors per 100 hours), and may merit further attention.

Resident raptor sightings showed a different pattern, with highest activity rates, 292 and 299 raptors/100 hours, recorded at Job Knob and Craters (Figure 4). Joe Knob was also significantly higher in resident activity than in migrants, with 30 birds recorded in 14.5 hours, for an activity rate (about 200 raptors per 100 hours) comparable to that at Cold Knob.



in sample
Beech Knob
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Fi
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4%
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MEADOW B
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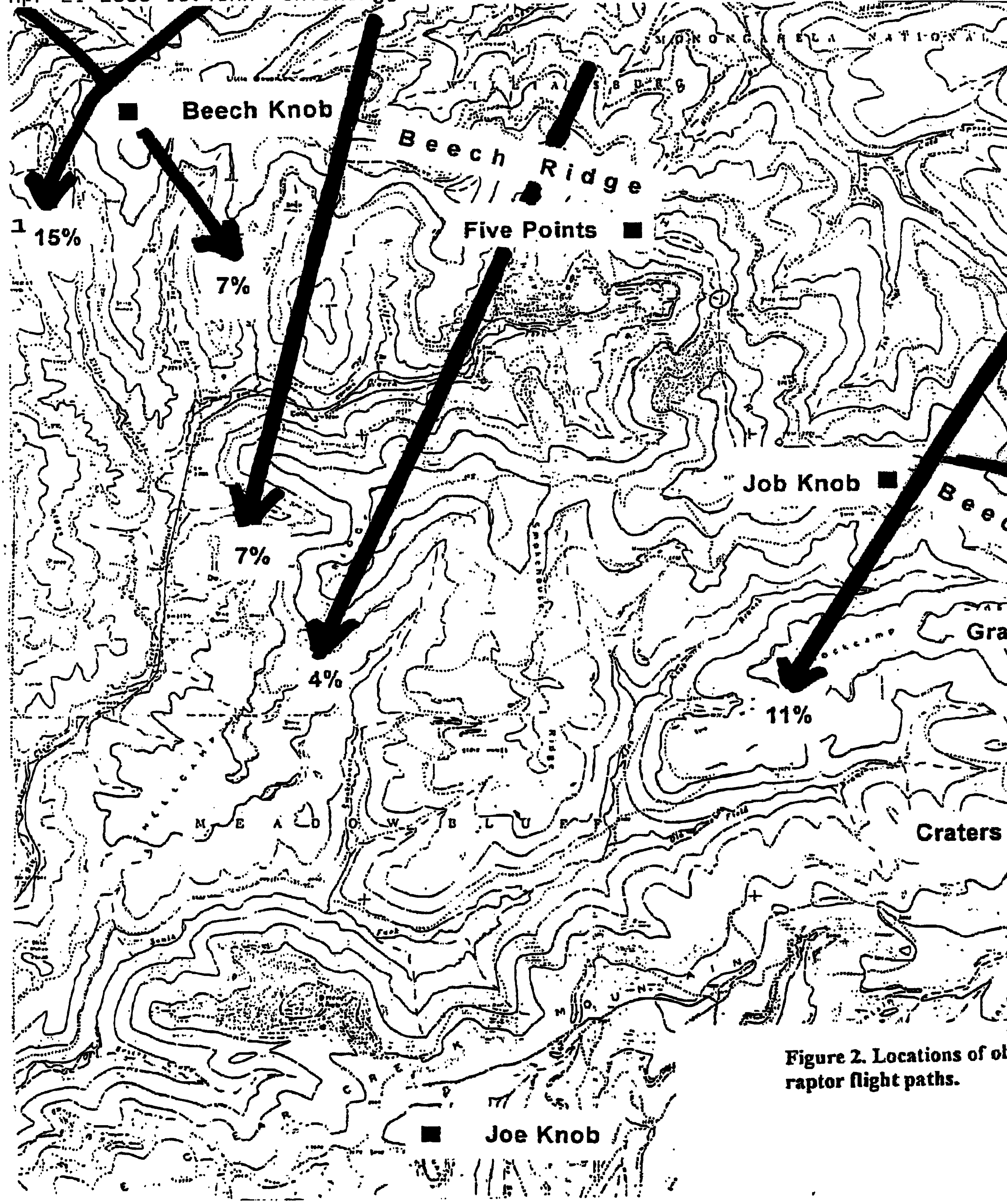
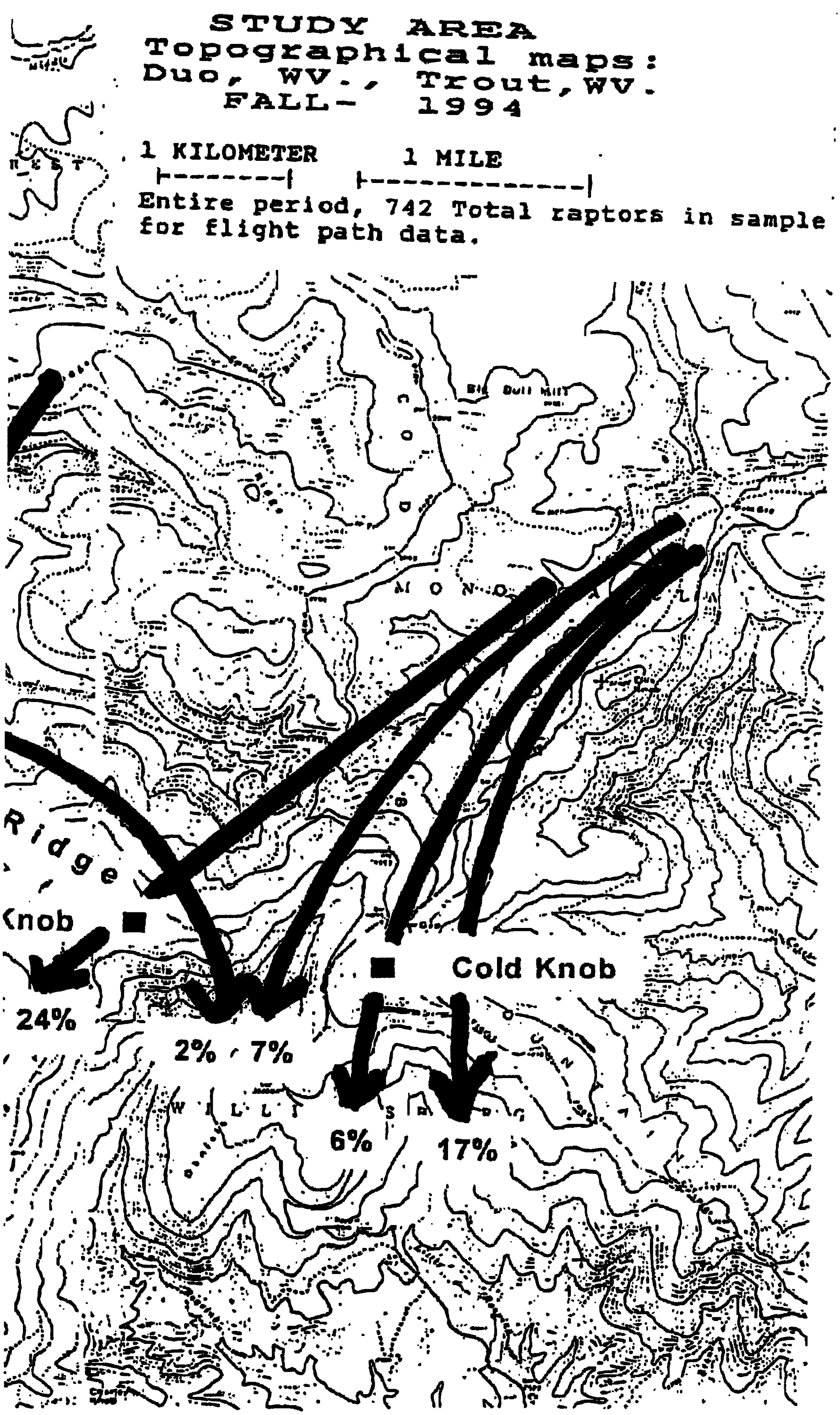


Figure 2. Locations of ob
raptor flight paths.



on sites along Beech Ridge, with predominant

Table 1: Site-by-site summary of migrant raptor observations.

	Beech Knob	Five Points	Job Knob	Cold Knob	Craters	Joe Knob	Totals
Start date	11 Sep	10 Sep	19 Sep	10 Sep	15 Sep	10 Sep	10 Sep
End date	23 Nov	19 Sep	16 Oct	29 Nov	29 Oct	11 Sep	29 Nov
Obs. Days	29	3	9	36	9	2	
Obs. Hours	161.5	20.5	51	192.5	36.5	14.5	476.5
Turkey Vulture	49	0	5	101	0	0	155
Black Vulture	0	0	0	7	0	0	7
Osprey	3	0	0	4	0	0	7
Bald Eagle	0	0	0	1	0	0	1
Northern Harrier	4	0	1	10	0	0	15
Sharp-shinned Hawk	47	4	31	61	14	1	158
Cooper's Hawk	12	1	2	29	1	0	45
Northern Goshawk	0	0	0	3	0	0	3
Unid. Accipiters	7	1	4	5	3	1	21
Total Accipiters	**66**	**6**	**37**	**98**	**18**	**2**	**227**
Red-shouldered Hawk	4	0	0	3	1	0	8
Broad-winged Hawk	58	10	28	16	3	3	118
Red-tailed Hawk	102	3	0	216	1	0	322
Unid. Buteos	18	1	0	18	0	0	37
Total Buteos	**182**	**14**	**28**	**253**	**5**	**3**	**485**
Golden Eagle	1	0	0	6	0	0	7
American Kestrel	15	0	2	11	1	1	30
Merlin	1	0	0	0	0	0	1
Unid. raptors	6	5	6	20	1	1	39
Total Raptors	**327**	**25**	**79**	**511**	**25**	**7**	**974**
Percent of Total	**33.5**	**2.6**	**8.1**	**52.6**	**2.6**	**0.7**	**100.1**
Passage Rate #/100 hours	**202**	**122**	**155**	**265**	**68**	**48**	**204**

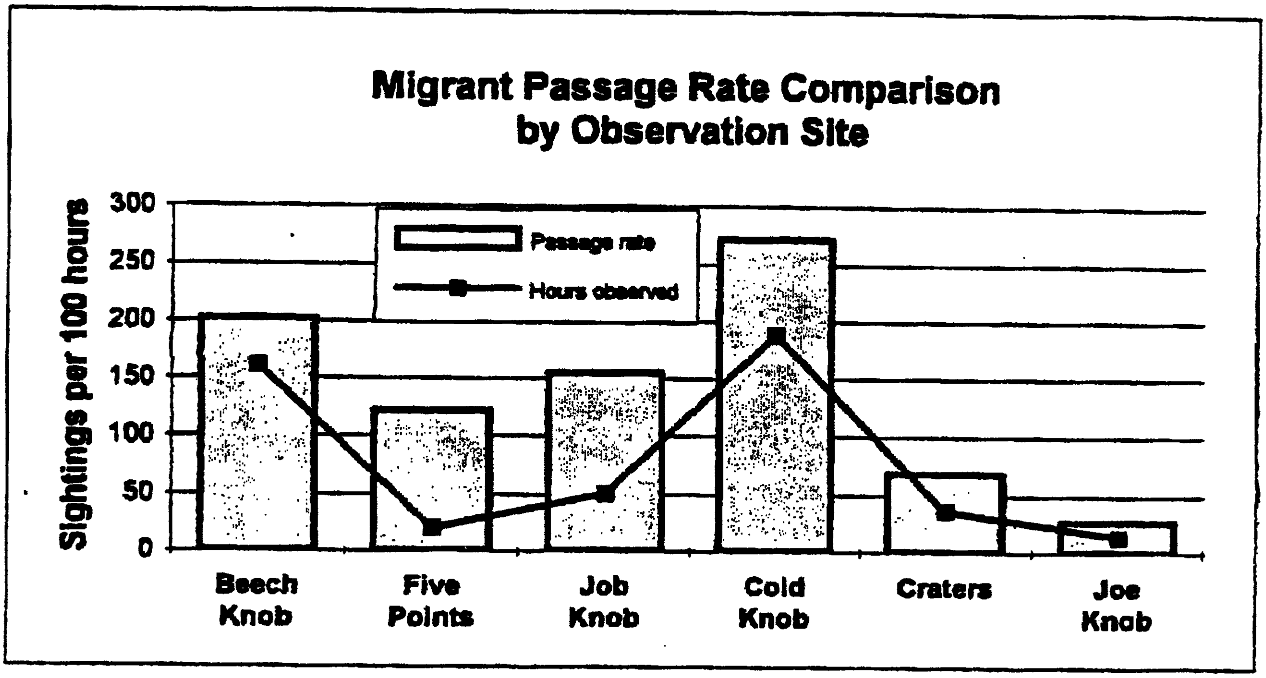


Figure 3. Passage rates (raptors per 100 hours) compared site by site, with hours of observation, for sites ranging north to south on Beech Ridge, West Virginia. N=974; hours=476.5.

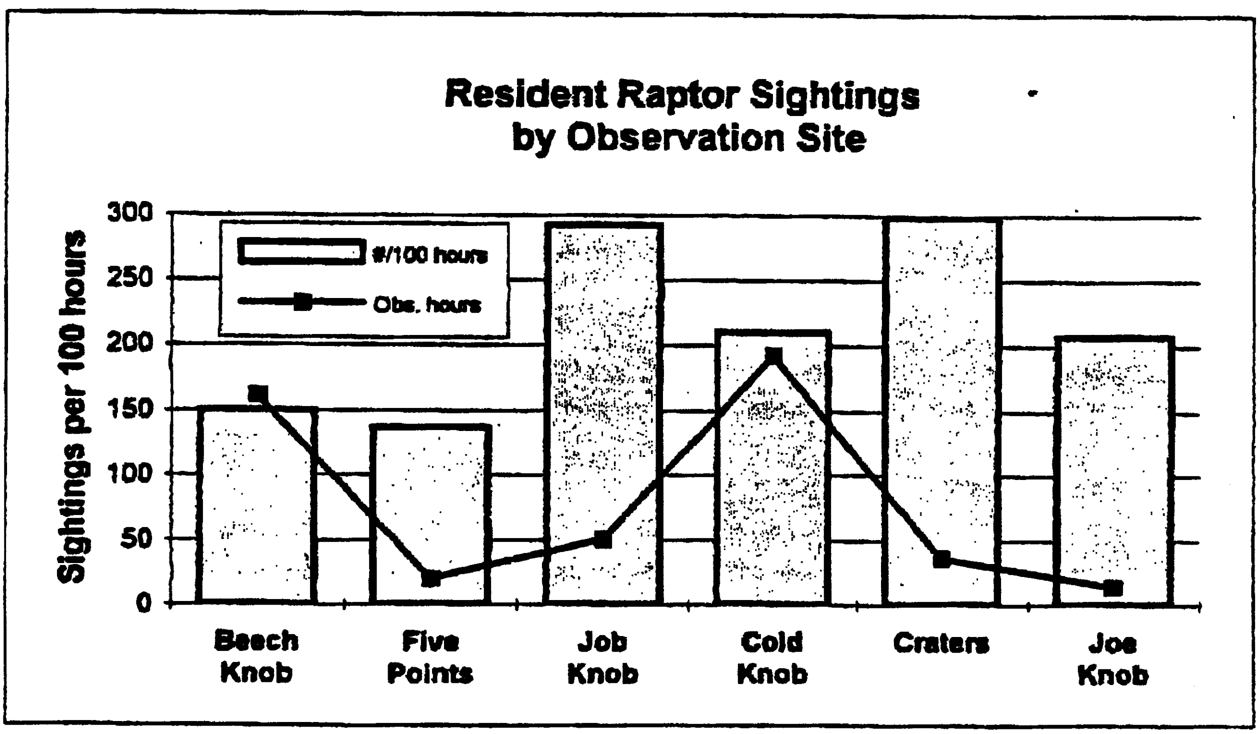


Figure 4. Comparison of sightings of resident raptors by observation site, with hours of observation for sites from north to south along Beech Ridge, West Virginia, Fall 1994. N=954; hours=476.5.

Resident Raptor Activity

This study differs from some other migratory censuses where a migration corridor is the focus. In this case attention was given to an entire region. Thousands of acres of forest, clear-cuts, and reclaimed strip-mines that make up the study area provide ideal foraging habitat. Our observations suggest that many transient birds arrive in the study area and remain for a period of time, ranging from hours to months. Immature birds may arrive in the area early in the season as a function of post-fledging dispersal. Other birds are perhaps in search of winter territories. Some are simply feeding while en route. Because of their frequent activity at lower altitudes and because they remain in the area for longer periods, these birds may be most at risk around wind turbines.

As was true for migrants, most resident raptors were observed from Beech Knob or Cold Knob (Table 2). The Job Knob and Craters sites were more productive for residents than for migrants, and actually showed higher sighting rates (Table 2, Figure 4).

The overall activity rate for all species averaged 2 raptors per hour (Figure 5). The most common (65% of total) was the Turkey Vulture, with an average of 1.3 per hour and single hourly counts as high as 14 (Table 3). Red-tailed Hawks (31% of total) were also commonly seen hunting, with a total of 159 sightings at a frequency of 0.33 per hour. Other active resident birds were Red-shouldered Hawks (53 sightings, 0.11/hr.), Black Vultures (45 sightings, 0.09/hr.), and Northern Harriers (31 sightings, 0.06/hr).

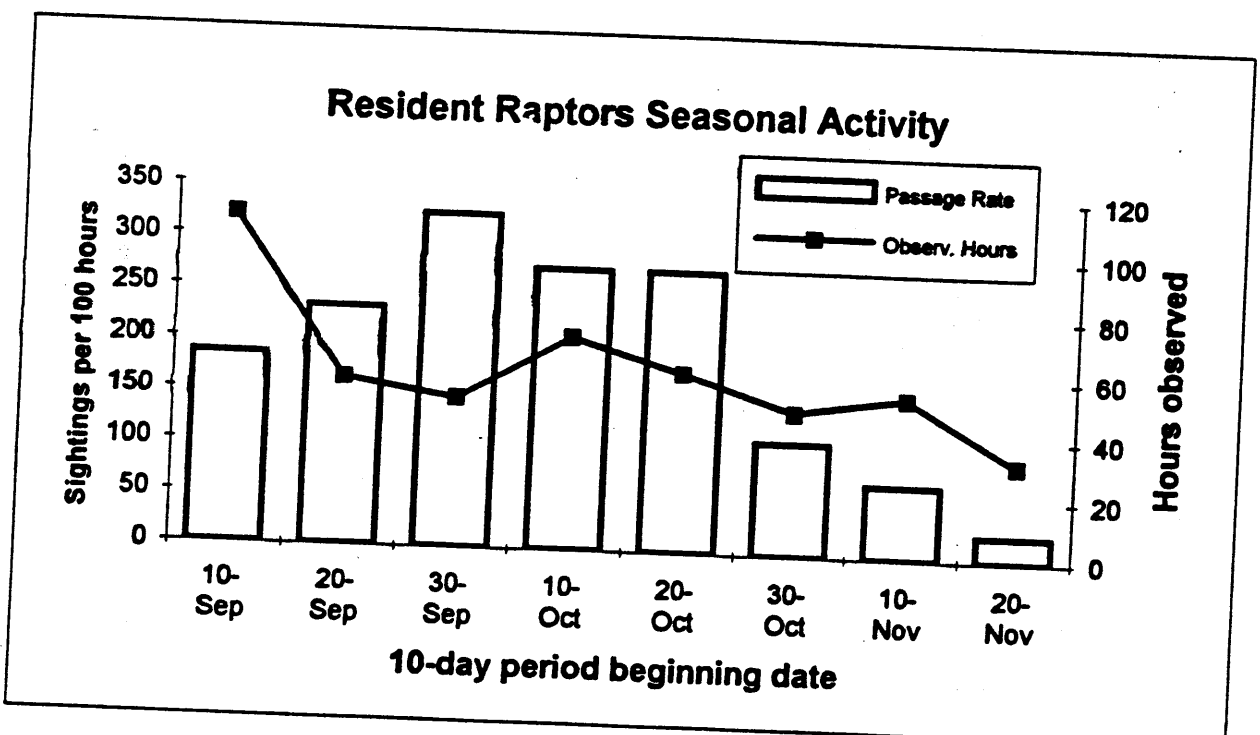


Figure 5. Resident raptor activity for all sites, 10 September through 29 November, Beech Ridge study area, West Virginia. N=954; total hours=476.5.

Table 2: Summary of resident raptor observations by observation site.

	Beech Knob	Five Points	Job Knob	Cold Knob	Craters	Joe Knob	Totals
Start date	11 Sep	10 Sep	19 Sep	10 Sep	15 Sep	10 Sep	10 Sep
End date	23 Nov	19 Sep	16 Oct	29 Nov	29 Oct	11 Sep	29 Nov
Obs. Days	29	3	9	36	9	2	
Obs. Hours	161.5	20.5	51	192.5	36.5	14.5	476.5
Turkey Vulture	157	24	107	249	71	15	623
Black Vulture	3	0	3	27	12	0	45
Osprey	0	0	0	0	0	0	0
Bald Eagle	0	0	0	0	0	0	0
Northern Harrier	10	0	6	5	7	3	31
Sharp-shinned Hawk	3	1	2	1	2	0	9
Cooper's Hawk	3	1	1	0	0	0	5
Northern Goshawk	0	0	0	0	0	0	0
Unid. Accipiters	0	0	0	2	0	0	2
Total Accipiters	6	2	3	3	2	0	16
Red-shouldered Hawk	13	1	20	11	5	3	53
Broad-winged Hawk	0	0	0	0	0	0	0
Red-tailed Hawk	37	1	9	96	9	7	159
Unid. Buteos	4	0	0	4	3	0	11
Total Buteos	54	2	29	111	17	10	223
American Kestrel	7	0	1	0	0	2	10
Unid. raptors	6	0	0	0	0	0	6
Total Sightings	243	28	149	395	109	30	954
Percent of Total	25.5	2.9	15.6	41.4	11.4	3.1	99.9
Activity Rate #/100 hours	150	137	292	205	299	207	200

Table 3: Resident raptor species, with total sightings and rates observed, Beech Ridge study area, West Virginia, Fall 1994

Common Name	Scientific Name	Total	Percent	Sighting Rate*
Turkey Vulture	*Cathartes aura*	623	65	131
Black Vulture	*Coragyps atratus*	45	5	9
Osprey	*Pandion haliaetus*	0	–	–
Bald Eagle	*Haliaeetus leucocephalus*	0	–	–
Northern Harrier	*Circus cyaneus*	31	3	7
Sharp-shinned Hawk	*Accipiter striatus*	9	1	2
Cooper's Hawk	*Accipiter cooperi*	5	<1	1
Northern Goshawk	*Accipiter gentilis*	0	–	–
Red-shouldered Hawk	*Buteo lineatus*	53	6	11
Broad-winged Hawk	*Buteo platypterus*	0	–	–
Red-tailed Hawk	*Buteo jamaicensis*	159	17	33
Golden Eagle	*Aquila chrysaetos*	0	–	–
American Kestrel	*Falco sparverius*	10	1	2
Merlin	*Falco columbarius*	0	–	–
Unid. accipiter		2	<1	<1
Unid. buteo		11	1	2
Unid. raptors		6	<1	1
Total raptors		**954**	**100**	
Ave. sighting rate				**200**

Species Composition of Migrating Raptors

Fall 1994 raptor migration observations in the study area yielded 974 raptors in 14 species. Observations were dominated by Red-tailed Hawks, with Turkey Vultures and Sharp-shinned Hawks also abundant (Table 4). Daily counts by site are presented in the Appendix (Table A2). Fully 50% of the raptors observed were buteos; 23% were accipiters. Species composition varied in relation to the time of year (see Seasonal Migration), but was generally consistent with observations at Harvey's Knob, VA (see Regional Comparison).

Table 4: Migrating raptors by species, with total numbers and passage rates observed, Beech Ridge study area, West Virginia, Fall 1994.

Common Name	Scientific Name	Total	Percent	Passage Rate*
Turkey Vulture	*Cathartes aura*	155	16	33
Black Vulture	*Coragyps atratus*	7	<1	1
Osprey	*Pandion haliaetus*	7	<1	1
Bald Eagle	*Haliaeetus leucocephalus*	1	<1	<1
Northern Harrier	*Circus cyaneus*	15	2	3
Sharp-shinned Hawk	*Accipiter striatus*	158	16	33
Cooper's Hawk	*Accipiter cooperi*	45	5	10
Northern Goshawk	*Accipiter gentilis*	3	<1	<1
Red-shouldered Hawk	*Buteo lineatus*	8	<1	1
Broad-winged Hawk	*Buteo platypterus*	118	12	25
Red-tailed Hawk	*Buteo jamaicensis*	322	33	68
Golden Eagle	*Aquila chrysaetos*	7	<1	1
American Kestrel	*Falco sparverius*	30	3	6
Merlin	*Falco columbarius*	1	<1	<1
Unid. accipiter		21	2	4
Unid. buteo		37	4	8
Unid. raptors		39	4	8
Total raptors		**974**	**100**	
Ave. passage rate				**204**

Temporal Patterns

Seasonal Migration

Raptors were already migrating in numbers when we began observations on September 10th. Broad-winged Hawks were the earliest migrants and had the most compressed flight; 94% of the Broad-winged passage was observed during the 9 days between September 10th and the 22nd (Figure 6), and none was seen after September 29th. American Kestrels were also observed early in the study, with 71% passing in September, 26% in October, and a lone bird in November. Accipiters were seen throughout the period, with 72% of the Sharp-shinned Hawks flying between September 20th and October 21st (Figure 7). Turkey Vultures were first recorded on October 15th; 84% of these migrants passed between October 28th and November 19 (Figure 8). The largest number of any one species was recorded during November, with 84% of migrating Red-tailed Hawks observed between November 4th and November 22nd (Figure 9).

Because of the seasonal differences among the most abundant species, migration activity is more consistent through the season than anticipated (Figure 10). The only obvious peak is created by the large passage of Red-tailed Hawks and Turkey Vultures late in the season. Although Broad-winged Hawk counts declined in late September, accipiter counts increased in early to mid-October. Turkey Vulture counts were high in late October and early November, and Red-tailed Hawks reached a peak in mid-November.

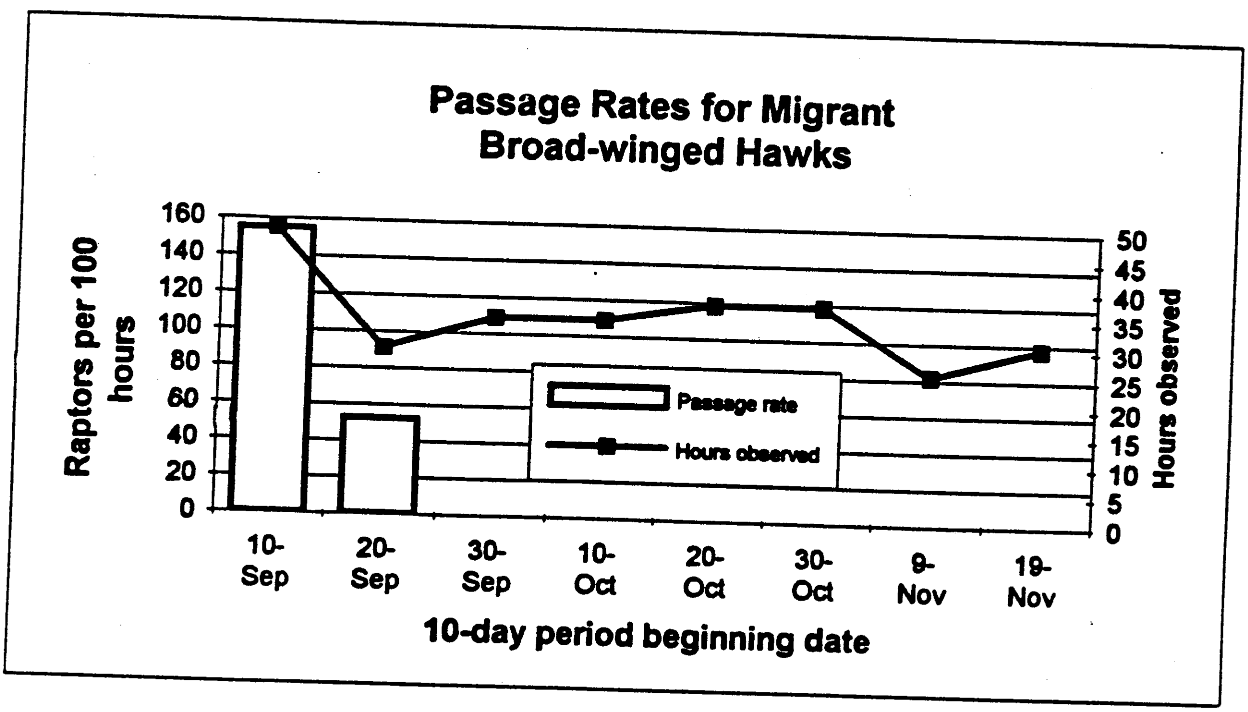


Figure 6. Seasonal migration pattern for Broad-winged Hawks migrating across Beech Ridge, West Virginia, Fall 1994, using data from best site each day. N=90; hours=275.

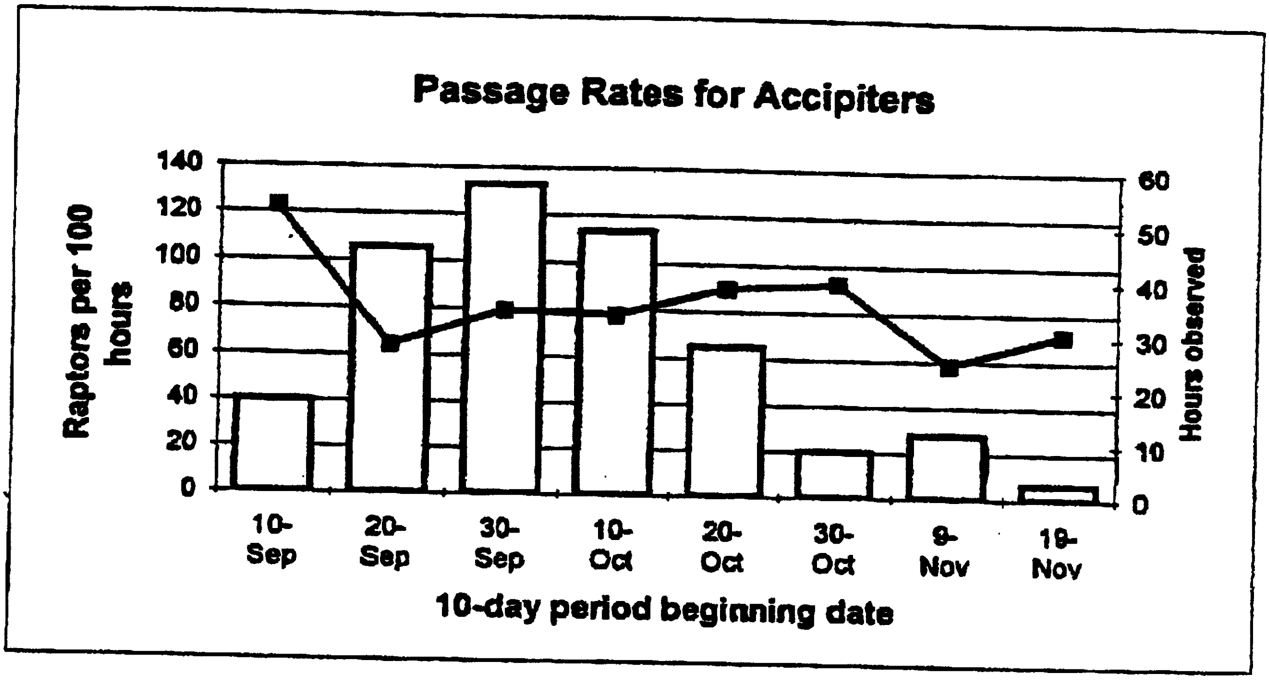


Figure 7. Seasonal migration pattern for accipiters migrating across Beech Ridge, West Virginia, Fall 1994, using data from best site each day. N=175; hours=281.

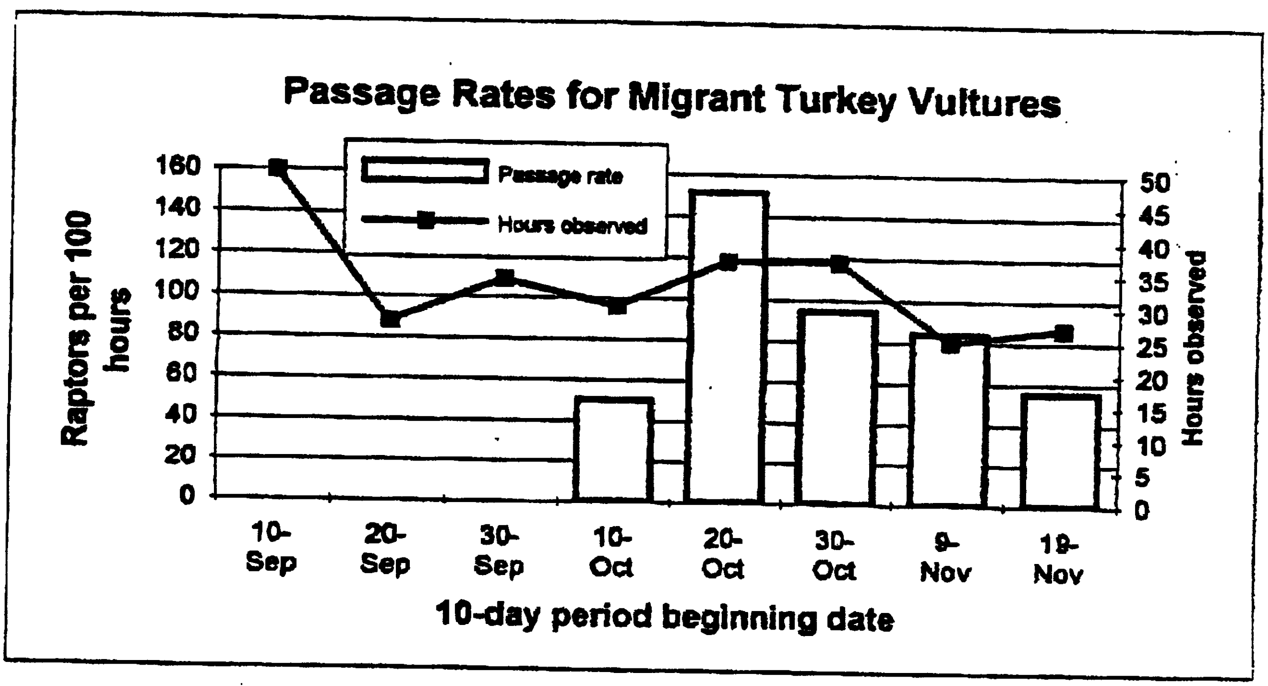


Figure 8. Seasonal migration pattern for Turkey Vultures migrating across Beech Ridge, West Virginia, Fall 1994, using data from best site each day. N=141; hours=267.5.

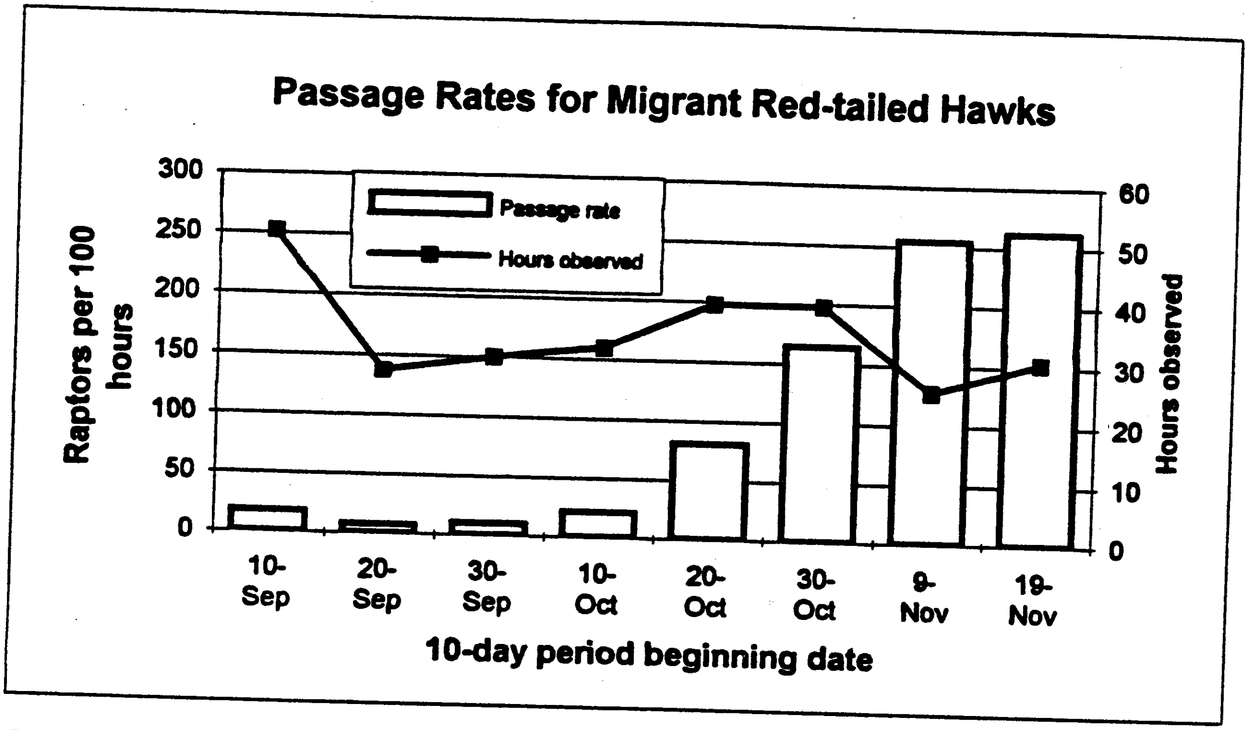


Figure 9. Seasonal migration pattern for Red-tailed Hawks migrating across Beech Ridge, West Virginia, Fall 1994, using data from best site each day. N=283; hours=275.

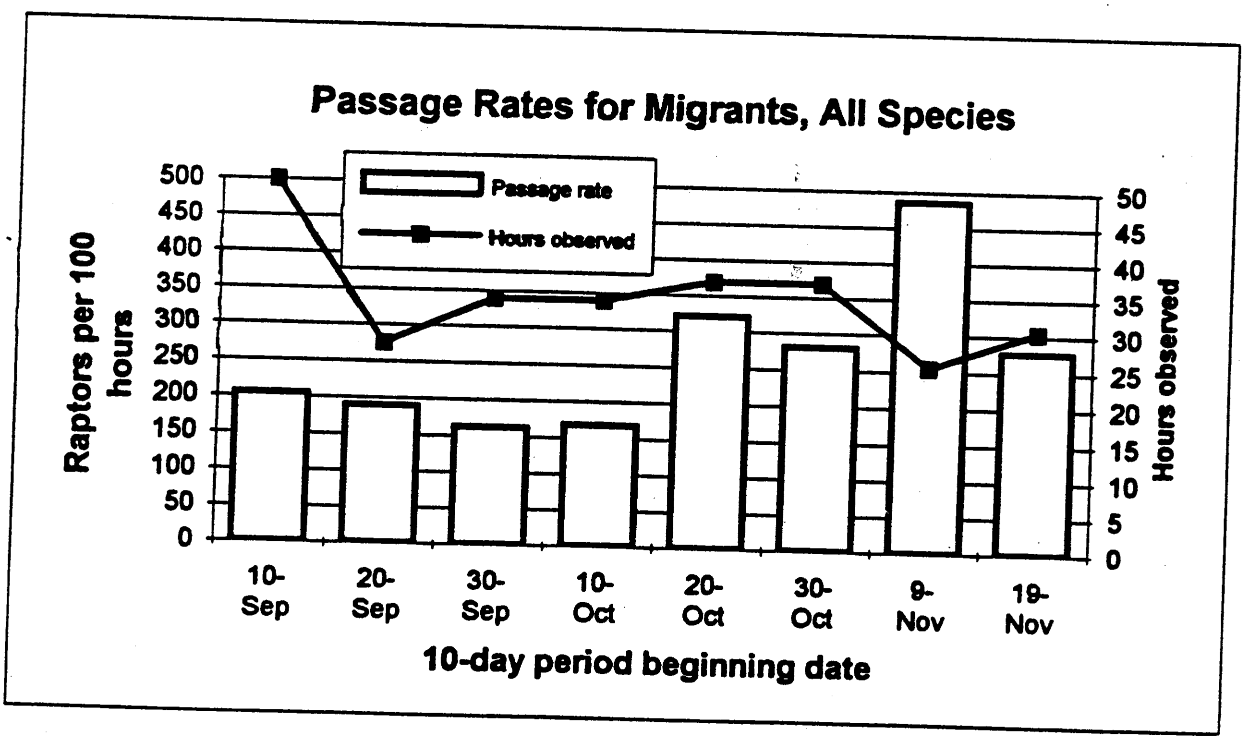


Figure 10. Seasonal migration pattern for all raptors migrating across Beech Ridge, West Virginia, Fall 1994, using data from best site each day. N=714; hours=275.5.

Daily Flight Rhythms

Passage rates for all species increased sharply until 12:00, then declined more gradually through the afternoon and evening hours (Figure 11). The peak occurred earlier in the day than the flights observed at western sites (Hoffman *et al.* 1992), but is similar to the pattern found in eastern studies (Heintzelmann 1986). One explanation given for the afternoon decline in sightings after 12:00 is increasing thermal activity in the afternoon causes birds to pass at higher altitudes where they are difficult to detect (Kerlinger 1985).

Flight rhythms varied by species. Passage rates for Sharp-shinned Hawks peaked between 10:00 and 11:00 then sharply declined through 14:00 followed by a brief increase between 15:00 and 16:00 (Figure 12). Broad-winged Hawks passed later in the day than most other species (Figure 13); Red-tailed Hawks followed the overall pattern, with peak passage rates between 100 and 1300 (Figures 14 and 11).

Resident activity patterns were more consistent through the day than those of migrants (Figure 15). However, some seasonal variation occurs, with morning and mid-day activity higher in October, and a distinct decline in overall activity in November.

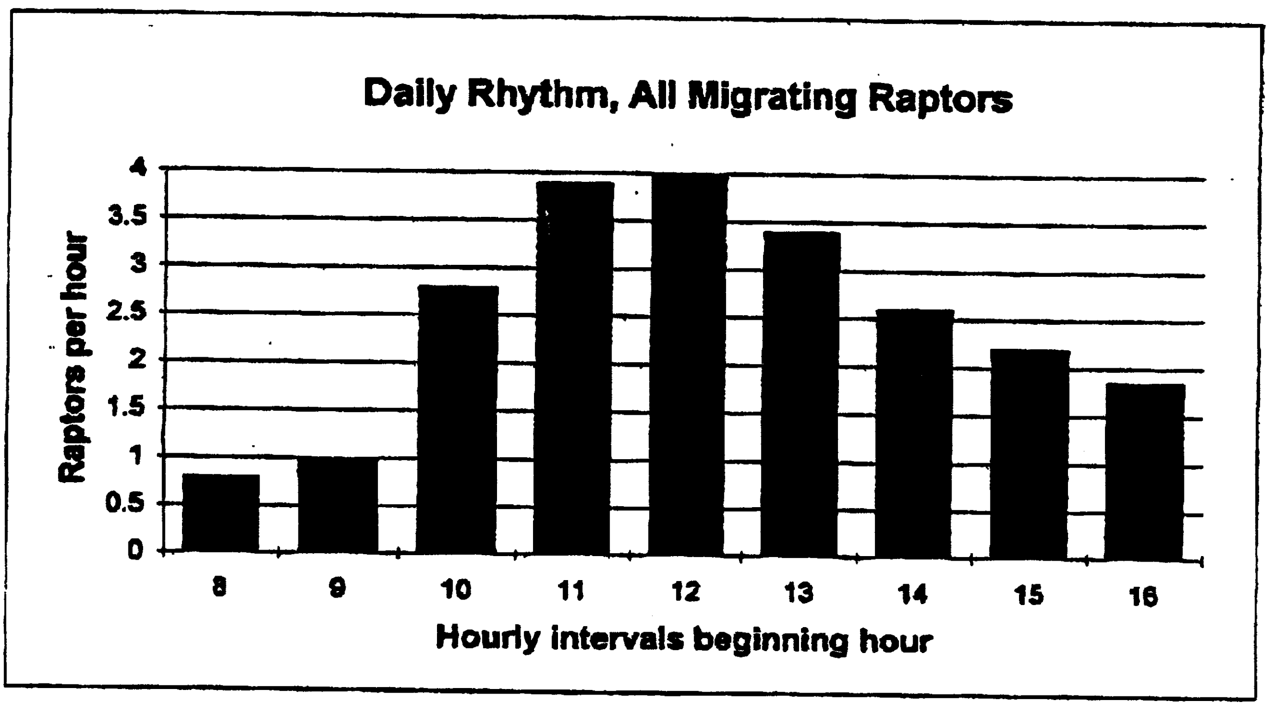


Figure 11. Daily flight rhythm for all species migrating across Beech Ridge, West Virginia, Fall 1994. N= ; hours=226.

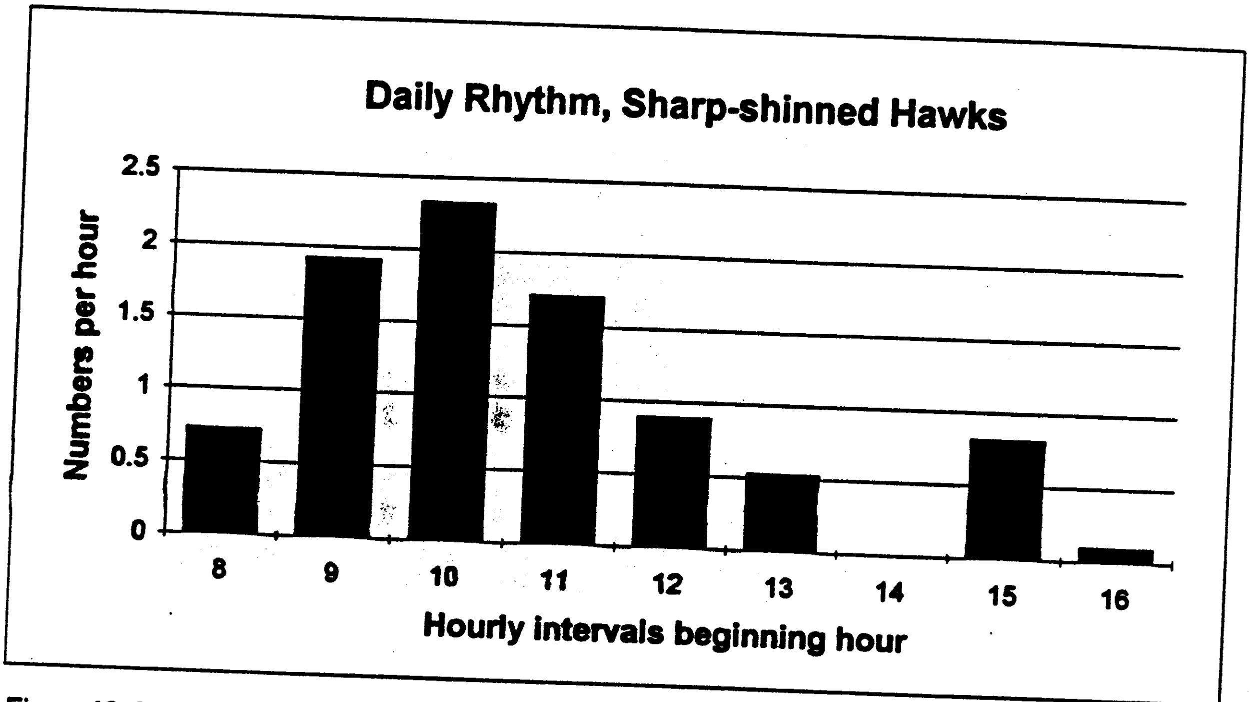


Figure 12. Daily flight rhythm for Sharp-shinned Hawks migrating across Beech Ridge, West Virginia, Fall 1994. N=86; hours=64.5.

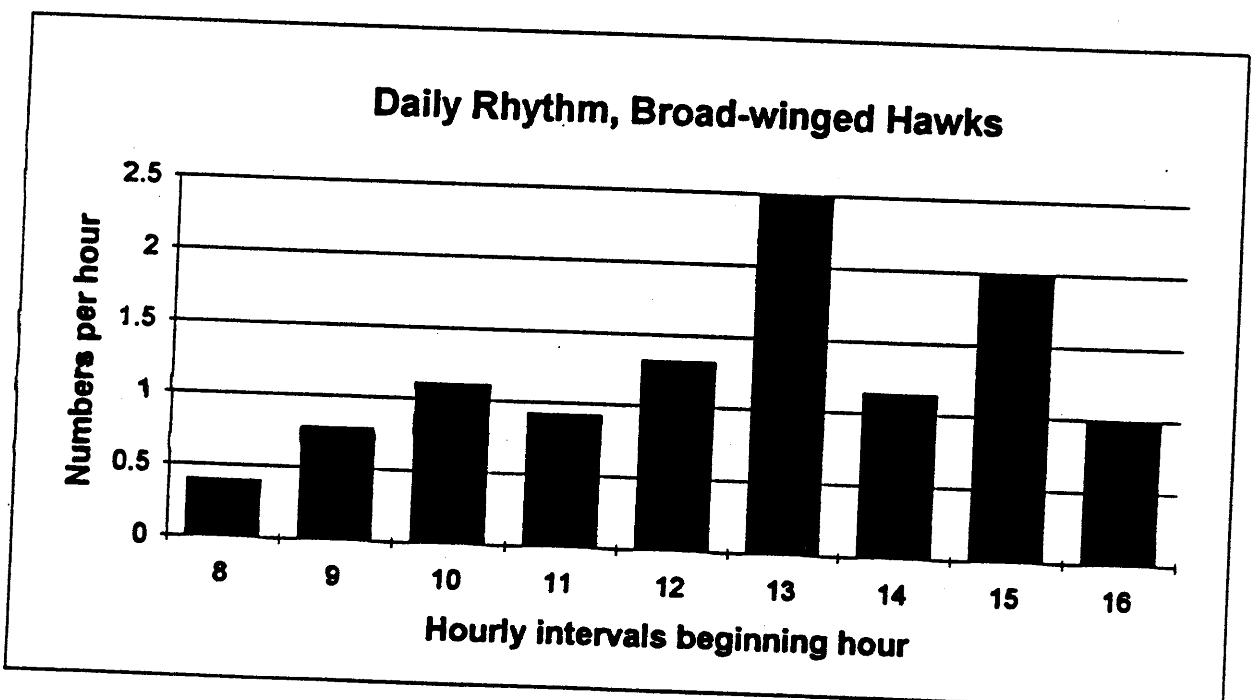


Figure 13. Daily flight rhythm for Broad-winged Hawks migrating across Beech Ridge, West Virginia, Fall 1994. N=99; hours=73.

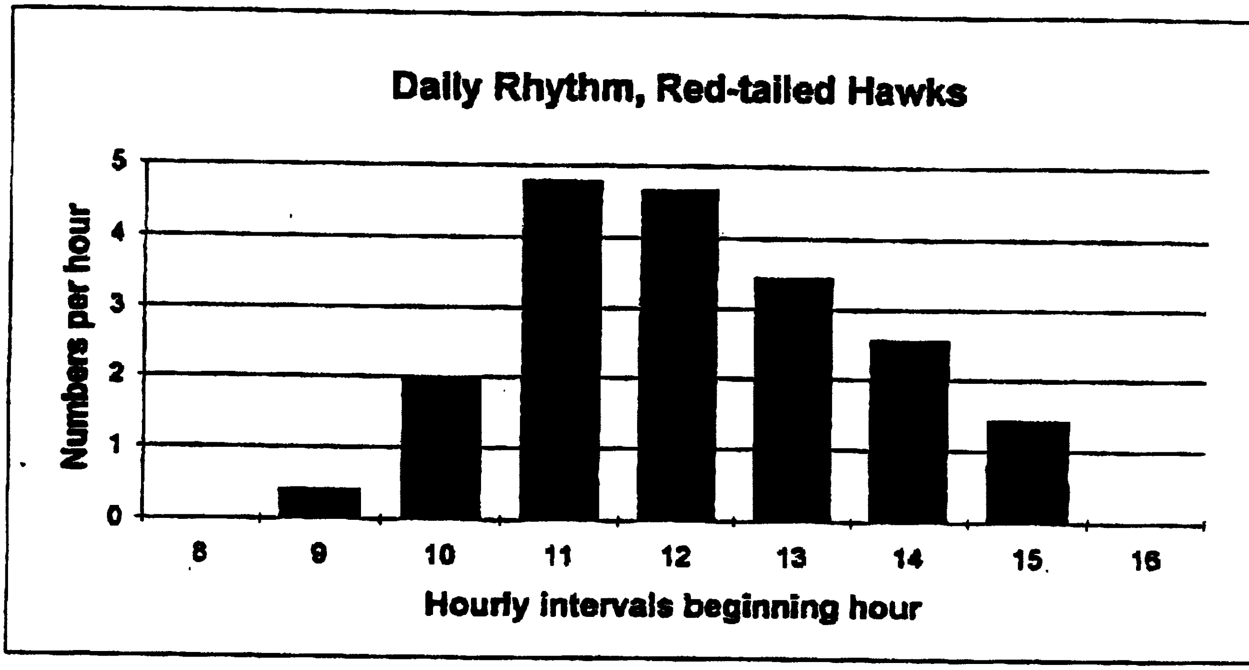


Figure 14. Daily flight rhythm for Red-tailed Hawks migrating across Beech Ridge, West Virginia, Fall 1994. N=263; hours=92.5.

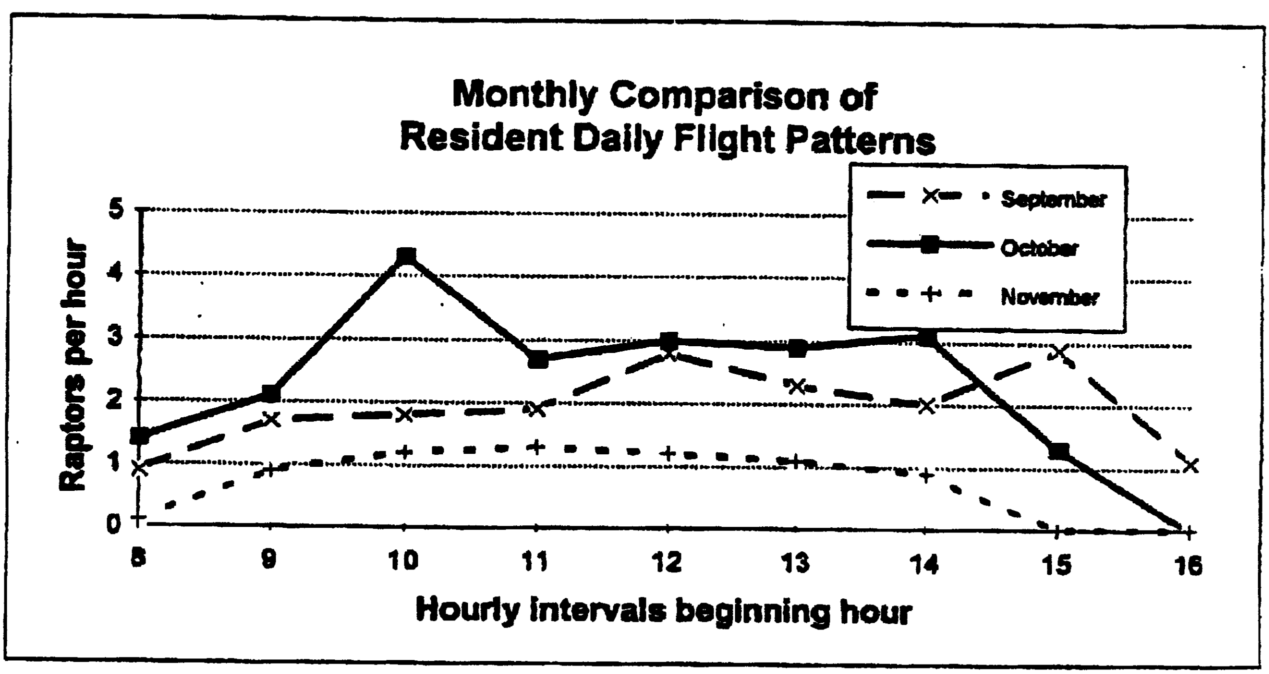


Figure 15. Daily flight rhythm of resident raptors summarized by month. Beech Ridge study area, West Virginia, Fall 1994.

Weather Effects

Typically an increased passage rate was experienced immediately preceeding a front, associated with southerly winds. As the front approached, migration slowed while winds shifted to the north and northwest. After passage of a front, flight rates generally increased; the duration of the increase varied (Figure 16).

Interactions between weather conditions and migration behavior have been well documented at many other sites (Hall *et al.* 1992, Clemens and White 1994).

Spatial Patterns

Flight Directions

Information on specific migration pathways was recorded whenever possible. More than half (54%) of 742 migrating raptors used four different routes from the northeast across Cold Knob and continuing to the southwest (Figure 2). Two other routes (used by 22% of the raptors) crossed Beech Knob and continued south and southwest. Because most of our observations were made at Cold Knob and Beech Knob, flight paths for these areas are better understood.

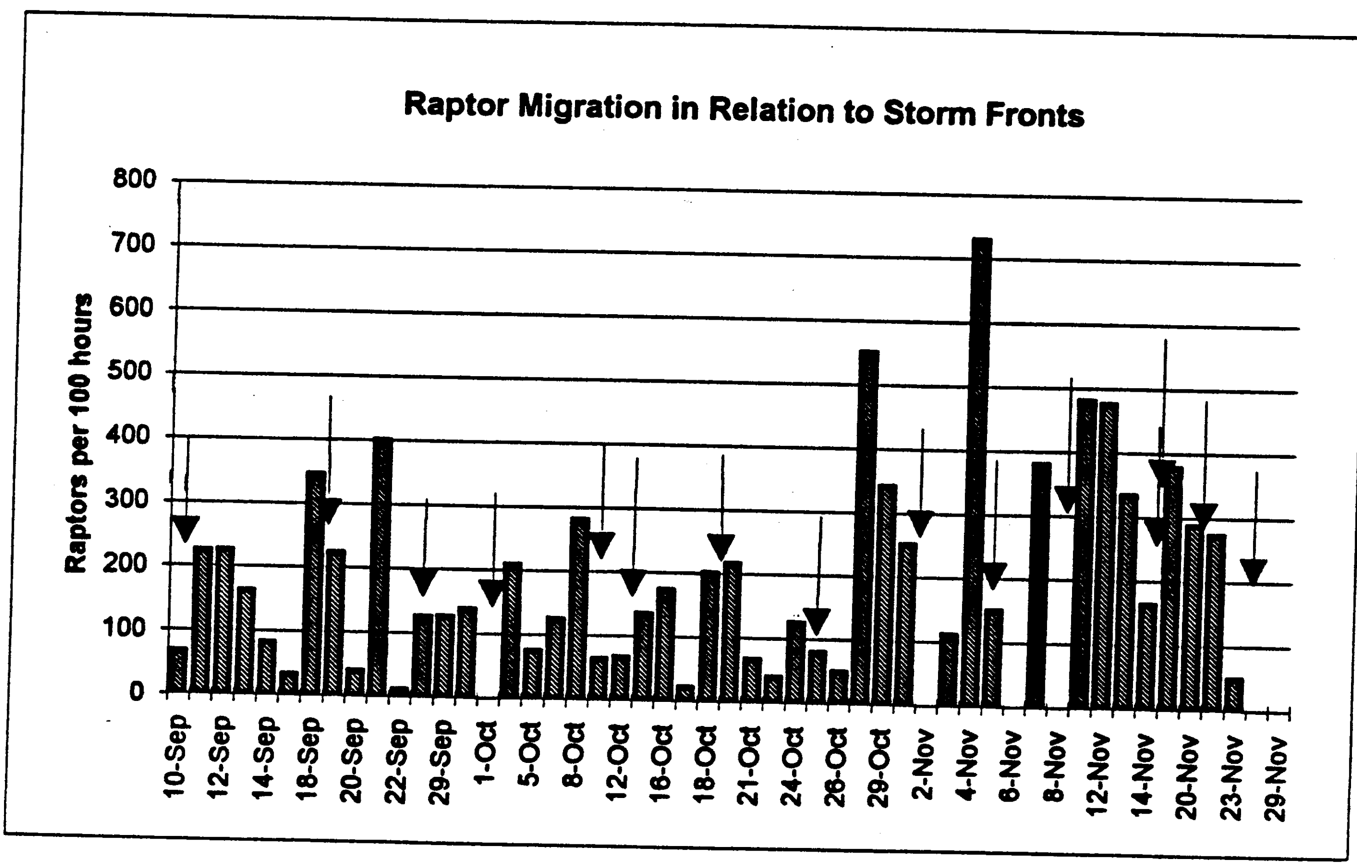


Figure 16. Passage rates for migrating raptors in relation to passage of storm fronts (arrows), Beech Ridge study area, West Virginia, Fall 1994. N=974; hours=476.5.

Flight Altitudes

A majority of migrants (91%) flew at an altitude above 50 meters (Figure 17). Of these, 80% were counted on clear to partly cloudy days. Thermal production is greater on clear days, which allows raptors to gain higher altitudes. This effect produces a change of flight altitude in relation to the time of day—as thermals increase, especially in mid-afternoon, raptors tend to fly higher (Figure 18).

Wind speed was probably less of a factor influencing flight altitude because fewer birds are migrating during periods of strong winds. However, more raptors are likely to be flying low as wind speed increases (Figure 19). High winds tend to break up thermals, causing raptors to travel at lower altitudes, where they can take advantage of ridge updrafts (Kerlinger 1989).

Not all raptors in the area were actively migrating. Hunting and other activities of local birds generally occurred at lower altitudes. Resident activities were recorded at the average rate of two sightings per hour through the period (see Resident Raptor Activity).

Weather Effects

Wind direction also affected where migration occurred over the study area. Generally a higher passage rate was recorded at the north end (Beech Knob) of the study area during winds from the north and east; at the south end (Cold Knob) an increase in the passage rate was recorded during winds from the south (Figures 20, 21).

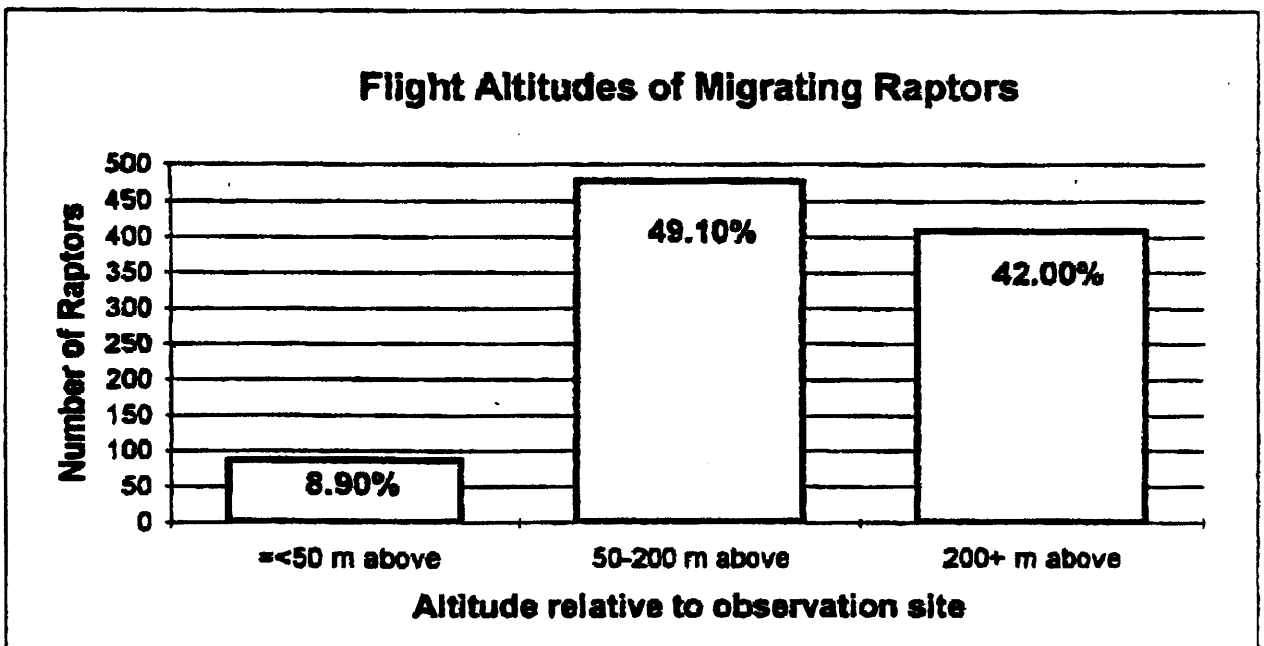


Figure 17. Total raptors observed at all sites by altitude (in meters) of flight relative to observation site, 10 Sep through 29 Nov. N=974; hours=476.5.

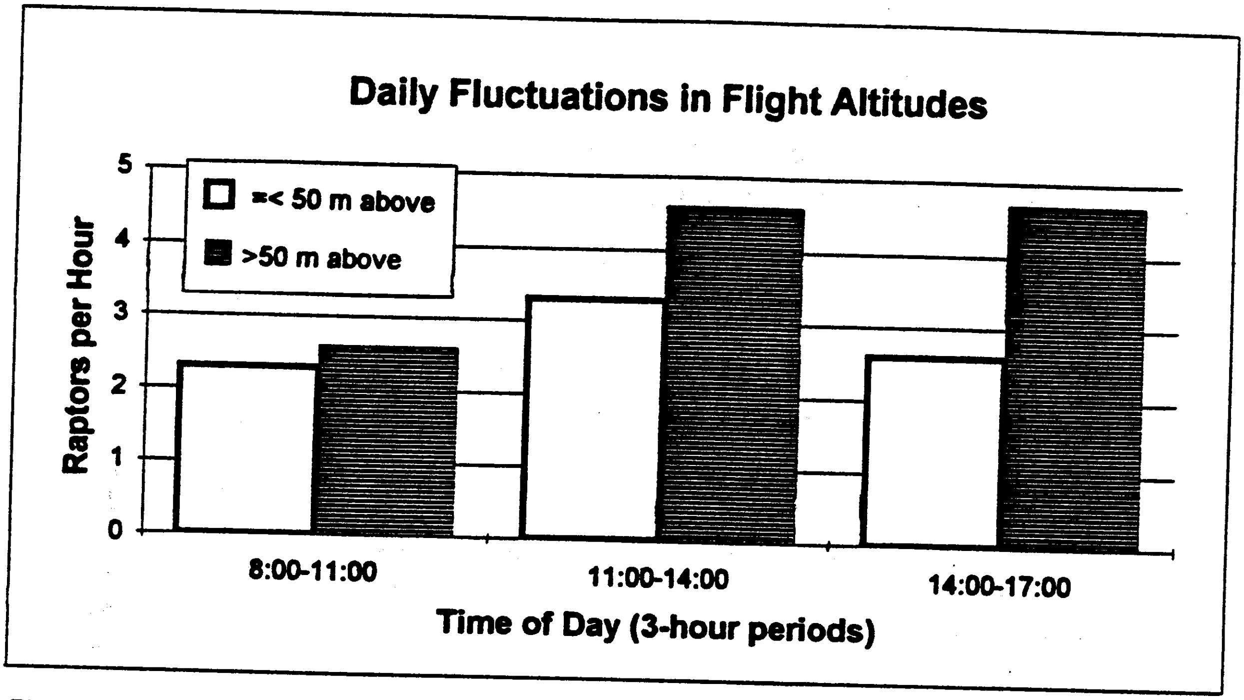


Figure 18. Daily fluctuations in flight altitude for all sites, Beech Ridge study area, West Virginia, Fall 1994.

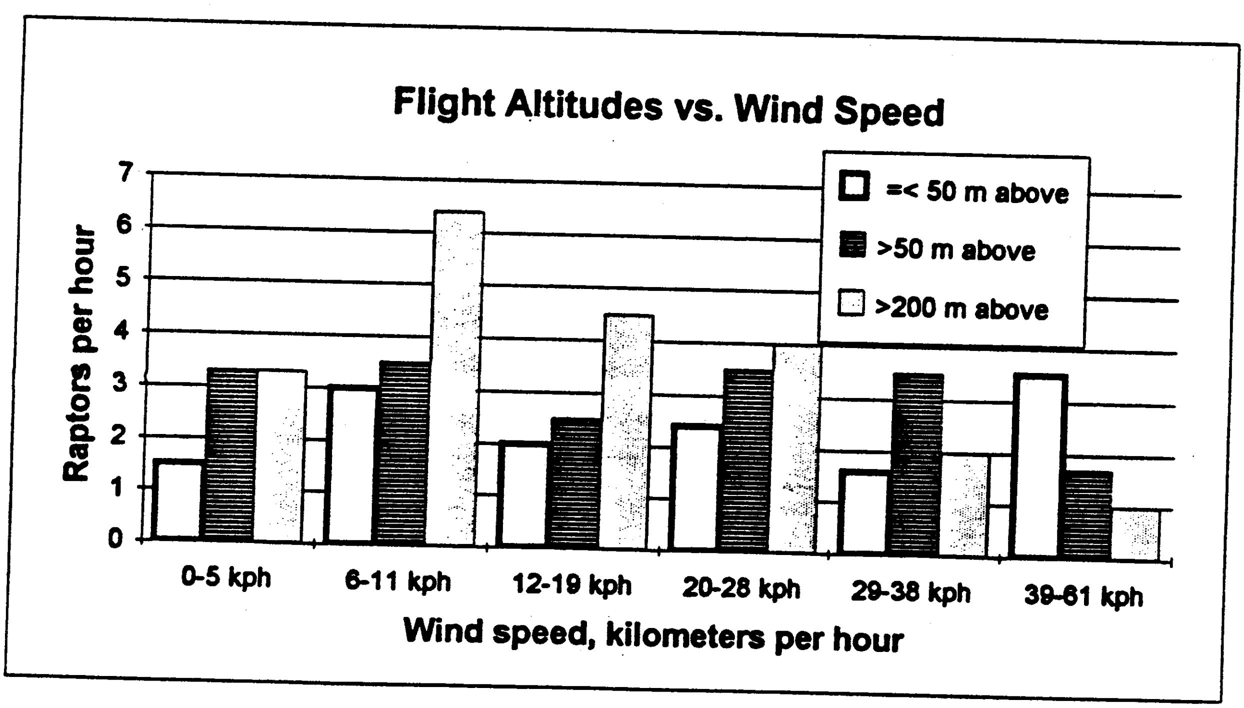


Figure 19. Variation in raptor flight altitude with wind speed, all sites, Beech Ridge study area, West Virginia, Fall 1994.

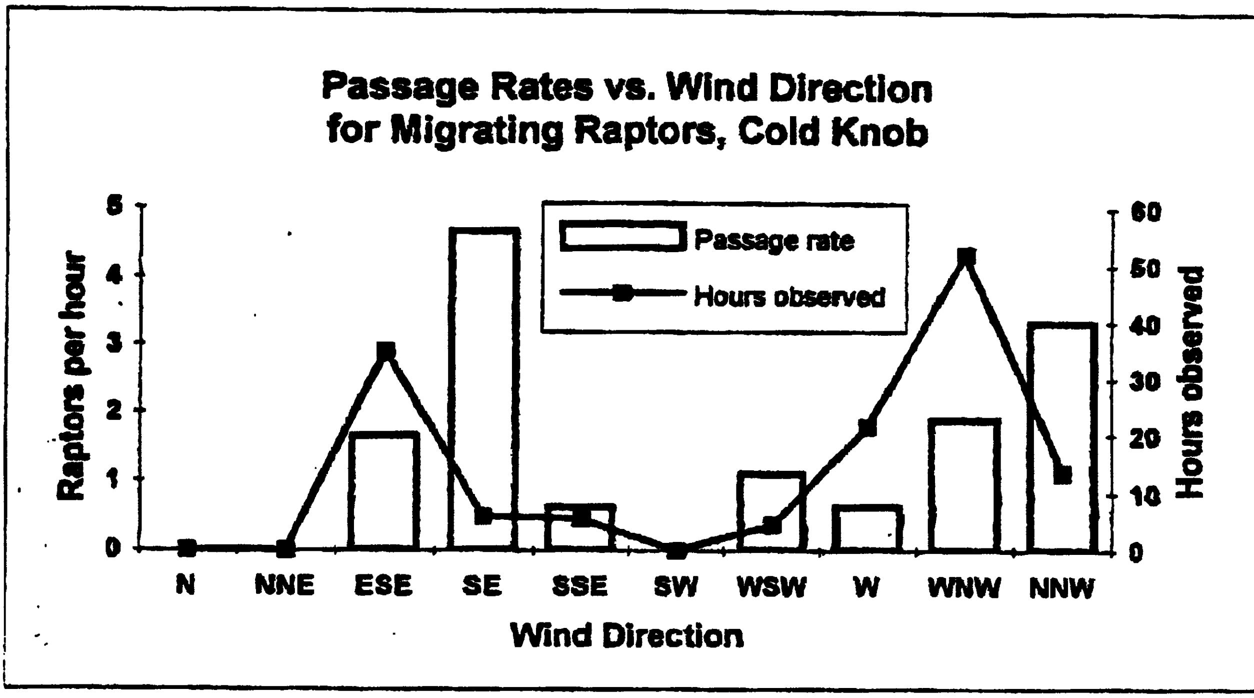


Figure 20. Passage rates for migrating raptors in relation to wind direction at Cold Knob, with hours observed for each direction. N=294; total hours=138.

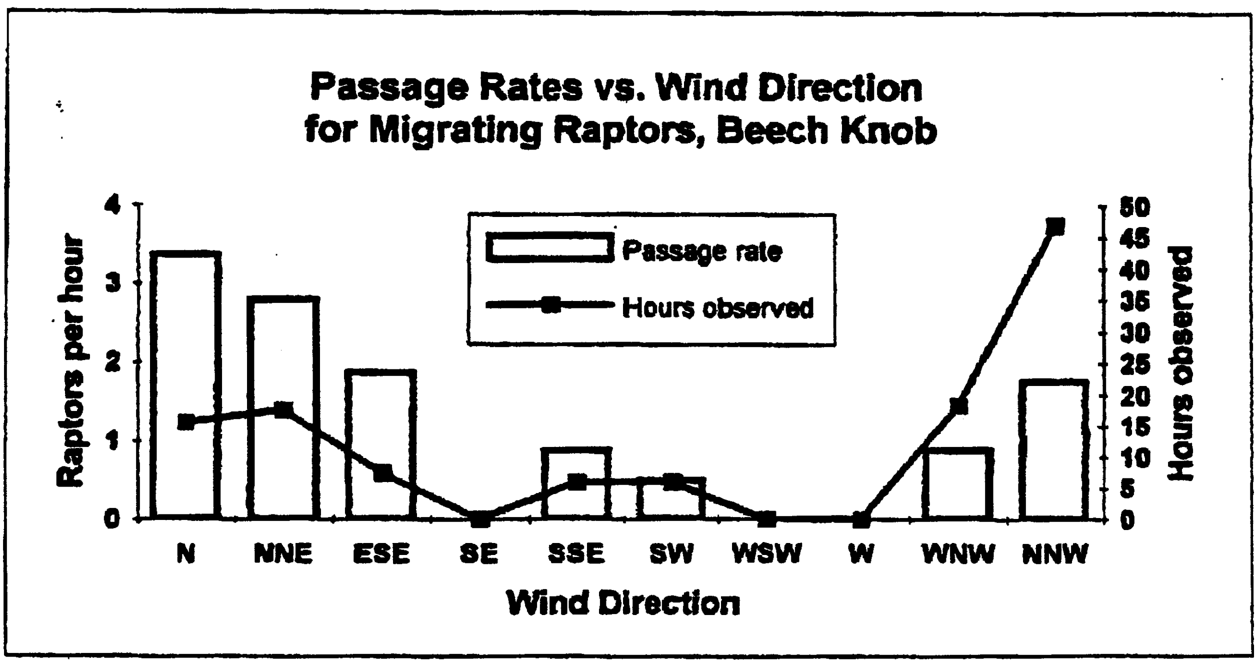


Figure 21. Passage rates for migrating raptors in relation to wind direction at Beech Knob, with hours observed for each direction. N=256; total hours=118.

Site Accounts

Beech Knob

This site is located at the northern extreme of the study area. Observations were made here from September 11th through November 23rd. Beech Knob was the second most productive site, with 327 migrants recorded in 161.5 hours (29 days) of observation (Table 1, Figure 3). Average passage rate for this site was 202 raptors per 100 hours. The highest count for Broad-winged Hawks was made here, with a rate of 0.87 per hour in September. The passage rate for Red-tailed Hawks during November was 198 per 100 hours, compared to 209 per 100 hours at Cold Knob. Distant views from Beech Knob were good, and numbers of hawks flying over central points in the study area were recorded from this site.

Resident activity at this site was slightly below average at 1.5 sightings per hour (Table 2, Figure 4). Resident birds were predominantly Turkey Vultures (65%) and buteos (22%).

Five Points

Five Points (named after a nearby road intersection) was discovered during a volunteer weekend held during the first 2 days of the study. One of only two Merlins observed was seen at this site during the volunteer weekend. This site was monitored from September 10th to 19th, after which observations for this part of the study area were continued from Beech and Job Knobs. A total of 25 migrating raptors was recorded in the three days of observation (Table 1), for an average rate of 122 birds per 100 hours, with Broad-winged Hawks dominating the flight.

Job Knob

This site was used as a midpoint lookout from September 19th through October 16th. As it became apparent that raptors tended to cross Beech Ridge, observations were started at Job Knob in order to determine extent of the migration through the center of the study area. Although high-altitude flight over Job Knob was observable on clear days from Beech and Cold Knobs, low-altitude flight was probably missed from those viewing points. A total of 79 raptors, predominantly accipiters, was observed here in 9 days (51 hours) of observation (Table 1). Overall passage rate was 155 raptors per 100 hours.

During the first part of October, the highest two-day consecutive count (27) for Sharp-shinned Hawks was made at Job Knob (7 Oct.-8 Oct.). Many of these birds were observed flying low. The highest single count of Broad-winged Hawks (25) was made at Job Knob (19 Sept.). These birds were crossing the Grassy Knob area and would also have been visible from Cold Knob.

Resident Turkey Vultures were very active during September and October at this site (Table 2). Resident activity was brisk at 2.9 sightings per hour. By late October when migrant activity was dominated by Red-tailed Hawks, Job Knob was abandoned because the area was being adequately covered from Beech and Cold Knobs.

Cold Knob

A total of 511 migrating raptors was recorded in 192.5 hours (36 days) of observation between 10 Sept. and 29 Nov., making this the most productive site (53% of all migrants observed). The overall passage rate was 265 raptors per 100 hours (Table 1). Except for the first

10 days of October, observations were regular at this site throughout the study period. Six different flight paths were documented at Cold Knob (Figure 2). Of a total of 7 Golden Eagles recorded during the study, 6 were spotted from Cold Knob (Table 1), as was the only Bald Eagle observed.

Resident activity was common at Cold Knob, with an average of 2 sightings per hour. Areas within two kilometers to the northeast, north, and northwest (including Grassy Knob) are particularly well used, especially by Red-tailed Hawks. Winds from the east create an updraft over Low Gap, and hawks use this while hunting on windy days. On calm days thermals replace updrafts.

Craters (of the Moon)

During 36.5 hours of observation, 25 raptors were recorded at Craters between September 15th and October 29th (68 raptors per 100 hours, Table 1). Craters (also referred to as the Hill Climbs) is a favorite recreational spot located on Old Fields Mountain, which runs more or less perpendicular to Beech Ridge. Craters is located 3.5 kilometers southwest of Cold Knob. Observations were made here to determine whether birds seen crossing the Cold Knob area continued in a southwesterly direction along Old Fields Mountain. Results suggest that a small percentage of raptors follows this ridge in a southwesterly direction, but most cross over this ridge and fly due south. On Oct. 4th, 12 accipiters were observed following this ridge. More data are needed to evaluate conditions that may affect the use of this ridge as a flyway.

Northern Harriers were especially active hunting in this area (see Species Accounts). Once part of an extensive strip-mined area, now reclaimed, the terrain of Craters is suited well for Harriers and provides numerous updrafts and poor cover for prey.

Joe Knob

This site was originally chosen in the spring of 1994 because of its good visibility. During the first two days of observations this fall, however, very few migrants were observed compared with the other sites observed on the same days, and the site was dropped from further consideration. Only 7 raptors were observed during 14.5 hours on September 10th and 11th.

Resident activity was moderate, with 30 raptors sighted during the two days. Most of these were buteos and Turkey Vultures (Table 2).

Regional Migration Comparison

Hanging Rocks, Peter's Mountain

Peter's Mountain is located approximately 30 miles southeast of the study area in the Ridge and Valley Province of the Allegheny Mountains. It is a well known migration corridor, with hawkwatchers regularly in attendance from the beginning of the second week in September to the end of that month. However, October observations are variable and November counts are rare. Records from Hanging Rocks indicate an overall migrant raptor passage rate more than ten times comparable rates for the Beech Ridge study area (Table 5). At Hanging Rocks, Broad-winged Hawks clearly dominated the flight (Hurley and Davis 1994).

Table 5: Comparison of data from the Beech Ridge study area and Hanging Rocks locations, limited to birds observed September 10th through October 30th, 1994.

	Hanging Rocks		Beech Ridge*	
Species	**Number**	**% of total**	**Number**	**% of total**
Osprey	20	1%	4	2.3%
Bald Eagle	3	0.15%	0	0%
Northern Harrier	3	0.15%	4	2.3%
Sharp-shinned Hawk	144	7%	50	29%
Cooper's Hawk	28	1.4%	7	4%
Red-shouldered Hawk	3	0.15%	0	0%
Broad-winged Hawk	1771	87%	82	47%
Red-tailed Hawk	29	1.4%	13	7.5%
American Kestrel	39	2%	14	8%
Golden Eagle	2	0.11%	0	0%
Total Raptors	**2042**		**174**	
Hours observed	96.5		96.5	
Passage rate (# per 100 hours)	2116		180	

* Data for Beech Ridge are sampled to correspond to the hours and days during which observations were recorded at Hanging Rocks. This table thus records only records for the early part of the season and for limited daily hours during that period.

Yearly averages for Peter's Mountain indicate that the overall passage rate for this part of the country was down from previous years for species that migrate in September and October. Broad-winged Hawks typically migrate in September in large numbers. The previous four-year average at Peter's Mountain was 3409 Broad-winged Hawks for the season. This year's flight totalled 1974 Broad-wings, only 58% of the previous four-year average. The passage rate for all species at Peter's Mountain was 59% of the four-year average.

Other studies have documented the inverse relation between numbers of raptors observed and thermal lift. As thermal lift increases, the birds pass lookouts at much higher altitudes and are more difficult to spot (Kerlinger 1985). Because Broad-winged Hawks use thermals to gain altitude while migrating, it is possible that, with so much sunny weather and good thermal production, many passed at high altitudes and were simply not seen. This suggests that numbers of Broad-winged Hawks observed at the study area are likely to be more numerous than in 1994, during years with less favorable conditions for high altitude flight. This may also hold true for other species of raptors.

Harvey's Knob

In Virginia, farther east of Peter's Mountain, is a long-term migration lookout at Harvey's Knob. Records here are more complete through the season, and thus provide a better comparison for species of raptors besides Broad-winged Hawks. The species composition recorded at the study area seems similar to the average recorded from 1990 to 1993 at Harvey's Knob (Figure 22), with Broad-winged Hawks more abundant at Harvey's Knob and redtails dominant at the Beech Ridge study area.

Regional trends suggest that migrating raptor numbers are variable from year to year at both Harvey's Knob and Hanging Rocks (Figure 23). In recent years, the flight at Harvey's Knob has varied from about 3000 to nearly 9000 birds (Lindsay 1994).

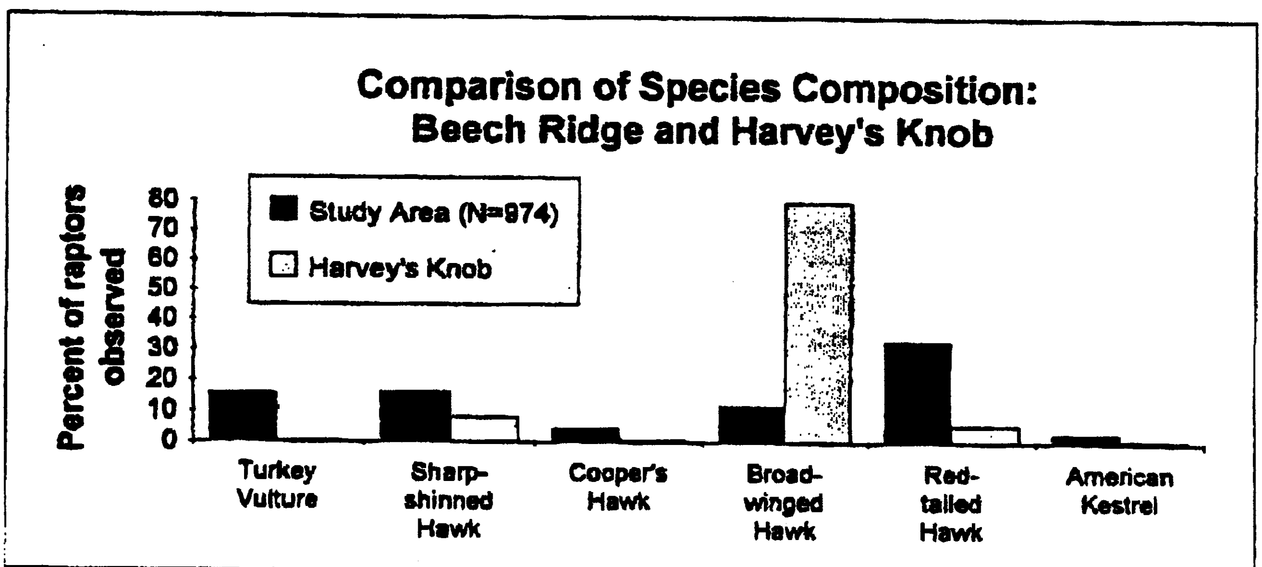


Figure 22. Comparison of species composition for dominant species observed at the Beech Ridge study area (Fall 1994) and average at Harvey's Knob, Virginia, 1990-1993.

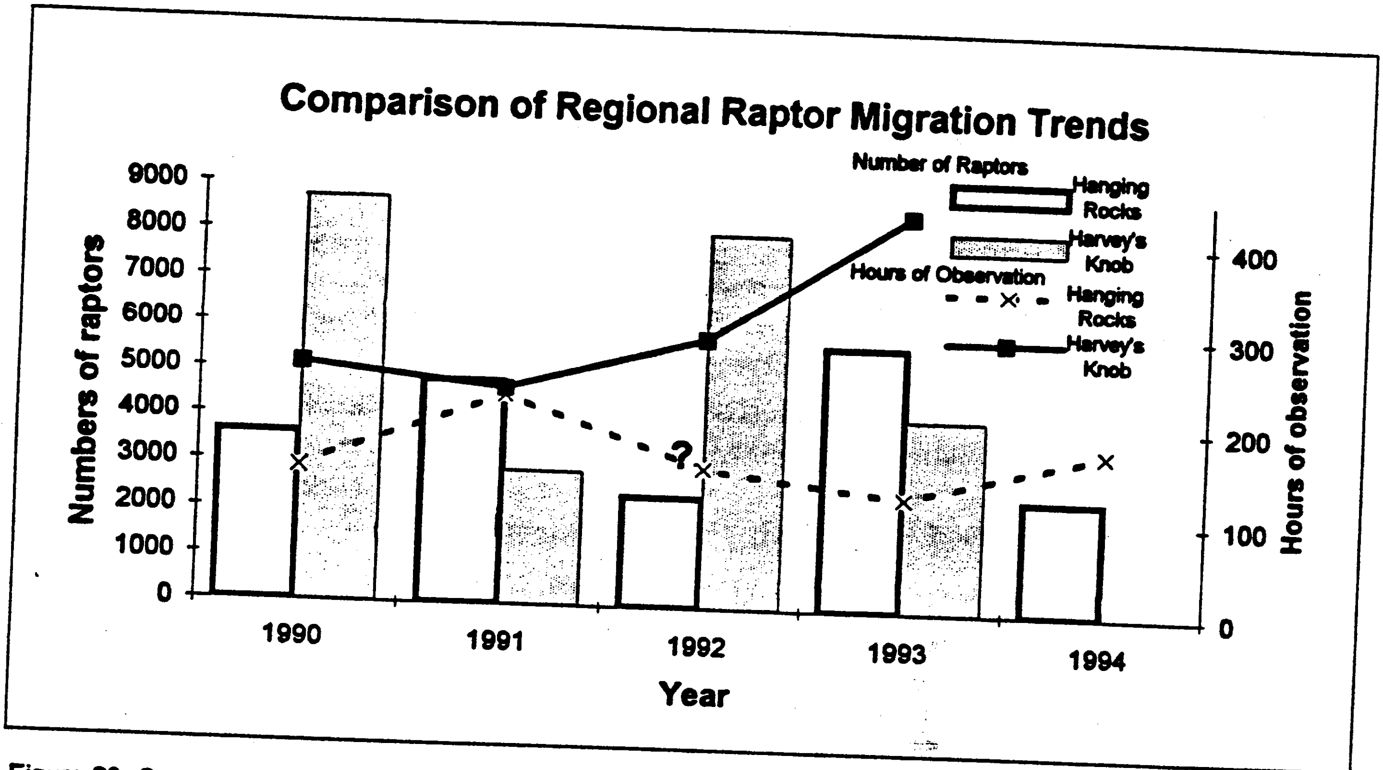


Figure 23. Comparison of raptor migration count data for regional sites Hanging Rocks and Harvey's Knob, 1990-1994. Hours unknown for 1992 at Hanging Rocks.

Species Accounts

Turkey Vulture

The first migrant Turkey Vultures were recorded on October 15th. Migration continued through November 22nd, with a passage rate of 66 birds per 100 hours during that period (Figures 8, 24). Most (65%) of the Turkey Vultures were recorded at Cold Knob; a total of 155 was observed at all sites (Table 2), comprising 16% of the entire raptor flight.

Resident Turkey Vultures were active throughout the area during September and October at a rate of 168 sightings per 100 hours for that period (Figure 24). During November the rate dropped to 30 sightings per 100 hours. Turkey Vultures were the dominant resident species at all sites (Table 2).

Black Vulture

Although this species is generally considered as non-migratory (Dunne 1988), 7 birds passed Cold Knob in late October following a migratory course. Resident Black Vultures were observed at the average rate of 9.5 sightings per 100 hours (Table 3).

Osprey

One Osprey was seen on August 8th during a field trip to the study area, and indicates some possible early arrivals to the area. Osprey migration is generally an early-season phenomenon: the last Osprey was seen on October 15th. During the migration period from September 10th through October 15th, the passage rate for Osprey was 2.7 birds per 100 hours; a total of 7 was observed.

Bald Eagle

Only one Bald Eagle was seen during the entire period. An immature bird was seen at Cold Knob on September 16th.

Northern Harrier

Migration of harriers was recorded sparsely throughout the period with an average passage rate of 3 birds per 100 hours. A concentrated period occurred between November 6th and the 13th, when 9 birds passed in 4 days (Figure 25).

Adjacent to reclaimed strip-mines and other open areas, Northern Harriers were regularly seen hunting. This raptor courses low over open country while hunting. This behavior may put the Northern Harrier at greater risk around wind turbines. Resident activity was most often observed during September and early October but extended into November as well. Average resident activity rate for the entire period was 6.5 sightings per 100 hours.

Sharp-shinned Hawk

Migration occurred from September 10th through November 12th at an average rate of 38 birds per 100 hours; 158 migrants were recorded. The passage rate between September 20th and October 21st was 66 birds per 100 hours, representing 72% of the entire flight (Figure 7).

Resident activity rate for Sharp-shinned Hawks averaged 2 sightings per 100 hours; 9 sightings were recorded during the period. The Sharp-shinneds' hunting methods keep them low and in the trees, often out of sight, which may be why this common species shows such a low resident activity rate.

Cooper's Hawk

Migration occurred throughout the period at the rate of 9 birds per 100 hours, with 45 birds counted. The most concentrated flight was in October (60%), with 24% in September and 16% in November. Only 5 resident sightings were recorded. These occurred in September and early October (see Sharp-shinned Hawk).

Northern Goshawk

Only three Goshawks were observed for the entire period. These were at Cold Knob on October 16th and 30th.

Red-shouldered Hawk

Only 8 migrating Red-shouldered Hawks were recorded for the entire period, a rate of 1.7 birds per 100 hours. Resident Red-shouldered Hawks were seen regularly, often two or three at a time. These sightings often consisted of two immature birds accompanied by an adult. During September and October the resident activity rate was fairly constant at 14 sightings per 100 hours. During November activity dropped to 3 sightings per 100 hours.

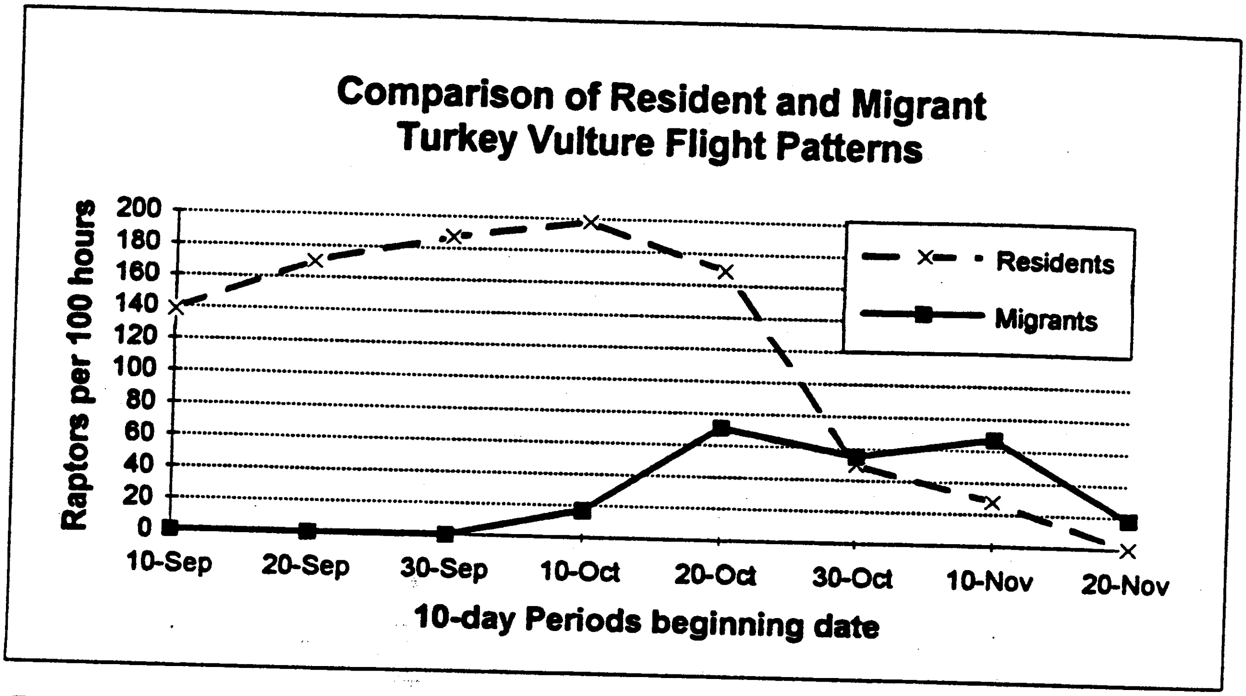


Figure 24. Resident and migrant activity for Turkey Vultures throughout season
All sites, 476.5 observation hours.

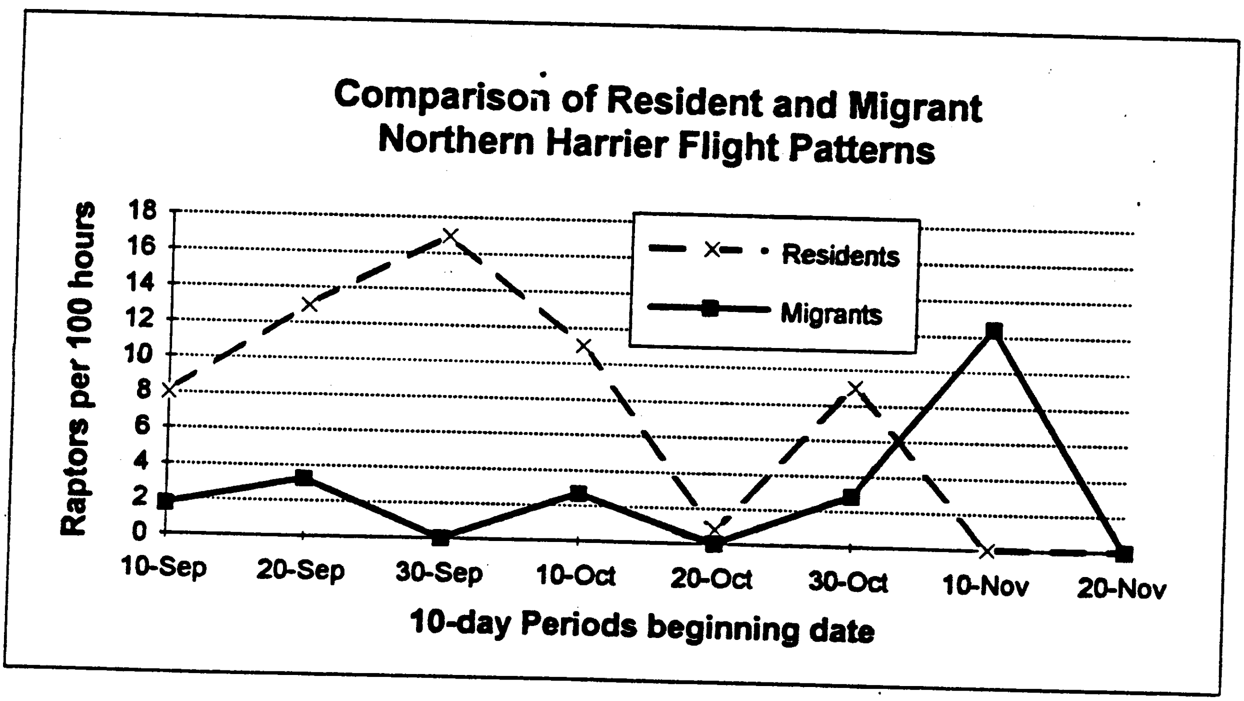


Figure 25. Resident and migrant activity for Northern Harriers throughout season
All sites, 476.5 observation hours.

Broad-winged Hawk

Broad-winged Hawk migration was confined to September; 118 birds were counted, with a passage rate of 69 birds per 100 hours. A concentrated flight (95%) occurred between September 10th and the 22nd with a passage rate of 99 birds per 100 hours for that period (Figure 6). Flocking behavior during migration is characteristic for Broad-winged Hawks; large groups will occasionally pass through an area, although their routes may vary from year to year. These raptors also tend to fly very high, which makes observations difficult, especially when thermal updrafts are strong. No resident Broad-winged Hawks were observed.

Red-tailed Hawk

Red-tailed migrants were the most plentiful of all species, with 322 birds counted. Overall passage rate was 68 birds per 100 hours. In November when the redtail migration was concentrated (81%), passage rates jumped to 205 birds per 100 hours (Figure 9). Resident birds were active the entire period, but tapered off in November (Figure 26). The overall sighting rate for residents was 33 per 100 hours.

Golden Eagle

A total of 7 Golden Eagles was counted, six of these from Cold Knob. The first bird was seen on October 17th, the last three on November 20th.

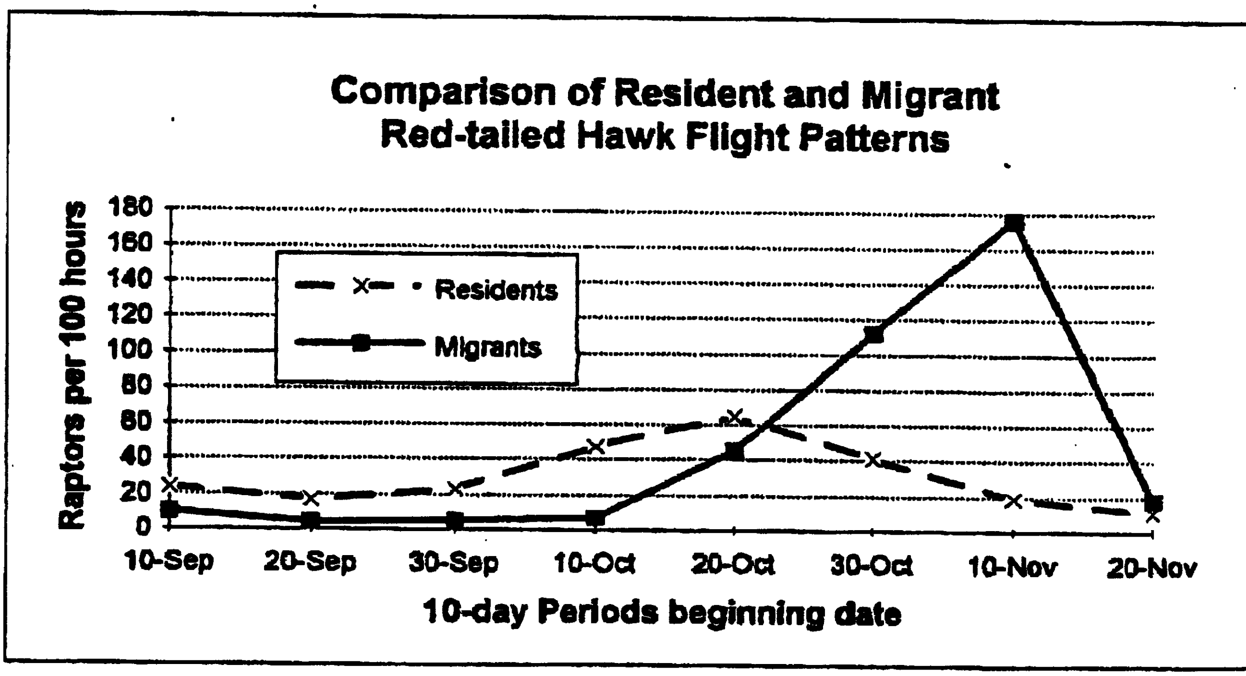


Figure 26. Resident and migrant activity for Red-tailed Hawks throughout season
All sites, 476.5 observation hours.

American Kestrel

American Kestrel migration was concentrated (71%) in September, with a passage rate of 13 birds per 100 hours. Overall the rate was 6 birds per 100 hours; 30 birds were counted. The only resident activity recorded for this species was in September and on the 1st of October. Activity rate was 5.6 sightings per 100 hours during that period.

Merlin

One Merlin was counted at Beech Knob on October 15th. A second bird was seen on September 11th at the Five Points Site during the volunteer weekend.

Unidentified Raptors

A total of 97 unidentified raptors was recorded during the study. Unidentified buteos (37), unidentified accipiters (21), and unknown raptors (39) together made up 10% of the migratory flight recorded.

Other Bird Species

Informal records were kept of other bird species seen. Raven sightings were common; activity rates averaged 2.4 ravens per hour. Crows were observed migrating beginning in late October and continuing through November; a total of 310 was counted. On November 11th, 60 Tundra Swans were observed from Beech Knob migrating at high altitude. Also sighted were 190 unidentified ducks, 93 Red-breasted Mergansers, and 16 Canada Geese.

Passerine species observed included Snow Bunting (only one recorded at Cold Knob), Red-headed Woodpecker, Vesper Sparrow, Woodcock, and Purple Finch. Warbler species noted were Pine Warbler, Cape May Warbler, Black-throated Blue Warbler, and Palm Warbler.

Volunteer Weekend

During two days of observations by volunteers at the beginning of the study, resident and migrant raptors were counted at seven observation sites. Results of the volunteer weekend are presented separately in a report to Kenetech by Dr. Edward Michaels.

Summary and Conclusions

Raptor Migration

Although Beech Ridge is a prominent topographic feature in the study area, it does not act as a migration route or show a funneling effect to any measurable degree. Most raptors observed were crossing the ridge rather than flying along it. Its prominence provides a good vantage point for observation, and almost a thousand migrating raptors were recorded during the 51 sample days. Overall passage rate, however, was only about 204 raptors per 100 hours (10 to 20% of the rate for flyways in the region), indicating that this is not a major flyway. There is, however, a moderate observable migration of raptors through the Beech Ridge area. Flight lines and altitude of migrants vary with wind speed and direction, and passage rates vary with the time of year and approaching cold fronts. In relation to the proposed wind power project, these observations suggest some concern for the welfare of raptors flying through the area.

The migration recorded seemed relatively consistent throughout the season, although some species, such as Broad-winged Hawks and Osprey, passed through early in the season and others, especially Red-tailed Hawks, were concentrated late in the year. Overall daily flight rhythms showed a peak between 1100 and 1300 hours, again with slight variations among species.

Although migration appeared to be dispersed over the area, concentrations did occur at the north and south ends of the study area. The Cold Knob area (south) was most heavily used. The location of concentrated flights was apparently influenced by weather conditions. Understanding the influence of weather on the number of migrating raptors and the routes used is important. During this season, because conditions were mild, with plenty of sun and moderate winds, raptor migration occurred at higher altitudes, and thus fewer birds were seen. During seasons with strong northern fronts, high winds, and more cloud cover, raptors may be more concentrated and are likely to be seen flying at lower altitudes in greater numbers.

Flight paths also appear to be affected by the weather on a daily basis. Cloud cover can vary from one end of the study area to the other, affecting where thermals form. Wind direction had an obvious influence on which flight paths were utilized. For example, during southeast winds, a strong updraft formed just northeast of Cold Knob. This updraft influenced the flight paths used by most of the migrants, concentrating them in the general area.

Altitude Summary

Raptors migrating through the area this season had a relatively low chance of intercepting proposed wind turbines. Only 9% of the migrating raptors were observed flying low; 91% were more than 50 meters above the observation sites. This proportion will likely vary with weather conditions, especially wind speed.

Resident Raptors

Raptors that remained in the area for a period of time are potentially more at risk. Resident activity in the study area averaged 2 sightings per hour and was strongest in September and October. The activity of residents may vary from year to year. These include transients stopping to hunt and rest, as well as long-term residents. Both groups frequently fly at low altitudes.

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Appendix: Data Tables

Table A1. Daily summary of weather observations, Beech Ridge study area, West Virginia, Fall 1994.

Table A2. Daily counts of migratory raptor observations, Beech Ridge study area, West Virginia, Fall 1994.

Table A3. Selected data used in calculations of daily flight rhythms of migrating raptors.

Table A4. Selected data used in seasonal passage rate calculations, Beech Ridge study area, West Virginia, Fall 1994

Table A5. Selected data used in seasonal activity calculations for resident raptors, Beech Ridge study area, West Virginia, Fall 1994.

Table A1. Daily summary of weather observations, Beech Ridge study area, West Virginia, Fall 1994.

Date	Site	Weather	Wind Dir	Vel Kph Low	Vel Kph High	Temp oC Low	Temp oC High	Hours	Total Bir Observed
SEPTEMBER 1994									
Sept 10	Five Pnt	M'cldy	NW	6	19	22	*26	5	3
	Cold	Clear-M'cldy	WNW	20	28	12	17	6.5	5
	Joe	P'cldy-Rain	NNW	20	49	17	23	6.5	4
Sept 11	Beech	Fog-P'cldy	NNW	12	28	12	13	9	45
	Cold	P'cldy-Clear	WNW	29	38	16	18	8.5	9
	Joe	P'cldy-Clear	N	20	49	16	20	8	3
Sept 12	Beech	Clear-P'cldy	NNW	0	5	20	27	4	9
Sept 13	Beech	Clear	NNW	6	8	15	20	8	13
Sept 14	Beech	Clear-O'cast	NNW	29	49	14	20	8.5	7
Sept 15	Beech	P'cldy-M'cld	VAR NNW	12	19	20	23	3	0
	Craters	M'cldy	N	12	28	21	24	3	2
Sept 17	Front	Rain						No Obs.	
Sept 18	Beech	M'cldy	N	12	19	14	17	5	15
	Five Pnt	P'cldy	N	12	38	14	20	7.5	14
	Cold	P'cldy	NNW	20	40	10	12	5.5	33
Sept 19	Beech	Clear-P'cldy	NNE	12	38	13	25	8	16
	Five Pnt	P'cldy	N	12	28	11	14	8	8
	Job	Clear-P'cldy	NNW	1	28	15	21	6	25
Sept 20	Beech	Clear-P'cldy	SSE-N	0	11	14	20	7	0
	Job	Clear	SSE	6	19	15	20	8	6
Sept 21	Cold	P'cldy-M'cld	ESE	6	15	8	16	5	25
	Craters	M'cldy	SSE	20	28	14	15	1.5	1
Sept 22	Job	O'cast	ENE	6	28	10	13	5	0
	Cold	O'cast	ESE	6	25	13	17	4	1
Sept 25	Cold	M'cldy	SSE	12	28	18	21	4	5
Sept 26	Front	Rain						No Obs.	
Sept 29	Beech	O'cast-P'cld	WNW	29	61	5	10	6.5	15
	Job	M'cldy-Clear	NNW	20	38	11	13	7	8
	Cold	M'cldy-P'cld	WNW	39	61	10	13	4	4
Sept 30	Beech	Clear	NNW	1	28	8	18	8	11
								170	287

Table A1. Daily summary of weather observations, Beech Ridge study area, West Virginia, Fall 1994.

OCTOBER 1994

Oct 1	Beech	Clear	WNW	39	49	14	20	4	0
Oct 4	Beech	P'cldy-Clear	NNW	1	19	8	13	5	12
	Craters	P'cldy-Clear	NNW	12	38	7	16	8	15
Oct 5	Craters	Fog-M'cldy	N	20	38	6	17	4	3
Oct 7	Beech	Clear	S	1	11	12	16	4	3
	Job	Clear	SSE	6	11	10	19	8	15
	Craters	Clear	N-SSE	0	* 5	12	23	4	2
Oct 8	Job	Clear w/Haze	S	6	28	8	15	5	14
Oct 9	Front	Rain						No Obs.	
Oct 10	Beech	Fog-P'cldy-C	NNE	20	38	2	7	4.5	7
	Job	Clear	NNE	6	28	3	6	4	1
	Craters	Clear	N Var	6	28	6	9	4	0
Oct 12	Job	Clear	SSE	29	49	8	8	4	0
	Cold	P'cldy	ESE	20	49	0	6	5.5	8
	Craters	Clear	SSE	29	49	5	13	4	1
Oct 13-14		Rain						No Obs.	
Oct 15	Beech	Clear-P'cldy	ESE	0	28	11	15	7.5	14
	Cold	Clear	ESE	1	19	7	10	7	11
	Craters	Clear	S	12	38	8	16	4	0
Oct 16	Beech	Clear	NE-NNW	0	11	3	12	6	2
	Job	Clear	ENE	6	11	6	12	4	10
	Cold	Clear	ESE	0	11	2	10	8	19
Oct 17	Cold	Clear	W Var-ESE	1	11	3	12	4.5	1
Oct 18	Cold	P'cldy	W-NNW	6	19	10	14	4	8
Oct 19	Front	Rain						No Obs.	
Oct 20	Beech	M'cldy-O'cas	NNW	20	38	15	20	4	8
	Cold	O'cast	WNW	12	19	12	13	2.5	6
Oct 21	Beech	O'cast	WNW	12	28	11	13	4	3
	Cold	M'cldy	WNW	6	19	9	10	5	3
Oct 22	Cold	M'cldy-Rain	ESE	6	19	5	8	2.5	1
Oct 24	Cold	Clear	W	6	28	5	10	4	5
Oct 25	Cold	P'cldy-clear	W	29	49	2	7	5	4
Oct 26	Beech	P'cldy-O'cas	N	12	49	2	5	4	2
Oct 28	Cold	Clear	W-ESE	1	11	0	4	8	44
Oct 29	Beech	Clear	SW Var	0	19	12	16	6	3
	Cold	Clear	S	6	11	1	8	7	54
	Craters	Clear	WNW-S	0	28	9	17	4	1
Oct 30	Cold	Clear	W Var	1	11	14	17	6	15
								175	295

Table A1. Daily summary of weather observations, Beech Ridge study area, West Virginia, Fall 1994.

NOVEMBER 1994

Oct 31- Nov 1		Rain and snow						No Obs.	
Nov 2	Cold	M'cldy-P'cld	W Var	29	61	0	4	5	0
Nov 3	Cold	Clear-P'cldy	WSW	12	38	11	16	4.5	5
Nov 4	Cold	Clear-M'cldy	W-ESE	1	11	11	18	7	51
Nov 5	Cold	O'cast	WNW-ESE	1	11	16	18	4	6
Nov 5 evening- Nov 6 morning		Rain							
Nov 6	Cold	O'cast	WNW	39	61	13	14	2	0
Nov 7	Beech	Clear	NNE-SSE	1	28	7	12	7	26
	Cold	P'cldy	ESE	6	38	7	10	7	27
Nov 8	Cold	P'cldy	W Var	29	49	12	13	4	0
	Beech	O'cast	NNW	29	61	12	15	1.5	0
Nov 9-10		Rain						No Obs.	
Nov 11	Beech	Clear	SE-NNW	6	11	11	12	6.5	32
	Cold	Clear	SE	0	19	0	3	6	28
Nov 12	Beech	P'cldy	NNW	1	19	10	13	5	6
	Cold	P'cldy-clear	WNW	1	28	5	6	7	52
Nov 13	Beech	P'cldy	NNW	1	5	14	16	4	4
	Cold	M'cldy-P'cld	WNW	1	28	10	12	6.5	31
Nov 14	Cold	P'cldy-O'cas	NNW-WNW	1	19	11	12	5.5	9
Nov 15-18		Overcast and rain through per						No Obs.	
Nov 19	Beech	Clear	N	1	49	5	10	6.5	43
	Cold	Clear-P'cldy	WNW	12	49	3	11	6.5	5
Nov 20	Beech	O'cast	SSE	29	61	8	12	4	3
	Cold	O'cast	ESE	12	38	8	13	7.5	30
Nov 21		Rain						No Obs.	
Nov 22	Beech	Clear	NNW	50	74	0	1	7	25
	Cold	Clear	NNW	50	74	2	4	4	4
Nov 23	Beech	Clear	WNW	29	74	-5	-1	4	2
Nov 25		Snow showers						No Obs.	
Nov 26	Cold	Clear-O'cast	SSE-ESE	20	28	0	5	3	0
Nov29	Cold	P'cldy	WNW	12	28	0	1	2.5	0
								127.5	389

Table A2. Daily counts of migratory raptors by site, Beech Ridge study area, West Virginia, Fall 1994.

SEPTEMBER 1994	SITE	TV	BV	OS	BE	NH	SS	CH	NG	UA	RS	BW	RT	UB	GE	AK	ML	UR	Total	Day	Obs. Total Hours
Sept 10	Five Pa											1	2						3		5
	Cold						3					1						1	5		6.5
	Joe						1			1		1				1			4	12	6.5
Sept 11	Beech			1		1	8			1		24	1	3		4		2	45		9
	Cold						2	2		1		2				1		1	9		8.5
	Joe											2						1	3	57	8
Sept 12	Beech											3	2	4					9	9	4
Sept 13	Beech					1						9		2				1	13	13	8
Sept 14	Beech						1					1		1		2		2	7	7	8.5
Sept 15	Beech																		0		3
	Craters											2							2	2	3
Sept 18	Beech						1	1				10	3						15		5
	Five Pa						3			1		5		1				4	14		7.5
	Cold			2			6				1	4		5		2		13	33	62	5.5
Sept 19	Beech						1	1				8		2		4			16		8
	Five Pa						1	1				4	1					1	8		8
	Job											25							25	49	6
Sept 20	Beech																		0		7
	Job					1		1				3				1			6	6	8
Sept 21	Cold					1	10	1				9	2	1		1			25		5
	Craters											1							1	26	1.5
Sept 22	Job																		0		5
	Cold							1											1	1	4
Sept 25	Cold						4	1											5	5	4
Sept 29	Beech						10	1				3				1			15		6.5
	Job						2	1		3						1		1	8		7
	Cold			1			2									1			4	27	8
Sept 30	Beech			1			4				2		1			3			11	11	8
				5		4	59	11		7	3	118	12	19		22		27	287		174

Table A2. Daily counts of migratory raptors by site, Beech Ridge study area, West Virginia, Fall 1994.

OCTOBER 1994	SITE	TV	BV	OS	BE	NH	SS	CH	NG	UA	RS	BW	RT	UB	GE	AK	ML	UR	Total	Day Total	Obs. Hours
Oct 1	Beech																		0	0	4
Oct 4	Beech						5	3		2			2						12		5
	Craters						10	1		1	1					1		1	15	27	8
Oct 5	Craters						1			2									3	3	4
Oct 7	Beech						3												3		4
	Job						13			1								1	15		8
	Craters						2												2	20	4
Oct 8	Job						14												14	14	5
Oct 10	Beech						5	1		1									7		4.5
	Job						1												1		4
	Craters																		0	8	4
Oct 12	Job																		0		4
	Cold			1			4	2								1			8		5.5
	Craters						1												1	9	4
Oct 15	Beech	9		1			1	1									1	1	14		7.5
	Cold						2	3					5			1			11		7
	Craters																		0	25	4
Oct 16	Beech						2												2		6
	Job	5					1											4	10		4
	Cold				1	1	8	4	2	1			1					1	19	31	8
Oct 17	Cold														1				1	1	4.5
Oct 18	Cold					1	4	1					1					1	8	8	4
Oct 20	Beech						4	1		3									8		4
	Cold	2	2				1									1			6	14	2.5
Oct 21	Beech						2									1			3		4
	Cold							2					1						3	6	5
Oct 22	Cold												1						1	1	2.5
Oct 24	Cold						1	2		1	1		1						6	6	4
Oct 25	Cold						1						3						4	4	5
Oct 26	Beech												2						2	2	4
Oct 28	Cold	18	5					3		1			17						44	44	8
Oct 29	Beech	2											1						3		6
	Cold	36					3	2		1			7	2		2		2	55		7
	Craters												1						1	59	4
Oct 30	Cold	1					3	1	1				6	2				1	15	15	6
		73	7	2	1	2	92	27	3	14	2		49	4	1	7	1	12		297	175

Table A2. Daily counts of migratory raptors by site, Beech Ridge study area, West Virginia, Fall 1994.

NOVEMBER 1994	SITE	TV	BV	OS	BE	NH	SS	CH	NG	UA	RS	BW	RT	UB	GE	AK	ML	UR	Total	Day Total	Obs. Hours
Nov 2	Cold																		0	0	5
Nov 3	Cold	2											3						5	5	4.5
Nov 4	Cold	15					1	1					30	3	1				51	51	7
Nov 5	Cold	1											5						6	6	4
Nov 6	Cold																		0	0	2
Nov 7	Beech	16						1					7	2					26		7
	Cold	2				2	1						21	1					27	53	7
Nov 8	Cold																		0		4
	Beech																		0	0	1.5
Nov 11	Beech	5				2		1			1		19	3	1				32		6.5
	Cold	8				4	1						15						28	60	6
Nov 12	Beech	2											4						6		5
	Cold	11				1	2	1					35	1	1				52	57	7
Nov 13	Beech												4						4		4
	Cold	2					2	1					22	3		1			31	35	6.5
Nov 14	Cold												9						9	9	5.5
Nov 19	Beech	10						1			1		31	1					44		6.5
	Cold	1											4						5	49	6.5
Nov 20	Beech	3																	3		4
	Cold	2						1					24		3				30	33	7.5
Nov 22	Beech	2											23						25		7
	Cold										1		3						4	30	4
Nov 23	Beech												2						2	2	4
Nov 26	Cold																		0	0	3
Nov29	Cold																		0	0	2.5
TOTALS		82				9	7	7			3		261	14	6	1				390	127.5

Table A3. Selected data used calculations of daily flight rhythms of migrating raptors.

Broad-winged Hawk Daily Flight Rhythms Original five hour obs. day

Date	Site	800-900	900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	1600-1700	HR
SEPTEMBER 1994											
Sept 11	Beech	0	0	0	0	0	2	6	11	5	9
	Cold	0	0	0	1	0	0	0	1	0	8.5
Sept 13	Beech	1	1	2	0	0	1	4	0		8
Sept 18	Beech				5	0	0	0	5		5
	Five Pnts	0	0	0	0	2	2	0	1		7.5
Sept 19	Beech		0	5	2	0	1	0	0	0	8
	Five Pnt		1	0	0	3	0	0	0	0	8
	Job		0	1	0	6	18	0	0		6
Sept 30	Job	1	1	0	0	0	1	0	0	0	8
Sept 21	Cold		4	2	1	2	0				5
									Total bird	99	73
		0.4	0.78	1.11	0.9	1.3	2.5	1.11	2	1	
		8	9	10	11	12	13	14	15	16	
No. obs. Hr. each Hr. p		5	9	9	10	10	10	9	9	5	

Broad-Winged Hawk, Daily Rythms, Sample, Sept.11-Sept.30
Sites: Beech, Five Points, Job, Cold Knob
10 Site observations over 6 days, 73 Total obs. hrs.
99 Total Broad-Winged Hawks in sample

Rmd-tailed Hawk Daily Flight Rhythmf Original Min five Hr. Obs. Day

Date	Site	900-1000	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1500-1600	HR
Oct 28	Cold	2	4	1	5	0	4	1	8
Oct 30	Cold	0	0	3	3	0	0		6
Nov 4	Cold	0	1	9	9	6	4	1	7
Nov 7	Beech	0	2	0	2	0	2	0	7
	Cold	1	3	3	4	3	4	3	7
Nov 11	Beech	0	2	6	6	3	3	0	6.5
	Cold		1	5	5	3	1	0	6
Nov 12	Beech		0	1	0	3	0		5
	Cold	0	5	10	6	5	3	6	7
Nov 13	Cold	1	8	1	2	7	3	0	6.5
Nov 14	Cold	0	0	7	2		0	0	5.5
Nov 19	Beech	0	1	10	9	5	6	0	6.5
Nov 20	Cold	0	0	7	7	2	4	3	7.5
Nov 22	Beech	1	1	4	4	8	2	3	7
								Total Hour	92.5
								Total Bird	263
First series		0.42	2	4.79	4.64	3.46	2.57	1.42	
x-axis series		9	10	11	12	13	14	15	
No. obs. Hr. each Hr. period		12	14	14	14	13	14	12	

Table A3. Selected data used calculations of daily flight rhythms of migrating raptors.

Sharp-shinned Hawk Daily Flight Rhythms Min. 4.5 Hr. Obs. Day

Date	x-axis series	8 900	9 1000	10 1100	11 1200	12 1300	13 1400	14 1500	15 1600	16 1700	HR
SEPTEMBER 1994											
Sept 11	Beech	0	0	2	0	0	1	0	4	1	9
	Cold					1	1	0	3	0	5.5
Sept 21	Cold		4	0	3	3	0				5
Sept 29	Beech		6	0	2	1	1	0			6.5
Oct 4	Beech	0	1	2	2	0					5
	Craters	2	4	2	0	1	0	0	0		8
	Job	3	1	6	1	0	1	0	1		9
Oct 8	Job	2	0	8	3						5
Oct 10	Beech	0	0	1	2	2					4.5
	Cold	0	3	2	1	1	1	0	0		8
											64.5
First series		1	2.17	2.56	1.56	1	0.71	0	1.6	0.5	

Sharp-Shinned Hawk, Daily Rhythms, Sept.11--Oct.10 Total bird 86
Sites: Beech, Cold, Job, Craters
10 Site observations over 6 days, 64.5 Total obs. Hrs.
86 Total Sharp-Shinned Hawks in sample

No. Obs. Hr. each Hr.	7	9	9	9	9	7	6	5	2

Table A4. Selected data used for seasonal passage rate calculations.

All Species (Figure 10)

Date	Site	Raptors	Obs. Hrs.
9-10	Joe	4	6.5
9-11	Cold	9	8.5
9-12	Beech	9	4
9-13	Beech	13	8
9-14	Beech	7	8.5
9-15	Craters	2	3
9-18	Cold	33	5.5
9-19	Job	25	6
Totals		102	50
9-20	Job	6	8
9-21	Cold	25	5
9-22	Cold	1	4
9-25	Cold	5	4
9-29	Beech	15	6.5
Totals		52	27.5
9-30	Beech	11	8
10-1	Beech	0	4
10-4	Beech	12	5
10-5	Craters	3	4
10-7	Job	15	8
10-8	Job	14	5
Totals		55	34
10-10	Beech	7	4.5
10-12	Cold	8	5.5
10-15	Beech	14	7.5
10-16	Cold	19	8
10-17	Cold	1	4.5
10-18	Cold	8	4
Totals		57	34

Date	Site	Raptors	Obs. Hrs.
10-20	Cold	6	2.5
10-21	Beech	3	4
10-22	Cold	1	2.5
10-24	Cold	5	4
10-25	Cold	4	5
10-26	Beech		4
10-28	Cold	44	8
10-29	Cold	54	7
Totals		119	37
10-30	Cold	15	6
11-2	Cold	0	5
11-3	Cold	5	4.5
11-4	Cold	51	7
11-5	Cold	6	4
11-6	Cold	0	2
11-7	Cold	27	7
11-8	Beech	0	1.5
Totals		104	37
11-11	Beech	32	6.5
11-12	Cold	52	7
11-13	Cold	31	6.5
11-14	Cold	9	5.5
Totals		124	25.5
11-19	Beech	44	6.5
11-20	Cold	30	7.5
11-22	Beech	25	7
11-23	Beech	2	4
11-26	Cold	0	3
11-29	Cold	0	2.5
Totals		101	30.5

Broad-winged Hawk (Figure 6)

Date	Site	Raptors	Obs. Hours
9-10	Five Pnt	1	5
9-11	Beech	24	9
9-12	Beech	3	4
9-13	Beech	9	8
9-14	Beech	1	8.5
9-15	Craters	2	3
9-18	Beech	10	5
9-19	Job		256
Totals		75	48.5

Date	Site	Raptors	Obs. Hours
9-20	Job	3	8
9-21	Cold	9	5
9-22	Job	0	5
9-25	Cold	0	4
9-29	Beech	3	6.5
Totals		15	28.5

Observation hours and sites for *All Species* were used for the remainder of the 10-day periods.

Table A4. Selected data used for seasonal passage rate calculations.

Accipiters (Figure 7)

Date	Site	Raptors	Obs. Hrs.
9-10	Cold	3	6.5
9-11	Beech	9	9
9-12	Beech	0	4
9-13	Beech	0	8
9-14	Beech	1	8.5
9-15	Beech	0	3
9-18	Cold	6	5.5
9-19	Beech	2	8
Totals		21	52.5
9-20	Job	1	8
9-21	Cold	11	5
9-22	Cold	1	4
9-25	Cold	5	4
9-29	Beech	11	6.5
Totals		29	27.5
9-30	Beech	4	8
10-1	Beech	0	4
10-4	Beech	10	5
10-5	Craters	3	4
10-7	Job	14	8
10-8	Job	14	5
Totals		45	34
10-10	Beech	7	4.5
10-12	Cold	6	5.5
10-15	Cold	5	7
10-16	Cold	15	8
10-17	Cold	0	4.5
10-18	Cold	5	4
Totals		38	33.5
10-20	Beech	8	4
10-21	Beech	2	4
10-22	Cold	0	2.5
10-24	Cold	4	4
10-25	Cold	1	5
10-26	Beech		4
10-28	Cold	4	8
10-29	Cold	6	7
Totals		25	38.5
10-30	Cold	5	6
11-2	Cold	0	5
11-3	Cold	0	4.5
11-4	Cold	2	7
11-5	Cold	0	4
11-6	Cold	0	2
11-7	Cold	1	7
11-8	Cold	0	4
Totals		8	39.5
11-11	Cold	1	6
11-12	Cold	3	7
11-13	Cold	3	6.5
11-14	Cold	0	5.5
Totals		7	25
11-19	Beech	1	6.5
11-20	Cold	1	7.5
11-22	Beech	0	7
11-23	Beech	0	4
11-26	Cold	0	3
11-29	Cold	0	2.5
Totals		2	30.5

Table A4. Selected data used for seasonal passage rate calculations.

Red-tailed Hawk (Figure 9)

Date	Site	Raptors	Obs. Hrs.
9-10	Five Pnt	2	5
9-11	Beech	1	9
9-12	Beech	2	4
9-13	Beech	0	8
9-14	Beech	0	8.5
9-15	Beech	0	3
9-18	Beech	3	5
9-19	Five Pnt	1	8
Totals		9	50.5
9-20	Beech	0	7
9-21	Cold	2	5
9-22	Job	0	5
9-25	Cold	0	4
9-29	Beech	0	6.5
Totals		2	27.5
9-30	Beech	1	8
10-1	Beech	0	4
10-4	Beech	2	5
10-5	Craters	0	4
10-7	Beech	0	4
10-8	Job	0	5
Totals		3	30
10-10	Beech	0	4.5
10-12	Job	0	4
10-15	Cold	5	7
10-16	Cold	1	8
10-17	Cold	0	4.5
10-18	Cold	1	4
Totals		7	32
10-20	Beech	0	4
10-21	Cold	1	5
10-22	Cold	1	2.5
10-24	Cold	1	4
10-25	Cold	3	5
10-26	Beech	2	4
10-28	Cold	17	8
10-29	Cold	7	7
Totals		32	39.5
10-30	Cold	6	6
11-2	Cold	0	5
11-3	Cold	3	4.5
11-4	Cold	30	7
11-5	Cold	5	4
11-6	Cold	0	2
11-7	Cold	21	7
11-8	Cold	0	4
Totals		65	39.5
11-11	Beech	19	6.5
11-12	Cold	35	7
11-13	Cold	22	6.5
11-14	Cold	9	5.5
Totals		85	25.5
11-19	Beech	31	6.5
11-20	Cold	24	7.5
11-22	Beech	23	7
11-23	Beech	2	4
11-26	Cold	0	3
11-29	Cold	0	2.5
Totals		80	30.5

Table A4. Selected data used for seasonal passage rate calculations.

Turkey Vulture (Figure 8)

9-10 through 9-19: Total hours 50, see *All Species* for dates and sites

9-20 through 9-29: Total hours 27.5, see *All Species* for dates and sites

9-30 through 10-9: Total hours 34, see *All Species* for dates and sites

Date	Site	Raptors	Obs. Hours
10-10		0	4.5
10-12		0	5.5
10-15	Beech	9	7.5
10-16	Job	5	4
10-17	Cold	0	4.5
10-18	Cold	0	4
Totals		14	28
10-20	Cold	2	2.5
10-21	Beech	0	4
10-22	Cold	0	2.5
10-24	Cold	0	4
10-25	Cold	0	5
10-26	Beech	0	4
10-28	Cold	18	8
10-29	Cold	36	7
Totals		56	37

Date	Site	Raptors	Obs. Hours
10-30	Cold	1	6
11-2	Cold	0	5
11-3	Cold	2	4.5
11-4	Cold	15	7
11-5	Cold	1	4
11-6	Cold	0	2
11-7	Beech	16	7
11-8	Beech	0	1.5
Totals		35	37
11-11	Cold	8	6
11-12	Cold	11	7
11-13	Cold	2	6.5
11-14	Cold	0	5.5
Totals		21	25
11-19	Beech	10	6.5
11-20	Beech	3	4
11-22	Beech	2	7
11-23	Beech	0	4
11-26	Cold	0	3
11-29	Cold	0	2.5
Totals		15	27

Table A5. Selected data used in seasonal activity calculations for resident raptors, Beech Ridge study area, West Virginia, Fall 1994.

Resident Flight Patterns: Comparison for Sept., Oct., Nov.,
New Version, 6 Hour Min. Sample.

Date	Site	700 800	800 900	900 1000	1000 1100	1100 1200	1200 1300	1300 1400	1400 1500	1500 1600	1600 1700	1700 1800	HR
SEPTEMBER 1994													
Sept 10	Joe	2	1	3	3	0	6	0	0				6.5
	Cold		2	5	0	0	0	1					6.5
Sept 11	Beech		0	0	1	2	1	5	1	2	3		9
	Cold		0	0	0	0	2	3	2	3	0		8.5
	Joe		1	1	6	2	3	4	0	2			8
Sept 13	Beech		0	0	3	2	1	2	2	0			8
Sept 14	Beech		2	1	2	0	0	1	0	0	0		8.5
Sept 18	Five Pats		0	3	2		7	3	1	0			7.5
Sept 19	Beech		.	3	5	1	3	2	3	2	2		8
	Five Pat			1	0	2	1	2	0	1	0		8
	Job			0	3	2	2	0	11	0			6
Sept 20	Beech		0	0	2	1	4	0	0	0			7
	Job		1	2	6	3	9	7	2	7	1		8
Sept 29	Beech			1	0	1	1	0	0	0			6.5
	Job			2	0	1	1	1	0	3	1		7
	Cold		3	2	1	2	2	3	2	4			8
Sept 30	Beech		1	5	2	4	2	4	4	17			8
No. Hrs. sampled / hr.			12	17	17	16	17	17	17	15	7	Birds 258	129
1st Series			1.93	1.71	2.12	1.44	2.65	2.24	1.75	2.73	1		
Oct 4	Craters		0	3	6	4	8	1	6	2			8
Oct 7	Job		0	5	4	2	4	3	3	2			8
Oct 15	Beech			0	1	2	2	1	0	0			7.5
	Cold			3	3	4	1	6	0	0			7
Oct 16	Beech			0	3	4	2	0	0				6
	Cold		1	1	20	3	4	7	12	0			8
Oct 28	Cold		0	3	2	6	8	6	3	6			8
Oct 29	Beech			1	1	1	4	5	2				6
	Cold			0	3	0	1	1	1	0			7
Oct 30	Cold			0	4	2	1	0	4				6
No. Hrs. sampled / Hr.			4	10	10	10	10	10	10	7		Birds 198	71.5
2nd Series			2.79	1.6	4.7	2.8	3.5	3	3.1	1.43			
Nov 4	Cold			0	3	0	0	0	2	0			7
Nov 7	Beech			0	0	0	0	1	1	2			7
	Cold			0	3	2	3	3	1	1	0		7
Nov 11	Beech			0	0	0	2	1	1	1			6.5
	Cold				0	1	0	1	0	0			6
Nov 12	Cold			0	1	2	0	0	0	0			7
Nov 13	Cold			1	0	1	3	3	0	2			6.5
Nov 19	Cold			0	1	1	4	2	1				6.5
	Beech			0	0	0	0	1	0	0			
Nov 20	Cold			0	0	1	0	1	4	0	0		7.5
No. Hrs. sampled/ hr. period				9	10	10	10	10	10	9	2	Birds 58	61
3rd Series				0.11	0.8	0.8	1.2	1.3	1	0.67	0		

AVIAN PHASE I ASSESSMENT OF BIRD POPULATIONS ON THE MEADWESTVACO WIND POWER PROJECT IN GREENBRIER COUNTY, WEST VIRGINIA: SPRING AND FALL 2005

Final Project Report
February 25, 2006

Prepared for Potesta & Associates, Inc.
and Beech Ridge Energy, LLC.

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APPENDICES

PROJECT SUMMARY

Beech Ridge Energy, LLC has proposed to develop a wind project with nearly 186 mW capacity in Greenbrier County, West Virginia. The maximum number of 124 proposed wind turbines will be erected on ridges in the proposed project area extending northeast of Rupert and Rainelle and north of Willamsburg, and south of Richwood, West Virginia and encompass areas such as Beech Ridge, Cold Knob, Grassy Knob, Nunly Mountain, and Old Field Mountain. The proposed project is located approximately four miles northeast of Rupert, West Virginia. The primary and historical land use in the project area is timber production and contour surface mining, and the project area is not densely forested or pristine. The proposed project area will also have some possible subsurface mining activities in the near future.

A wildlife impact study was conducted on the proposed project area in the mid-1990s. Michael (1994) provided a detailed analysis of wildlife impacts and an overall environmental assessment, while Lipton and White (1995) provided an assessment of fall raptor migration. These studies are now slightly out-dated and generally have smaller sample sizes than this phase I assessment. However, Michael (1994) and Lipton and White (1995) provided baseline data and studies that were well designed and executed. Recently, Curry and Kerlinger, LLC (2004) conducted a avian fatal flaw analysis (a desktop analysis) and concluded minimal impacts on bird populations by wind power development in the proposed project area. However, the Curry and Kerlinger (2004) analysis is flawed by the lack of a site examination, and the study of the impacts of the placement of wind turbines on Appalachian ridges and in the pathway of migratory birds requires a detailed field investigation. Along with this phase I study, these studies provide an overall examination of the potential impacts on bird populations due to wind power development.

The principal **objectives** of this study were to (1) provide a Phase I analysis of bird populations and potential impacts and risks due to wind power development, and (2) compare results of this study to baseline data (Michael 1994; Lipton and White 1995) and other studies (e.g., Mountaineer and Mount Storm Wind Projects). The main goal of this report was to provide information that would aid in risk assessment and project development that is less likely to expose avian species to potential collision with turbines. During the spring and fall 2005 seasons, the following studies were conducted: (1) spring and fall fixed-point count surveys to assess species composition, habitat use, and flight characteristics, and a spring line transect study to assess relative abundance and bird-habitat associations, (2) spring and fall raptor studies to assess migratory patterns, relative abundance, and nesting, (3) a nocturnal bird survey, (4) a survey for Golden-winged and Cerulean Warblers (two species proposed for potential listing under the Federal Endangered Species Act; U.S. Fish and Wildlife Service), and (5) a mist-netting and bird banding project to assess the fall migration pattern in comparison with other fall banding stations such as Allegheny Front Migration Observatory (AFMO) in Grant County and the Three Rivers Migration Observatory (TRMO) in Raleigh County. Further, weather patterns were assessed to predict impacts of adverse weather on birds in the area and where weather patterns may increase avian mortality at potential turbine locations, and an analysis of microsetting of turbines.

Diurnal Avian Use Surveys

Diurnal fixed-radius (50 m) avian point count surveys were conducted at least twice a week at each of 100 points between May 10 and June 20, 2005 and from August 23 through November 15, 2005. A total of 1,925 and 3,395 10-minute point count surveys were accumulated in the spring and fall, respectively. Observers tallied 21,167 observations, which included 5,781 spring observations and 15,386 fall observations. A total of 93 species were observed during the spring fixed-point surveys, while a total of 108 species were observed during the fall. With all methods pooled (see methods below), a total of 124 species were confirmed for the project area. A total of 100 species were collectively confirmed with the spring study, while the fall study tallied 121 species from all methods pooled.

Passerines were the most numerous group observed and comprised 84.9 percent of all groups observed and 86.4 percent of the total birds observed during fixed-point surveys. In the spring, passerines made up 89.5 percent of the groups observed, and 87.3 percent of the total birds tallied on fixed-point surveys. In the fall, passerines comprised 81.6 percent of all groups observed and 79.6 percent of the total birds observed during fixed-point surveys.

The most numerous (total number of individuals counted) species observed on the spring fixed-point surveys were the Red-eyed Vireo, American Crow, Turkey Vulture, American Robin, Yellow-rumped Warbler (migrant through the area), and Blue Jay. The most numerous resident warblers were the Chestnut-sided Warbler, Black-throated Green Warbler and Ovenbird. The chestnut-sided Warbler is a species of mountainous shrublands, and appears to have responded favorably to the clearcut activities within the proposed project area. Both of the latter two warblers are forest species. The Eastern Wood-Pewee was the most abundant flycatcher in the spring fixed-point surveys, and is a characteristic species of deciduous woodlands.

Passerine subgroups varied in relative abundance and in the relative percent of the passerine group. Warblers were the most numerous birds in the proposed project area and comprised 17.7 percent of all birds observed on the spring fixed-points and 18 percent of the avian groups, as well as 20.3 percent of all passerines during the spring. Thrushes, corvids, and vireos were also fairly numerous groups of passerines observed in the proposed project area during the spring study.

The numbers for passerines vary by group because of the number of individuals per group and the number of species within a subgroup, e.g., there are a lot more woodpeckers, flycatchers, thrushes in the area than titmice, chickadee, kinglet, and wren species. They also varied with habitat heterogeneity, habitat availability, and patch size.

Raptors and woodpeckers were the next most common groups of birds observed during the spring fixed-point surveys. A total of 366 raptors were observed on the spring fixed-point surveys, which comprised 6.3 percent of the total number of individuals recorded. Vultures comprised 82 percent of the raptors recorded during the spring fixed-point surveys. The most numerous hawk observed on the spring fixed-point surveys was the Sharp-shinned Hawk. Woodpeckers comprised 3.9 percent of all avian groups and 3.3 percent of all individuals during the spring study. The Downy Woodpecker and Northern Flicker were the most numerous woodpeckers on the spring fixed-point surveys.

Waterfowl, shorebirds, upland gamebirds, doves, cuckoos, nightjars (goatsuckers), swifts, and hummingbirds comprised 2.9 percent of all groups and 3.1 percent of all individuals observed in the spring fixed-point surveys. The only shorebird observed in the spring was the American Woodcock, and the only waterfowl were the Wood Duck and Mallard. No herons or bitterns were observed because of limited amount of natural wetlands in the area.

The two most numerous spring migrants of the northern/boreal forest that did not breed in the area or are near the southern limit of their continental breeding range in West Virginia were the Swainson's Thrush and Yellow-rumped Warbler. Species not observed on the spring fixed-point surveys, but were recorded via transects and additional (other than point-counts) roadside surveys were American Kestrel, Cape May Warbler, Bay-breasted Warbler, and the Vesper Sparrow.

This study compared the avian relative abundances (number of detections of each species per fixed-point survey). The five most abundant species on the spring fixed-point surveys (through calculations of mean number of observations per 10-minute survey) were the Red-eyed Vireo (0.26 detections/10-minute survey), American Crow (0.23 detections/survey), Yellow-rumped Warbler (0.20 detections/survey), American Robin (0.18 detections/ survey), and the Dark-eyed Junco (0.15 detections/survey). Together these five species comprised 1,327 individuals of the total 5,778 or 23 percent of all diurnal bird use recorded during the spring 2005 study. The five most abundant species along transects were the Red-eyed Vireo, Chestnut-sided Warbler, Black-throated Green Warbler, Veery, and Dark-eyed Junco.

During the fixed-point fall surveys, the five most numerous species were the European Starling, Blue Jay, Common Grackle, Turkey Vulture, and Cedar Waxwing. The Broad-winged Hawk was the most numerous hawk observed during the fixed-point fall surveys. The Eastern Phoebe was the most numerous flycatcher during the fall. The most numerous woodpecker recorded during fixed-point fall surveys was the Northern Flicker, while the most numerous thrushes were the American Robin and Gray-cheeked Thrush. Other numerous species noted on fixed-point fall surveys were the American Crow, Dark-eyed Junco, Chipping Sparrow, Cape May Warbler, Eastern Towhee, American Goldfinch, and the Black-capped Chickadee.

Raptors comprised 9.0 percent of the total birds observed during the fixed-point fall surveys, while the most numerous passerine group was the grassland birds and sparrows. Warblers comprised 9.9 percent of all birds observed and thrushes made up 8.4 percent of the birds observed during fixed-point fall surveys. Warblers and thrushes made up 21.3 percent of all passerines observed during the fall.

In the proposed project area, the species of concern or on the West Virginia Division of Natural Resources monitoring program were the Black Vulture, Osprey, Bald Eagle, Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk, Black-billed Cuckoo, Northern Saw-whet Owl, Common Nighthawk, Whip-poor-will, Red-headed Woodpecker, Yellow-bellied Flycatcher, Yellow-bellied Sapsucker, Alder Flycatcher, Brown Creeper, Swainson's Thrush, Golden-winged Warbler, Yellow-rumped Warbler, Blackburnian Warbler, Northern Waterthursh, and the Vesper Sparrow. The only federally listed species noted in the proposed project area was the Bald Eagle, which was observed during the fall season.

Temporal and Spatial Use and Flight Characteristics

Passerines utilized the proposed project area fairly consistently throughout the spring with the highest use in late May. Raptors use was also highest in late May. Woodpeckers showed highly fluctuating numbers and varied in temporal and spatial use. For most groups the difference in mean use across day (plotted by two-hour blocks) was highly variable, but with little difference between morning and afternoon times. Mean use was highest in the morning hours for passerines and lowest in early afternoon, while mean use was highest around early afternoon hours for raptors. Field observers generally noticed a significant increase in Turkey Vultures in afternoon surveys compared to morning surveys, and a slight decrease in numbers of Red-tailed Hawks with more seen soaring in the morning hours than in the afternoon.

An analysis of mean use per two-hour time periods in the fall disclosed similar results to those plotted for the spring use, except that passerines and woodpeckers showed two periods of peak use. These included the early morning hours and around mid-day for passerines and woodpeckers. This was also supported by banding data with most captures occurring just after sunrise and around mid-day. The number of migrants in the proposed project area showed more variation in the fall than in the spring. The peak migration period (highest number of migrants counted and banded) generally occurred in mid-September.

For all birds observed during the spring fixed-point surveys, approximately 29 percent were of birds flying. In about 80 percent of the cases, birds were detected by sound only and were assumed to be birds perched, foraging, and/or moving through the vegetation and not in a direct flight path or flying overhead. Most of the passerines observed flying, with the exception of corvids, starlings, waxwings, and finches, were often observed flying below 25 m and outside the "zone of risk" (flight height of 25-115 m). About 25.6 percent of the passerines observed were in flight and only about 32 percent of these were within the risk zone. Larger birds such as waterfowl and raptors were observed flying at or slightly above the “zone of risk”. For raptors as a group, 79 percent were observed flying within the “zone of risk” during the spring study.

During the fall surveys, 60 percent of the birds observed during fixed-point surveys were in flight. Most of these, however, were raptors, corvids, starlings, and blackbirds. Ninety-three percent of the raptors observed during the fall were in flight, while 84 percent of these were within the “zone of risk”. Fifty-seven percent of the passerines observed were in flight, while 38 percent of all woodpeckers were birds in flight. After exclusion of corvids, starlings, and blackbirds only 27 percent of the birds observed during the fall were birds in flight.

Corvids, starlings, waxwings, blackbirds, and finches appear at greater risk than other passerine subgroups during the fall. About 39 percent of the warblers in flight during the fall study were within the “zone of risk”. Except for a few groups such as swallows and raptors, there was considerable variation between spring and fall flight characteristics at the proposed project site. There was also considerable variation within a species. For example, about 56 percent of the Chipping Sparrows observed during the fall were in flight, while only 16 percent of the Chipping Sparrows observed during the spring were of flying birds.

Overall (spring and fall combined), raptors appear to be at greatest risk among the avian groups within the proposed project area. This risk appears higher in the fall than in the spring.

Raptor Study

During the spring study, a total of 68 raptors were observed with the broadcast call method and 39 during one-hour observation periods at point count localities. The number of raptors observed per hour was generally 0.09 birds/hr., and varied from 0.03 to 0.19 birds/hr during the spring season. Red-shouldered and Red-tailed Hawks responded to broadcast calls in areas where uncut forest abutted clearcuts, but did not respond to calls played in large, open clearcut areas. Red-shouldered Hawks had the highest sighting frequency during the spring raptor study. Northern Harriers and American Kestrel were found in higher abundance than with the spring fixed-point surveys. Confirmed breeding was noted in the Eastern Screech-Owl, Cooper’s Hawk, and the Broad-winged Hawk in the proposed project area.

Fourteen species of raptors were observed during the fall raptor study. Over 500 vultures were seen, as well as 12 raptor species comprising 685 individuals during 100 hours of stationary observations in the fall. Two Bald eagles were observed during the raptor survey. Passage rates did not vary during the fall study. Key areas during fall migration may include Grassy and Cold Knob due to the passage of Ospreys, eagles, and goshawks. Michael (1994) and Lipton and White (1995), both of whom reported the same dataset in their reports, found six of the seven Golden Eagles tallied during their fall raptor study at Cold Knob. Except for Turkey Vultures, the most numerous fall raptors were the Broad-winged Hawk, Sharp-shinned Hawk, and Red-tailed Hawk during the present study.

Weather Patterns

Basic weather data (temperature, cloud cover, precipitation, and wind speed) were recorded at the time of each point-count survey. Avian use was calculated for periods with low (between 0 percent and 25 percent) cloud cover, medium cloud cover (between 25 and 75 percent), and high cloud cover or overcast (between 75 and 100 percent cover). Avian use for periods with no rain or with some precipitation was also calculated, except for the fall since there were only eight days with rainfall. Mean difference in use was higher for passerines during times of 0-25 percent cloud cover, but most groups had higher mean use and activity during 25-50 percent cloud cover. Mean use varied by groups, however. Use by passerines and all bird species declined with onset of precipitation events in the spring, but there was no significant difference.

Habitats and Vegetation Types

Vegetation cover and type were measured at each survey point and plotted according to forest cover. Open survey points were defined as those with less than 20 percent of the ground covered by overhead vegetation, and cover types were grouped from 0-20 percent, 20-70 percent and greater than 70 percent (Young et al. 2004). Spring passerine use varied significantly with amount of forest cover. During the spring, passerine use was higher in areas with lowest canopy (0-20 percent).

Species composition and frequency of occurrence varied with landscape (contiguous forest, forest fragment, and clearings) and patch size in ha. Other significant variables in explaining species composition observed during the spring fixed-point surveys included tree diameter, percent canopy cover), while slope, aspect, number of dead snags, canopy height, and ground cover were insignificant.

Woodcock and Nocturnal Bird Survey

No woodcocks were observed during the spring and fall fixed-point surveys. During the spring, field observers searched for woodcocks at night and with the flush-method while walking transects during the day. Only one woodcock was found along the transects. Because woodcocks nest early (March - April) in the project area, this study was outside the time period to record the number of territorial males. Four sets of fledged young woodcocks were observed (May 10 - 31), as well as two woodcock nests with eggs (May 22 and 25). These latter clutches were probably re-nesting attempts following a previously failed clutch. All woodcocks were located in clearcut habitats and were scattered throughout the proposed project area.

In the spring, twelve nocturnal surveys yielded 242 individuals with 12 confirmed species and some unidentified calls from songbirds. Because the size and number of natural wetlands are very limited in the proposed project area, observers did not record species such as the American Bittern or any night-herons. Broadcast calls of nocturnal birds were made in suitable habitat, but no response from bitterns, rails, etc. were noted due to the limited number and size of natural wetlands. A total of five Whip-poor-wills were heard in the proposed project area during the spring nocturnal surveys. Nocturnal and flight call methods in the fall yielded 11 species and nearly 11,000 individuals. The most common of which included the Swainson's and Gray-cheeked thrushes and the Common Nighthawk.

Mist-Netting and Banding Data

A total of 75 species were tagged within the proposed project area compared to 92 at the Three Rivers Migration Observatory (TRMO, Raleigh County) during the fall period. A total of 1,612 individuals were captured within the proposed project area as compared to 2,936 at TRMO. The number of birds per 100 net hours was 44.91 at the proposed project site and 56.04 at TRMO. Therefore, the proposed project area did not produce as many captures of migrants as that found at TRMO. Some species such as the Golden-winged and Kentucky warblers were captured but not seen on point counts, while the opposite was also true within the proposed project area. For example, observers saw eight Wilson's Warblers, but none were captured during banding operations.

Slightly more birds per net hour were captured at Cold and Grassy knobs than at other banding localities within the proposed project area. The most numerous species captured within the proposed project area during the fall were the Dark-eyed Junco and Cape May Warbler, while the most numerous species captured at TRMO were the Tennessee Warbler and American Goldfinch (which is typical of that station based on 10 years of data). Except for Cape May Warblers, the number of boreal migrants (e.g., Tennessee, Black-throated Blue, Blackpoll, and Black-throated Green warblers) that breed in the northern and boreal forests was generally lower than that generally captured at the Allegheny Front Migration Observatory (AFMO at Dolly Sods, Grant County, West Virginia). Additional years of data are needed to confirm this, however.

Golden-winged and Cerulean Warblers Study

All 100 fixed-point localities were surveyed for Golden-winged and Cerulean Warblers. Two Golden-winged Warblers were tallied during the spring fixed-point surveys, while one also was located near Grassy Knob along a transect route. Song-playback produced six additional territorial males. Further, three more males were found outside the project area in areas near the border of the proposed project boundaries (e.g., near the Greenbrier and Nicholas counties border). All Golden-winged Warblers were located in clearcut and pole succession habitats. A total of nine territorial males is higher than the two recorded by Michael (1994), and the species may be expanding into clearcut habitats within the area, but the local population is exceedingly small. Golden-winged Warblers were absent from about 85 percent of the suitable successional habitat in the proposed project area. Golden-winged Warblers are an early successional species and respond favorably to most clearcut treatments across the landscape, so wind farm development in the area will most likely not harm the species. Golden-winged Warblers generally only remain in a clearcut area for only about 3-8 years post-logging, where the trees become too dense and shade out the required herbaceous layer needed by the species (Canterbury 2005).

Golden-winged Warblers (n = 9) occupied large territories of about 1.18 ha (3 acres) and were highly widespread throughout the proposed project area. The small population size allowed for larger territories, where the average in southern West Virginia coalfields is about 0.82 ha. (Canterbury et al. 1993, 1996). No pattern similar to that within the southern West Virginia coalfields (where 1-2 mi. contour mine routes along roads yield about 8-12 territorial males) was noted (Canterbury, unpubl. data; Shapiro et al. 2004). The vegetation of occupied territories and unoccupied areas of similar size and topography were not significantly different, e.g., had similar shrub density, herb density, etc. Golden-winged Warblers most likely respond to landscape variables, where large populations occur in the upland oak-dominated forest ridges of the southern West Virginia coalfields and excess males are forced into less suitable habitat (such as the beech-maple forest in the proposed project area) (Canterbury 2002). The low population density, large amount of unoccupied clear-cut habitats by Golden-winged Warblers, and the forest type within the proposed project area indicate the site is rather unsuitable for sustainment of large Golden-winged Warbler populations.

No Cerulean Warblers were observed during the study. The elevation and habitat (beech-maple forest) may be outside that preferred by the species. Cerulean Warblers are found only in very small numbers in the high Alleghenies of West Virginia (Hall 1983; Buckelew and Hall 1994), and typically do not occur above 3200 feet in the Allegheny Mountains Physiographic Province (Canterbury unpubl. data).

Species of Concern

Collectively with all methods and both spring and fall studies pooled, 22 species of concern were observed in the proposed project area. This included three Bald Eagles observed during fall migration.

Species found in the proposed project area and in need of conservation action within the Eastern Avifaunal Biome (Rich et al. 2004) include Golden-winged Warbler (immediate conservation action needed for this species), Prairie Warbler, Kentucky Warbler, Eastern Towhee, Brown Thrasher, Wood Thrush, Red-headed Woodpecker, Willow Flycatcher, Hooded Warbler, White-eyed Vireo, Carolina Wren, Red-shouldered Hawk, and Indigo Bunting.

Species found in the proposed project area and in need of conservation action within the Northern Forest Avifaunal Biome (Rich et al. 2004) include the Golden-winged Warbler (again, listed as immediate conservation action needed for this species), Bay-breasted Warbler (migrant through the project area), Canada Warbler, Chestnut-sided Warbler, Wood Thrush, Cape May Warbler (migrant through the project area), Yellow-bellied Flycatcher, Tennessee Warbler (migrant through the project area), Mourning Warbler, Blackburnian Warbler, Alder Flycatcher, Magnolia Warbler, Black-throated Green Warbler, and Blue-headed Vireo.

Because of the population size, distribution (e.g., some species mentioned above such as the Magnolia Warbler are at the periphery of their continental range within West Virginia), and population status (declining, increasing, or remaining stable), the only major concern due to the proposed wind farm in the project area would be with the Golden-winged Warbler. Recommendations are made within the report for this species, but the proposed project area has numerous available and currently unused (shrub and early successional) habitat by Golden-winged Warbler.

Conclusions

The overall goal of this study was to provide an assessment of the overall risk to bird populations due to wind project development. Most fatalities of birds at wind farms have been resident birds, rather than migrants (Johnson et al. 2002). Additional studies of breeding birds and microhabitats may be beneficial (although not required by regulatory agencies) in evaluating potential risks. Migrant birds vary in both temporal and spatial use of habitats, and there is considerable differences between spring and fall migration. Regulatory agencies require both spring and fall studies before wind projects can be permitted. Birds during spring migration are more dispersed and widely distributed through the habitats than fall migration, where localized concentrations may be found along major migratory flyways. The only major fall migration flyway known in the state is at Dolly Sods, but other parts of the Allegheny Front such as at Mount Storm (Young et al. 2004) appear to be broadfront and diffuse migration areas and with little to no concentration parallel along the ridges. By comparison of the proposed project with previous studies (Michael 1994; White and Lipton 1995; Curry and Kerlinger 2004; Young et al. 2004) and nearby wind farm projects within the Appalachians (e.g., Mountaineer Wind Energy, LLC. project at Backbone Mountain, Tucker County), the proposed project area does not appear to create unique situations and habitat features that would accelerate avian mortalities. The number of endangered Bald Eagles moving through the area in the fall is extremely low. Post-construction issues and monitoring to consider will most likely be (1) fall migration of Bald Eagles, and (2) fall raptor migration, and any potential impacts to species of concern and especially the Golden-winged Warbler. For the most part, populations of the species of concern (e.g., breeding Golden-winged Warblers and migrant eagles) are extremely low within the proposed project area.

The proposed project area contains a substantial amount of edge and successional habitats due to current and prior land use and these habitats (and the birds such as Golden-winged and Chestnut-sided warblers that respond to it) are in constant flux and difficult to manage. The small population size of Golden-winged Warblers, limited numbers of most species of concern (no significantly large concentrations, except a few species such as Chestnut-sided and Black-throated Green warblers), and lack of species such as the Loggerhead Shrike and the Cerulean Warbler, as well as the presence of small natural wetland areas and general lack of wetland species would indicate low to minimal impacts due to wind energy development. There may be temporary displacement of some species (such as Golden-winged Warblers and American Woodcocks), but recovery as additional clearcuts are produced by the landowner. The developer plans to use existing roads in the project area, which will minimize disturbance to many habitats and localized bird populations. Federal rules govern endangered species (French and Pence 1996) will be followed, as well as consultation with regulatory agencies.

INTRODUCTION

Wind farms and the construction and development of wind turbine energy are becoming an increasingly important piece of the ecology of the Appalachians. Impacts of wind turbines on ecosystems, habitats, and wildlife remain critically debated. One of the most critical issues remains the debate over placement of wind turbines on Appalachian ridgetops, where a bulk of nocturnal passerine flight occurs during the spring and fall in eastern North America. Mountain ridges in the eastern United States and especially those in the Appalachians are well known to support migratory pathways of passerines and raptors (Goodrich 1997; Young et al. 2004). Particular concern has been raised over the nocturnal migrants, where many of these are Neotropical migrants such as the warblers, vireos, thrushes, and tanagers that migrate long distances. Recent scientific meetings and technical summaries have been developed to resolve bird and bat impacts at wind project sites (Resolve, Inc. 2004).

Further questions have been raised in the debate over flight height (altitude) and the role that ridgetops and wind patterns play in migratory flight pattern. Williams et al. (2001) found that nocturnal fall migrants flying at low altitude (< 300 m) were influenced by topographic features and that migrants did not follow a broadfront pattern. Rather, Williams et al. (2001) argued that migrants follow paths parallel to the ridgelines, which may make them more vulnerable to towers and other objects placed on mountaintop ridges. Other data support broadfront migration patterns of nocturnal migrants (Canterbury unpubl. data; Young et al. 2004, Mabee et al. 2004). A substantial amount of data suggests that the Appalachians ridges are used by millions of nocturnal migratory birds each year, and development of ridges and mountaintops will remain a major concern. The Southern Appalachians represent the largest contiguous mountainous forest in the Eastern U.S. and contain some of the most diverse habitats.

Yet, researchers remain unclear as to whether placement of wind turbines on mountaintop ridges will cause substantial avian mortalities.

In general, impacts on avian populations, including raptor and passerine migrations, appear to be low at most modern wind sites and few to no mortalities have been reported (Kerlinger 2002; Resolve Inc., 2004). Yet, the debate over the potential impacts continues in the Appalachians and Eastern North America, where wind technology and any potential negative impacts remain relatively new to the ecology of the region. Some recent studies in the Appalachians include work on the Backbone Mountain Mountaineer Wind Energy project in Tucker County, West Virginia to assess bat and bird mortalities (Kerlinger 2000), Canterbury (2002), Young et al. (2004), and on-going studies and proposed wind farm projects, such as Liberty Gap/ Jack Mountain Wind Farm in Pendleton County, West Virginia. US Wind Force, LLC list six projects on their web site with proposed wind projects in Maryland, Pennsylvania, and West Virginia (http://www.uswindforce.com).

There has been several previous studies in the proposed project area. Michael (1994) conducted an environmental assessment and wildlife impact study. Lipton and White (1995) provided a fall 1994 raptor migration study in conjunction with HawkWatch International. Both these studies are excellent and detailed, but now outdated. Both studies, however, utilized the same fall dataset for migrant raptors.

Beech Ridge Energy, LLC is developing a wind project on the MeadWestvaco property located near the town of Rupert, West Virginia in Greenbrier County. The proposed project area is approximately four miles northeast of Rupert. In order to assess the potential impacts of site development and the effects of wind turbines on bird populations the following studies were conducted during the 2005 spring and fall migration period: (1) avian relative abundance and bird-habitat associations, (2) woodcock and nocturnal bird survey, (3) assessment of endangered and threatened bird species and species of high conservation concern such as Golden-winged and Cerulean warblers, (4) a raptor study, and (5) a fall banding study. The design and execution of these avian studies follow from those documented in the literature (e.g., Bibby et al. 1992; Canterbury 2002, Canterbury et al. 2002; Young et al. 2004). Both diurnal and nocturnal studies were employed and both diurnal and noctural studies provide valuable information on bird populations and for studying potential risks to avian populations due to wind farms. No radar study was conducted for this environmental assessment, but I relied on conclusions drawn form the Mabee et al. (2004) study at Mount Storm and other studies. Radar was not a necessary part of the study plan, and is an expensive assessment method that has not often yielded data above and beyond the standard avian census techniques (see Bibby et al. 2002). Radar studies have not been that informative at some wind projects and have provided data that is often difficult to interpret (e.g., data on flight heights, migration pattern, species composition, etc.; see Cooper and Mabee 2000; Mabee et al. 2004). In the present study, nocturnal bird surveys along with flight call studies were performed to assess nocturnal migration through the proposed project area. Further, Cooper (2004) recommended to improve wind-bird radar studies by collecting concurrent radar and mortality data to determine the relationship between numbers of migrants in the zone of exposure and mortality. Also needed are behavioral studies (to detect the proportion of migrants that detect and avoid turbines) and studies that develop common or comparable metrics to facilitate comparisons among radar studies (Cooper 2004). Finally, radar studies are currently outside the expertise of the author of this report.

This report contains information and data from all avian studies conducted on the proposed project site. Special attention was made to assess vulnerable species, such as the Golden-winged Warbler (see the Public Service Commission requirements outlined for the NedPower Mount Storm project, Young et al. 2004), raptors, flight characteristics, and nocturnal species.

Objectives of this Phase I Environmental Assessment

The principal goals of these studies outlined in this report were to (1) provide avian spring and fall migration studies that would evaluate the potential risks and impacts posed by wind project development, and (2) conduct a detailed phase I avian assessment. The purpose of a phase I avian assessment is to provide recommendations and information that would help in the project development, minimize impacts, and conform to industry and literature standards, as well as meet Public Service Commission, U.S. Fish and Wildlife Service, and West Virginia Division of Natural Resources standards and requirements. In addition, the results of this study are compared to that of Young et al. (2004) and to previous studies conducted on the proposed project site. Previous studies consist of a baseline avian and wildlife impact study (Michael 1994) and a fall raptor migration study (Lipton and White 1995).

Specific objectives include (1) assessment of spring and fall migrant and resident bird use at the proposed project site, (2) quantification of species composition and bird-habitat associations, and (3) documenting potential risks to bird populations due to wind project development and documenting federally listed species and species of concern in the proposed project area.

The study plan (e.g., fixed-point count grid) was designed to address questions about bird use of the site that could be used in impact assessments and to aid in wind plant design. Impacts assessments can rely on avian use, relative exposure, vegetation types, and other factors, as well as comparison to other sites and studies (Johnson et al. 2002). Information from this avian study can be used to evaluate turbine placement, to provide measures to minimize risks to avian populations, and can lead to additional studies and recommendations (such as nesting ecology and mircohabitat analyses, post-construction mortality studies, and long-term monitoring).

STUDY AREA

The MeadWestvaco wind power site is located about four miles northeast of Rupert in Greenbrier County, West Virginia (Figure 1), and the proposed project site includes the area from about two miles east of Quinwood and along the border of Greenbrier and Nicholas counties and extending eastward to Old Field Mountain and southward to about two miles of Anjean (Curry and Kerlinger 2004). The proposed project site is primarily located along Beech Ridge and is north of Williamsburg and south of Richwood (Figure 1), and described by Michael (1994), Lipton and White (1995) and Curry and Kerlinger (2004).

The project (study) area is within the Allegheny Plateau Physiographic Province and near the southern edge of the Allegheny Mountains Physiographic Province. The project area is about the same as that proposed by Kenetech Windpower, Inc. and outlined in the Michael (1994) and Lipton and White (1995) study and comprises about 200 km^2 (75 $mile^2$) area (Lipton and White 1995).

Beech Ridge is a prominent feature of the proposed project area and bisects the project area on a northwest to southeast line for 13.5 km (Lipton and White 1995). Michael (1994) provided a map of the study area with access roads. The habitats and description of the project (study) area remain relatively similar to that noted by Michael (1994) and Lipton and White (1995), except for additional clear-cuts and advancing succession of forest clear-cut areas that were logged 10 or more years ago. The typical forest type of the area is a beech-maple-cherry dominated forest. The proposed project area is mainly used for timber harvests. The forest land is a combination of mixed deciduous and northern hardwood with some pine plantations and the study area is listed by Buckelew and Hall (1994) as Appalachian oak. Apparently, a beech, maple, cherry dominated forest takes over after logging in many of the Appalachian oak forests of the region.

Traditionally, the project area land use has been hardwood timber production and coal mining. Much of the area was timbered in the 1910-1950 period, which resulted in extensive clearcut areas (Michael 1994). The forest of the proposed project area is now typically harvested in clearcut units of approximately 16 ha in size (Michael 1994). Most of the strip mine areas were reclaimed into grassland and harbor sediment control areas, which make up most of the wetlands in the area. These are temporary structures that gradually fill-in through succession, and the project area harbors relatively few natural wetlands. The landscape of the proposed project area is typically rugged, mountainous terrain with steep slopes. The proposed project area consists of high altitude plateaus and rugged peaks. The elevation of the proposed project area ranges from 920 m (2944 ft) to 1312 m (4200 ft). Tributaries and downslope along the watersheds generally range from 844 m (2700 ft) to 1031 m (3300 ft). Most of the bird sampling points (see below) were placed at elevations of 1000 m (3200 ft) to1312 m (4200 ft), which were typical of most of the access roads and proposed locations of turbines.

Dominant tree species include American beech (Fagus *grandifolia*), sugar maple (*Acer saccharum*), tulip poplar (*Liriodendron tulipfera*), black cherry (*Prunus serotina*), yellow birch (*Betula lutea*), red oak (*Quercus rubra*), and cucumber tree (*Magnolia acuminata*) as reported by Michael (1994). Striped maple (*Acer pensylvanicum*), mountain maple (*Acer spicatum*), and mountain laurel (*Kalmia latifolia*) are dominant in the understory. The shrub, herbaceous and ground layers consist of elderberry (*Sambucus* spp.), blackberry (*Rubus* spp.), greenbrier (*Smilax rotundifolia*), stinging nettle (*Urtica dioica*), jewelweed (*Impatiens pallida*), goldenrods (*Solidago* spp.), and numerous fern species. The reclaimed and unreclaimed mine areas contain mainly grasses, vetch (*Vicia* spp.), clover (*Trifolium* spp.) and some *Lespedeza* spp., along with black locusts (*Robinia pseudo-acacia*) and pines (*Pinus* spp.). These habitat descriptions are like those provided by Michael (1994) and Lipton and White (1995).

METHODS

The primary studies included a diurnal use survey that employed fixed-point surveys and transect surveys, a raptor study, nocturnal bird survey, and a study of Golden-winged and Cerulean warblers. A mist-netting and banding study was also conducted during the fall surveys. Methods follow standard avian techniques (Bibby et al. 1992; Ralph et al. 1993).

Selection of Sampling Points & Fixed-Point Surveys

Fixed-point surveys have been used to assess bird populations during migration (Bibby et al. 1992, Ralph et al. 1993, 1995). Fixed-points for bird sampling were selected systematically to survey a spatially representative sample of topography and vegetation types in the study area, and placement was based on availability of habitat and proximity to potential turbine locations (as plotted on a topological map). Fixed-points were GPS referenced and placed at least 250 m apart. Point counts were established so that all habitats (e.g., young and mature forests, clearcut areas, pole succession, roadsides, dense forest, reclaimed minelands, marshes and wet areas, and brushy areas) were sampled. A total of 100 fixed-radius (50 m) sampling points (Figure 2) were established and methods of data collection follow standard avian censuses techniques and previous studies (Bibby et al. 1992; Ralph et al. 1993).

Data were collected daily at the fixed-points, unless heavy rain prevented data collection. Data were collected from May 10 - June 20, 2005 and from August 23 - November 15, 2005. Data were collected twice weekly in the morning (starting shortly before or after daybreak at generally at 05:34 AM in the spring and lasting until noon) and afternoon (1500 to 2000 hr. and until dusk) at each sampling point. In the fall, data collection generally started at 0700 hr. and ended at dusk, and, thus, was dependent upon amount of daylight hours and changed with daylight savings time. Some point counts were conducted as early as 0500 hr. in the early part of the fall season. The morning period was considered from 30 minutes before sunrise to approximately three hours after sunrise and the evening survey period was considered to range from three hours before sunset to 30 minutes after sunset (Young et al. 2004).

Point counts were divided into groups or clusters based access (roads vs. walking) and location, and observers were randomly assigned to point count routes, as well as randomizing each day's start location. The survey points were divided into sets including 7-12 points depending on location for assignment of point count routes to field observers. The starting point within a route (block of points) were randomized so that the start time for a given point varied across the spring season. Point counts were 10-min. duration at each sampling location.

Standardized wind farm data sheets and point count data sheets were used, and observers were highly experience with identifying Eastern N.A. birds by sight and sound (see below) and with conducting point-count surveys. Start and end time was recorded for each survey, along with weather data such as temperature, wind speed, wind direction, cloud cover and precipitation. Birds were identified to species, number of individuals recorded, and aged and sexed when possible. Observers also recorded flight height and direction (if the bird was seen flying) and behavior (e.g., singing, perched, feeding young, on-territory, etc.). Vegetation at each fixed-point was quantified with the James and Shugart (1970) method described below.

The purpose of diurnal avian use surveys and methods such as avian point counts was to estimate the spatial and temporal use by birds at the site and which migrants use the area. Raptors, other large birds, and any bird species and large flocks not observed on a fixed-point, but observed between points were recorded and coded as in-transient observations and recorded on an incidental data sheet. Surveys took place throughout the daytime period and during all climatic conditions (observers even tried to collect data in heavy rain) to ensure adequate coverage and to meet any impeding permit requirements (Public Service Commission).

Transect Surveys

Five 500-m transects were placed parallel along the ridges and projected turbine locations and observers counted all birds seen and heard during daily counts from June 16th - 20th. From transect data, the relative abundance of resident birds was tallied and compared to Michael (1994). Transects are a common method to assess bird populations and techniques are reported in Ralph et al. (1993). Observers spent time searching and trying to flush woodcocks in suitable clearcut and pole successional habitats during transect surveys and while setting up the transects in May (n = 5 days).

Raptor Surveys

Broadcast call surveys are an effective method to sample raptor populations during the breeding season (McLeod and Anderson 1998). Broadcast call surveys were conducted from sunrise to 1300 hour at the 100 fixed-point survey localities from May

10 - June 15, 2005. Fixed-point survey locations were visited in a random order by surveying one out of every 5th point along a route until 50 of the points had been surveyed with the broadcast call method. Thirty-two additional points were surveyed without broadcast calls by having a field observer stationed for one-hour at the point and recording all raptors seen or heard, especially soaring and perched raptors. The one-hour observation periods were conducted in both morning (daybreak until noon) and afternoon hours (1300 to 1800 hours). Observational roadside surveys are a common method to assess relative abundance and flight behavior of raptors, which often use road edges for hunting (see citations within Bunn et al. 1995).

Broadcast call methods were similar to those described below for the nocturnal bird survey, except six calls were used in the raptor survey. The six vocalizations alternated between Great Horned Owl and Red-shouldered Hawk calls, because many raptor species are attracted to their vocalizations (Mosher and Fuller 1996; McLeod and Anderson 1998). The six calls were broadcasted for a 20-second duration at one minute intervals (20 seconds of vocalization, followed by a 40 second listening period), leaving a final listening period of four minutes and 40 seconds (and thus making a total of 10 minutes). Frequencies of detection (number/hr.) were calculated, and field observers spent time searching for nest in a 1-ha. area in the vicinity of a raptor response to broadcasted calls.

During the fall, broadcast surveys followed the spring methods and were conducted from September 1 - November 12, 2005. Like the spring surveys, a total of 50 broadcast surveys were performed. In addition, 100 hours of stationary observations were performed at eight localities (Beech Knob, Big Ridge, Cold Knob, Craters, Grassy Knob, Job Knob, Nunly Mountain, and Old Field Mountain) with 12.5 hr. at each site. Sites were selected based on logistics and those used in the Michael (1994) and the Lipton and White (1995) studies. The stationary raptor counts or observations were like those reported in previous studies and standard raptor observatory methods in the literature.

Weather Data

Weather data (temperature, precipitation, cloud cover, wind speed, etc.) were recorded with standard measures (e.g., maximum-minimum field thermometer, rain gauge, wind meters, etc.) used on site. Methods follow from standard avian census techniques (Bibby et al. 1992, Ralph et al. 1993). Surveys were conducted in all types of weather, except heavy rain on 13 days prevented data collection (e.g., which occurred on May 31 - June 2, June 8-9, 2005, and a few days in the fall). Data were collected on some days with constant rain, dense fog, and high winds (> 25 mph) and during days of cool, spring temperatures to observe the effects of weather on local bird populations and whether adverse weather conditions could potentially increase mortalities from turbine collisions (behavior and activity and flight changes due to weather conditions; Johnson et al. 2002).

Vegetation Sampling

Habitat features at each fixed-point location were quantified by measuring and identifying plants (Strausbaugh and Core 1977) and other habitat variables in June 2005. The James and Shugart (1970) circular-plot method of 0.04 ha. was utilized at each fixed-point locality. Tree diameter (dbh in cm), number and diameter of dead snags, canopy height, aspect, percent slope, percent forest cover and ground cover were measured using an ocular tube. Ground cover categories are described in James and Shugart (1970). Canopy height and percent slope were recorded with a clinometer. Elevation was recorded with a GPS unit and verified from mapping fixed-point locations on a topological map, and aspect was recorded with a compass. Vegetation sampling methods are described in James and Shugart (1970), Ralph et al. (1993), and Canterbury et al. (2002).

Woodcock and Nocturnal Bird Surveys

Nightjars (goatsuckers. e.g., Whip-poor-wills), owls, and other nocturnal bird species are some of the least studied groups of birds in North America. Methods employed a 10-minute point count and broadcast call surveys at many of the 100 diurnal fixed-point survey locations along the road access areas. The 10-minute broadcast surveys consisted of five minutes of broadcasting vocalizations and five minutes of observation/listening time. Calls that were played consisted of owl species (Eastern Screech-Owl and Great Horned, Barred, Barn, and Northern Saw-whet owls), along with calls of the Whip-poor-will and bitterns and rails. Calls were broadcasted at a volume of about 110 db at 1-m from the microphone speaker and the speaker was placed about 1.5 m above the ground and rotated 120E between the broadcasts.

The purpose of the nocturnal bird survey was to determine the absence/presence of species within the proposed project area, as well as relative abundance of nocturnal bird species. In the fall, the acoustic monitoring methods of Evans and Rosenberg (1999) were utilized to assess the number of nocturnal migrants moving across the proposed project area. The nocturnal surveys showed that some species (e.g., Barn Owl, American Bittern, etc.) did not occur in the project area (see Results below).

Golden-winged and Cerulean Warblers Surveys

The Golden-winged and Cerulean warblers are species that have experienced highly significant and long-term population declines in eastern North America and are in need of immediate conservation action (Rich et al. 2004). Both species have been evaluated for potential listing under the Endangered Species Act (ESA, 1973). Both species are also considered “umbrella” focal species of the Appalachians, where the Golden-winged Warbler occupies areas of early succession and the Cerulean Warbler occurring in mature deciduous forests.

Methods used to survey for these two vulnerable species are outlined in Shapiro et al. (2004) and require broadcast of each species songs at fixed-point survey locations. Song-playback methods followed those used in the Golden-winged Warbler Atlas Project (GOWAP) and the Cerulean Warbler Atlas Project for Private Lands (CEWAPPL) of the Cornell Laboratory of Ornithology. Song-playback and GOWAP and CEWAPPL protocols involve fixed counts (e.g., 3-10 minute duration), where observers alternate listening (without playing songs/calls) and broadcasting both species songs. If territorial males are present, they will respond to their species-specific song by coming to the "intruding male song" (broadcast call) in an attempt to defend their territory. The purpose of the Golden-winged and Cerulean warblers survey was to document numbers and breeding localities for these species within the proposed wind farm project area. Golden-winged and Cerulean warblers were assessed with fixed-point count surveys (see above), GOWAP and CEWAPPL roadside methods with call-playback that elicits responses from territorial males, and observational data. The observational surveys required an assessment of the overall study area for examination of potential breeding habitat for the two species. Fixed-point count localities and other potential suitable habitat areas were sampled for singing, territorial males with the GOWAP and CEWAPPL protocols, and territories mapped with spot-mapping (Bibby et al. 1992).

Although, no Cerulean Warblers were found in the proposed project area (see Results below), habitat features of Golden-winged Warblers were quantified (Canterbury et al. 2002), and followed the vegetation sampling noted above. It was the intent of these specialized studies on these two highly vulnerable species to plot breeding locations, determine vegetation characteristics of territories, and to measure linear distance to the nearest potential turbine locations. All Golden-winged Warbler sampling localities were geographically referenced with GPS units and plotted on a topographic map.

Habitat assessments and vegetation sampling of Golden-winged Warbler territories (and same would have been done for Cerulean Warblers if the species was present) were quantified by measuring and identifying plants and landscape variables at the end of the spring study as described above (see Vegetation Sampling).

Mist-Netting and Banding Data

One of the most effective ways to assess relative abundance and species composition for birds at localized study sites is to couple count data with banding data. Banding data often discloses species and numbers of birds not revealed by counts, and vice versa (Canterbury et al. 2002). Some species are secretive and may go undetected during counts and are picked up during mist-netting activities, or remain too high in the canopy and are only detected visually or with auditory methods.

Mist-netting and banding data were collected to compare the abundance and species composition (of mostly woodpeckers and passerines) at the proposed project site to a key migratory area in southern West Virginia, namely the Three Rivers Migration Observatory (TRMO) in Raleigh County. Mist-netting and banding data have been collected annually at TRMO since 1995 and published frequently in *The Redstart*, which now like for the Allegheny Front Migration Observatory (AFMO), there is relatively good precision on the relative abundance and species composition of migrants coming through the area. The TRMO site is in the Allegheny Plateau and with mist nets placed at elevations of 2400 (750 m) - 2600 ft. (812 m) in old fields and along an upland mixed-deciduous forest and areas with clearcuts (age 7-9 years).

Licensed banders with 12 years of banding experience from the Southern West Virginia Bird Research Center ran from 10 - 15 mist nets/day at road access areas (Beech Ridge, Pole Road, Grassy Knob, Cold Knob, Old Field and Nunly Mountains) to survey the migrants coming through the area. Banding was carried out on 40 days within the proposed project site, but was curtailed on 12 days due to high wind and/or rain. The capture and banding of birds followed standardized banding protocols and methods used at TRMO (see Canterbury et al. 2005, for example). Birds were identified, aged, and sexed according to standard protocols (Pyle 1997).

Data Compilation and Storage

Standardized data sheets were used on all surveys and acoustic methods employed in this study. An electronic database (Excel) was created to store, retrieve, organize, and analyze the data. Data from field sheets were entered into a spreadsheet using a pre-defined format. All data forms, field notebooks, and electronic files are available from the Southern West Virginia Bird Research Center and retained for subsequent queries and analyses. Data were entered into electronic files by qualified technicians. Raw data sheets were compared with computer files for errors. Irregularities and potential errors were discussed with field observers and corrected where appropriate. Errors in data entries were traced back to original field data sheets and appropriate changes in all steps made. Field observers were required to check accuracy and completeness of data forms, and any changes (e.g., correction of a species identifying code) were documented for future reference and initialed and dated by the person making the change.

Quality Control

The field data collection was carried out by the author of this report and field technicians from the Southern West Virginia Bird Research Center (SWVBRC), who have 19 years of research and field ecology experience. Further, the author of this report served as Principal Investigator (PI) for the avian studies and directed all phases of the research on the project, including examining the data for completeness, accuracy, and legibility. The PI was in the field 40 days this spring and 69 days during fall conducting the research, and all field technicians have extensive experience with identifying eastern U.S. birds by song and plumage. The SWVBRC staff and the PI were responsible for the data collection in the Mount Storm Wind Power Project, Grant County, West Virginia (Young et al. 2004).

The PI and his staff at the SWVBRC have published widely on Appalachian and West Virginia bird populations, conducted numerous environmental impact and assessment studies such as on wind farms, road development, mountaintop removal and valley-fill mining, and suburban sprawl. The SWVBRC staff founded the Three Rivers Migration Observatory and have extensive experience with migratory birds, as well as conducting avian point counts, training birders, and breeding bird surveys.

The PI is a national expert on Golden-winged and Cerulean warblers, a member of the Golden-winged and Cerulean Working Groups, and Telecommunication Towers Working Group. The PI is a member of Partners In Flight, former Editor of the *Proceedings of West Virginia Academy of Science*, and has worked on numerous avian conservation projects, including the Important Bird Areas program of the National Audubon Society.

Quality assurance and control measures were implemented at all stages of the study, including field data collection, data entry and analysis, and report writing. Readers may contact the author of this report for staff resumes of SWVBRC personnel.

Statistical Analyses, Data Presentation, and Products

All sampling point localities were downloaded from hand-held GPS units into Garmin MapSource Version 3.0 software and plotted. Figures were created with SigmaPlot 5.0 and analyzed (e.g., ANOVA) with SPSS, Version 13.0. Statistics reported included (1) species lists, (2) relative use by species, species groups, observation location and time of day and habitat, (3) species composition and mean frequency of occurrence, (4) relative abundance (use) by species and avian groups, (5) flight characteristics (e.g., height) by species and avian groups, (6) percent vegetation cover, and (7) location of vulnerable species such as the Red-shouldered Hawk and Golden-winged Warbler.

Data were standardized for variation in location and time by calculating an estimated mean use (number of observations per 10-minute survey). The frequency of occurrence by a species was calculated as the percent of surveys in which the species occurred. Mean use divided by total use of all species and expressed as a percent was used as a measure of species composition. Frequency of occurrence and percent composition provided relative estimates of avian diversity for the project area. A species may have high use estimates for the site due to the presence of large flocks, but the frequency of occurrence may indicate few observations on the data forms, and, thus, less risk exposure risk from the project, for example. Data were plotted to illustrate site use by habitat, species groups, time of day, and weather. The product produced is this technical report that provides a Phase I Study and avian assessment for the proposed project area, and adhering to standards and requirements of regulatory agencies.

RESULTS AND DISCUSSION

Species Composition (Methods Pooled)

Birds observed in the project area are listed in American Ornithologists' Union (AOU) order (AOU 2006). Table 1 shows the common (vernacular) and scientific names of each species observed. The only federally threatened or endangered bird species observed in the project area was the Bald Eagle (n = three individuals seen during fall migration). Twenty-two species of concern (those with an asterisk in Table 1) in West Virginia were noted in the proposed project area during the study. Curry and Kerlinger (2004) provided an overview of species tracked by the West Virginia Division of Natural Resources' Wildlife Diversity Program (WVDNR), the criteria used to rank species, and estimated (based on breeding bird survey, Christmas bird counts, and other available data) their occurrence in the proposed project area. Michael (1994) also provided an analysis of federally threatened and endangered species and species of concern in the proposed project area. The only endangered or threatened avian species noted by Michael (1994) was a single Bald Eagle observed flying past Cold Knob in October 1994. Three Bald Eagles were observed during the fall raptor survey of the present study. Thirty-three Bald Eagles were observed during raptor counts along Peters Mountain, Monroe County this fall (see hangingrocktower.org). The Hanging Rock Raptor Observatory located on Peters Mountain and used for recording fall raptor migration is near the proposed project area and raptor migration count data has been recorded at this site since 1952.

A total of 124 bird species were observed during the study (Table 1). Observers confirmed 100 species during the spring study and 121 species during the fall survey. Of the 100 species observed during the spring in the project area, all but seven (Table 2) probably bred (reproduced) in the study area as determined with the presence of territorial, singing males well into mid-June for breeders. The Wood Duck, Whip-poor-will, and the Eastern Kingbird were observed during the spring, but not during the fall study. There were twenty-four species observed in the fall that were not observed during the spring in the proposed project area (Table 3). These differences are likely due to the increased observer coverage in the fall and the spring study considered only the second-half of the spring season (May and June, while no data was collected in March and April due to logistics).

Differences in the number of species in the spring and fall are also likely due to differences in weather patterns and food supply and other environmental conditions, and the fact that many migratory species are more dispersed in the spring than the fall. In general, flocking of large migratory flocks is also more noticeable in the fall than in the spring along Appalachian ridges. Further, spring migration tends to occur over a relatively shorter time period, where birds are typically motivated to arrive on breeding grounds. For example, the peak migration period for the Magnolia Warbler in West Virginia is the second half of May, and birds are typically observed from May 1 - May 31st, but a few stragglers remain into early June. However, Magnolia Warbler fall

migration starts as early as the third week in August and continues until the third week of October. The density also varies (generally higher in the fall than in the spring), and like with many species may depend upon annual reproductive success and post-breeding dispersal. Density is affected by the fact that migratory birds (especially passerines) are more dispersed in the spring, but more localized and site-concentrated in the fall. The Appalachian ridges are known to be highly important areas for migratory species, especially passerines and raptors, and may harbor millions of birds per year. Therefore, the identification of areas with high concentrations of migrants will be important in the conclusions drawn for wind site development and turbine locations.
Finally, banding was used in the fall study and field assistants and I captured several species not observed on point counts, where birds are recorded by sight and sound.

Fixed-Point Surveys

Surveys were conducted at each fixed-point count station approximately twice each week between May 10 - June 20 and from August 23 - November 15, 2005. Data were collected daily at the proposed project area, unless it was too windy or heavy rain prevented data collection. Field observers attempted to collect data during most days of adverse weather condition (high wind gusts and steady, heavy rain) for up to three hours during these conditions, but then were forced to abandon collection due to adverse weather.

During the spring study (May 10 - June 20), a total of 1,925 10-minute point count surveys were conducted, while field observers tallied 3,395 counts during the fall (August 23 - November 15) study period. Observers tallied 93 species and three unidentified warblers during the fixed-point surveys in the spring (Table 4). Seven additional species (making the total of 100 species referenced above) were observed during driving or walking between points or during other spring survey methods (raptor broadcast calls, Golden-winged Warbler study, nocturnal bird survey, etc., see methods). During the spring, a total of 5,781 observations of 4,389 different groups were recorded (a "group" is defined as an observation of a species of bird regardless of number seen. For example, a flock of six Brown-headed Cowbirds observed together is considered a group as well as an individual cowbird observed by itself). Some counts are likely to duplicate sightings of individuals, but this was most likely minimized by territorial behavior and points located 250 m apart.

In the fall, observers tallied 108 species on fixed-point counts, along with 9 unidentified birds. The unidentified birds included four warblers, one sparrow, and four hawks (Table 4). Thirteen additional species were observed during driving or walking between points or during other fall survey methods (raptor survey, nocturnal bird survey, and banding; see methods). During the fall point counts, a total of 15,386 observations of 5,813 different groups were recorded. In total (spring and fall), observers tallied 21,167 observations of 10,202 different groups (Table 4).

Passerines were the most numerous group observed and comprised 84.9 percent of all groups observed and 86.4 percent of the total birds observed during fixed-point surveys. In the spring, passerines comprised 89.3 percent of all groups observed and 87.3 percent of the total birds observed during fixed-point surveys. In the fall, passerines comprised 81.6 percent of all groups observed and 79.6 percent of the total birds observed during fixed-point surveys.

No waterbirds (e.g., bitterns, herons, grebes), shorebirds (e.g., snipe, killdeer, plovers, and sandpipers), and rails and coots (e.g., American Coot and Sora) were observed in the MeadWestvaco Wind project area, except the American Woodcock (a shorebird of old fields). Six Ospreys and a single Bald Eagle and Golden Eagle were seen soaring past the ridges during the fall migration point counts. Both eagles were observed at Grassy Knob. Half of the Ospreys were noted flying by Grassy Knob. All the Ospreys and both eagles were in south or southwest fall migration flight. During the present study, two additional Ospreys, three Golden Eagles and two Bald Eagles were tallied during a fall raptor study in the proposed project area (see below). In comparison, 77 Ospreys, 33 Bald and 14 Golden eagles were recorded this fall at Hanging Rock Raptor Observatory on Peters Mountain, Monroe County, West Virginia (http://hangingrocktower.org). Seven Golden and one Bald Eagle were reported by Lipton and White (1995) during a fall raptor migration study in the proposed project area, and Lipton and White (1995) tallied 974 individual raptors that comprised 14 species.

During the spring, the most numerous (total counted) species observed on the fixed-point surveys were the Red-eyed Vireo, American Crow, Turkey Vulture, American Robin, Yellow-rumped Warbler (migrant through the area), and Blue Jay (Table 4). The most numerous hawk observed on the fixed-point spring surveys was the Sharp-shinned Hawk, and raptors comprised 6.3 percent of all birds observed on the fixed-point surveys during the spring. The Downy Woodpecker and Northern Flicker were the most numerous woodpeckers observed during the spring (Table 4). The most numerous resident warblers were the Chestnut-sided Warbler, Black-throated Green Warbler, and Ovenbird (Table 4). The most numerous flycatcher in the spring was the Eastern Wood-Pewee (Table 4). The only blackbirds observed during the spring were Red-winged Blackbirds and Brown-headed Cowbirds. Upland gamebirds, doves, cuckoos, swifts, and hummingbirds comprised only 2.9 percent of the total birds observed during the fixed-point spring surveys, while woodpeckers comprised 3.3 percent.

During the fixed-point fall surveys, the five most numerous species were the European Starling, Blue Jay, Common Grackle, Turkey Vulture, and Cedar Waxwing (Table 4). The Broad-winged Hawk was the most numerous hawk observed during the fixed-point fall surveys. The Eastern Phoebe was the most numerous flycatcher during the fall (Table 4). The most numerous woodpecker recorded during fixed-point fall surveys was the Northern Flicker, while the most numerous thrushes were the American Robin and Gray-cheeked Thrush. Other numerous species noted on fixed-point fall surveys were the American Crow, Dark-eyed Junco, Chipping Sparrow, Cape May Warbler, Eastern Towhee, American Goldfinch, and the Black-capped Chickadee (Table 4).

Raptors comprised 9.0 percent of the total birds observed during the fixed-point fall surveys, while the most numerous passerine group was the grassland birds and sparrows. Warblers comprised 9.9 percent of all birds observed and thrushes made up 8.4 percent of the birds observed during fixed-point fall surveys. Warblers and thrushes made up 21.3 percent of all passerines observed during the fall.

The Wood Duck, Whip-poor-will, Eastern Kingbird, Golden-winged Warbler, Prairie Warbler, and Kentucky Warbler were observed on spring fixed-point counts, but not on the fall fixed-point counts. Some of these species, however, were captured and banded during the fall (see below).

Avian Use

Avian use, frequency of occurrence, and species composition were calculated to standardize the data for comparison between points, time of day, and with other studies (Young et al. 2004). For observations within 50 m of fixed-point surveys, avian use was calculated as the mean number of observations per 10-minute survey (Table 5). Like Young et al. (2004), references to abundance in the following discussion refer to estimates of use and not absolute density or number of individuals.

Based on use, the five most abundant species in the study area during the spring were the Red-eyed Vireo (0.26 detections/10-minute survey), American Crow (0.23 detections/survey), Yellow-rumped Warbler (0.20 detections/survey), American Robin (0.18 detections/ survey), and the Dark-eyed Junco (0.15 detections/survey). Together these five species comprised 1,327 individuals of the total 5,781 or 23 percent of all diurnal bird use recorded during the spring 2005 season.

The number of observations for most species observed was insufficient to draw strong statistical inference about the use of the site, which was similar to that found at Mount Storm (Young et al. 2004). Based on use estimates, passerines, raptors, and woodpeckers were the most abundant groups observed per 10-minute survey in the spring 2005 season (Table 5). Like in Young et al. (2004), birds were groups based on taxonomic order and ecological niche affinities, and the passerine subgroup with the highest use in the spring was the warbler subgroup. This was followed by sparrows and grassland birds, thrushes, corvids, and vireos (Table 5).

Based on fall use, the five most abundant species in the study area during the fall were the European Starling (0.89 detections/10-minute survey), Blue Jay (0.36 detections/ survey), Common Grackle (0.30 detections/survey), Turkey Vulture (0.24 detections/ survey), and the Cedar Waxwing (0.21 detections/survey). Together these five species comprised 6,533 individuals of the total 15,386 or 42 percent of all diurnal bird use recorded during the fall 2005 season. Overall use (spring and fall data combined) was highest for the European Starling and Blue Jay (Table 5). Overall use for passerines was 3.47 detections/survey and 0.35 detections/survey for raptors. Excluding starlings, grassland/sparrow birds had the highest passerine subgroup use (Table 5). Overall, the Black-throated Green Warbler had the highest use of any warbler, while the Dark-eyed Junco had the highest use for the grassland/sparrow group.

Percent Composition and Frequency of Occurrence

Species composition for fixed-point surveys is represented by the mean use for a species divided by the total use of all species and multiplied by 100 to provide a percent composition (Table 6; Young et al. 2005). No species had more than 16 percent frequency of occurrence in the spring (Table 6). The Red-eyed Vireo had the highest with 15.5 percent. This was followed by the American Crow (10.4 percent), Blue Jay (8.3 percent), American Robin (8.0 percent), Black-capped Chickadee (6.9 percent), Dark-eyed Junco (6.7 percent), Black-throated Green Warbler (6.3 percent), and Blue-headed Vireo (6.2 percent). All the remaining species were observed in less than 6 percent of the spring fixed-point surveys.

As a group, and due in part to the number of species and to the abundance of several common species, passerines comprised 89.5 percent of the spring avian use and were observed in 97.4 percent of the fixed-point count surveys. Raptors comprised 4.3 percent of the spring use, while woodpeckers comprised 3.3 percent. The remaining groups collectively comprised less than 3 percent of the avian use.

The Blue Jay had the highest percent frequency of occurrence in the fall with 23.4 percent (Table 6). This was followed by the Broad-winged Hawk (8.8 percent), American Crow (8.1 percent), Dark-eyed Junco (7.7 percent), Turkey Vulture (7.5 percent), Gray-cheeked Thrush (5.5 percent), and Eastern Phoebe (5.4 percent). Overall (spring and fall combined), the Blue Jay with 17.9 percent frequency of occurrence and the Red-eyed Vireo with 9.0 percent frequency of occurrence were the highest.

Passerines comprised 85.4 percent of the fall avian use and were observed 93.7 percent of the fixed-point count surveys. Raptors comprised 9.7 percent of the fall use. Overall (spring and fall used combined), passerines comprised 96 percent of the avian use at the site.

Flight Height Characteristics

For all birds observed during the spring fixed-point surveys, approximately 29 percent were of birds flying. In about 71 percent of the cases, birds were detected auditorily only and were assumed to be birds perched, foraging, and/or moving through the vegetation and not in a direct flight path or flying overhead. The proportion of observations of a bird species flying at heights that correspond with the rotor swept area of the turbines provides a rough estimate of the risk of collision for the species (Young et al. 2004). The "zone of risk" can be calculated based on turbine size, rotor diameter, and space occupied by turbine blades. Using a typical modern turbine and spatial parameters (e.g., 1.5 to 2.0 megawatt size turbines, rotor diameters of 70 to 80 meters and space occupied by turbine blades of 30 to 110 m), Young et al. (2004) calculated a "zone of risk" that would include an area from approximately 25 m to 115 m agl. This calculation also considered an estimated distance between the ground and the tip of the blade when pointing downward.

Flight characteristics data collected during the spring are summarized in Table 7. Most of the passerines observed flying, with the exception of corvids, starlings, waxwings, and finches, were often observed flying below 25 m and outside the "zone of risk". About 25.6 percent of the passerines observed were in flight and only about 32 percent of these were within the risk zone (Table 7). Larger birds such as waterfowl and raptors were observed flying at or slightly above the "zone of risk", but some species such as vultures have been noted to generally avoid the turbines and avoid collisions (Young et al. 2004). For raptors as a group, 79 percent were observed flying within the "zone of risk" during the spring (Table 7). Overall, 40 percent of the birds observed in flight were noted within the "zone of risk" (Table 7) during the spring.

In contrast to the spring, nearly 60 percent of the birds observed during the fall were in flight (Table 8). There were generally passerines observed coming over the ridges in south-board flight or soaring migrant raptors. Of the birds in flight during the fall study, 67 percent were in the "zone of risk" (Table 8). Ninety-three percent of fall raptors observed were in flight and 84 percent of these were within the "zone of risk" (Table 8). In consideration of fall population numbers, the raptors at highest risk appear to be vultures (but see below), Sharp-shinned Hawks, and Broad-winged Hawks.

Sixty-four percent of the passerines in flight during the fall were observed with the "zone of risk." However, these were generally large migratory flights of corvids, starlings, and grackles. If excluding these groups, only 27 percent of the birds observed during the fall were in flight and only 28 percent of these were within the "zone of risk." During the fall, corvids, starlings, waxwings, blackbirds, and finches appear at greater risk than other passerine subgroups (Table 8). About 39 percent of the warblers in flight during the fall study were within the "zone of risk" (Table 8).

Many factors may reduce the potential impacts of birds with turbines. The low abundance and territorial behavior of many raptors during the spring and summer may minimize impacts. Fall migration may pose additional risks, but some species such as resident vultures, crows, and ravens generally avoid collisions with turbines (Kerlinger 2000). Risk of collision with turbines includes a variety of factors such as turbine avoidance behaviors, flight speeds, flight direction, wind speed, wind direction, and location of birds in relation to blades within the rotor swept area (Johnson et al. 2002; Young et al. 2004). Post-construction behavior and avian mortality studies are critically needed to help determine the potential impacts.

Transect Data and Spatial and Temporal Use

Table 9 shows the relative abundance of species observed during surveys along five 500-m transects sampled in mid-June. During line transects, 69 species of 640 individuals were recorded. The five most abundant species were the Red-eyed Vireo, Chestnut-sided Warbler, Black-throated Green Warbler, Veery, and Dark-eyed Junco (Table 9). Species observed during transects but not on fixed-point surveys included the American Kestrel and Vesper Sparrow. Little variation in spatial use was observed at the site, and no significant differences in species composition across segments (e.g., northern and southern part) of the proposed project area were observed. In other words, the habitats were rather homogenous (managed for timber) and birds appeared evenly and widely distributed across the area and the number of species per fixed-point survey generally ranged from 3-7 during the spring. The number of species and number of individuals were slightly higher in clearcut and pole succession areas than forest areas in the project area (ANOVA, $p < 0.05$). Michael (1994) did find some variation in spatial use with a higher relative abundance along the Les McClung/ reclaimed strip mine transect than at Grassy Knob. Raptors were generally dispersed and migrated throughout the area in the fall of 1994, and similar passage rates were observed at Beech Knob and Cold Knob (Lipton and White 1995). However, Lipton and White (1995) found higher activity rates of resident raptors at Craters and Joe Knob (located off Beech Ridge southwest of Cold Knob) than at other sites.

The activity of raptors increased throughout the spring and started low and increased to a peak in late May and early June when some had fledged young and started post-breeding dispersal. Woodpecker use fluctuated throughout the spring and was highest in late May. Frequencies of passerines remained relatively constant across the spring, but the peak use appeared to be late-May. Figure 3 shows plots of mean use and frequency of occurrence for avian groups categorized into 5-day blocks from May 12 to June 15 (Young et al. 2004). In the spring study, mean use was also plotted by two-hour time periods to examine daily temporal variation (Figure 4). Most avian groups showed variable mean use across the two-hour blocks, but mean use was highest in the morning for passerines and raptor mean use peaked around mid-day and was highest from 1-3 PM. Field observers generally noticed a significant increase in Turkey Vultures in afternoon surveys compared to morning surveys, and a slight decrease in numbers of Red-tailed Hawks with more seen soaring in the morning hours than in the afternoon. Raptors often vary in active with time of day, especially during the non-breeding season (Bunn et al. 1995).

An analysis of mean use per two-hour time periods in the fall disclosed similar results to those plotted for the spring use, except that passerines and woodpeckers showed to periods of peak use (Figure 5). As noted in Figure 5, use was highest in the early morning hours and around mid-day for passerines and woodpeckers (Figure 5). This was also supported by banding data with most captures occurring just after sunrise and around mid-day. The number of migrants in the project area showed more variation in the fall than in the spring. The peak migration period (highest number of migrants counted and banded) generally occurred in mid-September. Figure 6 shows the number of observations per 10-min. fixed point survey during the fall for passerines and raptors.

During the fall 2005 study, field observers did not find significant variation among raptor passage rates across localities. The mean raptor passage rates at Beech Ridge (13.55 birds/hr), Big Ridge (9.06 birds/hr), Cold Knob (14.0 birds/hr), Craters (10.04 birds/hr), Grassy Knob (12.95 birds/hr), Joe Knob (12.61 birds/hr), Nunly Mountain (11.52 birds /hr), and Old Field Mountain (11.52 birds /hr) were not significantly different. The species composition with the migration of Bald Eagles may be more important to consider in the potential turbine setting within the Cold and Grassy Knob areas. In terms of fall passerine banding (see below), similar results were noted. More migrants were captured at Cold Knob than other localities, but the number of captures per 100 net-hours did not significantly vary and generally averaged 44.91 birds per 100 net-hours. Again the species composition may be more of concern, where, for example, most of the Cape May and Blackpoll warblers were captured at Cold and Grassy knobs, but not the other localities.

Observational and Roadside Data

Field observers recorded birds between points, along roads, and searched for any additional species not noted on point counts and transects. The only two species that were not noted during the spring point counts and transects were two warblers (Cape May Warbler and Bay-breasted Warbler) that breed in Canada and migrate through the area. Vesper Sparrows were observed during spring transects and while driving some access roads along successional and open habitats, but not on spring fixed-point surveys. Michael (1994) provided a detail analysis of birds along the roadways in the proposed project area, and bird species and relative numbers seen in the present 2005 spring study along the roads and while walking between points were similar to those reported by Michael (1994). In the spring, the most abundant species observed while diurnal driving included Red-eyed Vireo, Chestnut-sided Warbler, Veery, Dark-eyed Junco, Eastern Towhee, American Robin, American Crow, and Blue-headed Vireo. Species more likely to be observed while driving rather than walking transects included the American Crow, Common Raven, Gray Catbird, and Indigo Bunting. This is similar to that found by Michael (1994).

During the fall 2005 study, no additional species were detected while driving access roads during both day and night that were not otherwise detected with the fixed-point, raptor, and banding surveys.

Raptor Study

During the spring, a total of 68 raptors were observed with the broadcast call method and 39 during one-hour observation periods at point count localities (Table 10). The number of raptors observed per hour was generally 0.09 birds/hr., and varied from 0.03

to 0.19 birds/hr. (Table 10). Red-shouldered and Red-tailed Hawks responded to broadcast calls in areas where uncut forest abutted clearcuts, but did not respond to calls played in large, open clearcut areas. Some types of thinning practices and rates of timber harvest are believed to displace nesting pairs of Red-shouldered (a decline species, Bednarz et al. 1990) and Red-tailed Hawks (McLeod et al. 2000). Figure 7 shows the localities of 10 Red-shouldered Hawks that responded to broadcast calls. Red-shouldered Hawks had the highest sighting frequency (Table 10) and was slightly higher than that reported by Lipton and White (1995).

A total of nine Northern Harriers were observed with the broadcast and 1-hr. roadside observation methods and only three harriers were found during spring fixed-point counts, which indicates a need for a variety of sampling methods other than just fixed-point counts. This was also true of American Kestrel, where four birds were located during the spring raptor study and none were found on the fixed-points, and one bird was observed on the transects.

The most abundant raptor recorded during the spring raptor study (broadcast and stationary one-hr. observations) was the Red-shouldered Hawk (Table 10). Confirmed breeding was noted in the Eastern Screech-Owl with young birds observer on June 11, 2005 at Beech Knob. Raptors nest early with most eastern owls nesting in winter months and most hawks nesting March - May, but observers found two nests of Cooper's Hawk and a Broad-winged Hawk nest in the proposed project area. The Broad-winged Hawk nest was found along Pole Road on June 1, 2005, while the Cooper's Hawk nests were observed at Cold Knob and Nunly Mountain.

During the fall raptor study, 14 species were observed during 100 hours of stationary 1-hr. observations at eight sampling localities. The most abundant migrant raptors were Turkey Vulture (although is difficult to separate migrants from resident vultures without sophisticated and more detailed studies), Broad-winged Hawk, and Sharp-shinned Hawk. In fact, the Turkey Vulture was excluded from some tables and analyses due to the difficulty in separating resident and migratory birds. Along with the Red-tailed Hawk, these species are typically the most abundant species observed across raptor observatories within the Appalachians during the fall. The Red-tailed Hawk was the second-most abundant buteo in the project area during the fall 2005 study (Table 10). In a fall study of resident raptors, Michael (1994) and Lipton and White (1995) found Turkey Vultures and Red-tailed Hawks to be the most abundant species observed. Michael (1994) reported 974 raptors observed at 6 localities during 88 separate observations, where the most abundant species were the Red-tailed Hawk, Sharp-shinned Hawk, Turkey Vulture, and the Broad-winged Hawk.

Two Bald Eagles were noted during the raptor study (Table 10). These two eagles and a third one tallied during the fall fixed-point surveys were observed in early September. Three Golden Eagles were observed during the raptor study (Table 10) and were noted during November. Prior to these three Golden Eagle records, a Golden Eagles was noted during a fixed-point survey in late October. A single Northern Goshawk was seen flying past Cold Knob.

Weather Patterns

Basic weather data (temperature, cloud cover, precipitation, and wind speed) were recorded at the time of each point-count survey. Avian use was calculated for periods with low (between 0 percent and 25 percent) cloud cover, medium cloud cover (between 25 percent and 75 percent), and high cloud cover or overcast (between 75 percent and 100 percent cover) and is shown in Figure 8. Figure 8 shows the spring data. The fall data was similar and, thus, is not graphed. Avian use for periods with no rain or with some precipitation in the spring is shown in Figure 9. Mean difference in use was higher for passerines during times of 0-25 percent cloud cover, but most groups had higher mean use and activity during 25-75 percent cloud cover. Mean use varied by groups, however. During the spring season, use by passerines and all bird species declined with onset of precipitation events, but there was no significant difference. The were less than 10 days of rain/snowfall during the fall 2005 season and drought conditions persisted throughout much of the fall season. Therefore, it is unclear how much wet conditions during the fall will influence avian behavior in the project area, as well as the weather-induced (e.g., dense fog) interactions between birds and potential turbines. Weather conditions for fall raptor migration in the project area were briefly noted in Lipton and White (1995). Typically in the Appalachians of West Virginia, birds are use to a wet spring season and a relatively dry fall. The data reported in this report most likely show a typical migration pattern, despite the drier than average conditions during the fall 2005 season.

Habitats and Vegetation Types

Vegetation cover and type were measured at each survey point and plotted according to forest cover (Young et al. 2004). Passerine use plotted by forest cover during the spring study is shown in Figure 10. Open survey points were defined as those with less than 20 percent of the ground covered by overhead vegetation, and cover types were grouped from 0-20 percent, 20-70 percent and greater than 70 percent (Young et al. 2004). Passerine use in the spring was generally higher in areas with lowest canopy (0-20 percent), and differences could be due to preference for clearcuts as well as increased detectability in open areas. There was considerable variability with mean use and habitat cover among the passerine subgroups with forest-affinity species (such as titmice and chickadees) found more often in areas with greater than 70 percent forest cover.

Species composition and frequency of occurrence varied with landscape (contiguous forest, forest fragment, and clearings) and patch size in ha. (MANOVA, $F = 1248$, $p < 0.001$). Other significant variables in explaining species composition observed during the spring fixed-point surveys included tree diameter ($p < 0.01$) and percent canopy cover ($p < 0.05$), while slope, aspect, number of dead snags, canopy height, and ground cover were insignificant ($p > 0.05$).

The vegetation types were not as variable as those in the Mount Storm area, and consisted of managed timber lands with forest interdispersed by clearcuts and surface mines. A discussion of vegetation types in the proposed project area was provided by Curry and Kerlinger (2004). Habitats in the proposed project area are a combination of contiguous forest, forest patches, and clearings (this study, and Curry and Kerlinger 2004).

Woodcock and Nocturnal Bird Survey

The American Woodcock requires dense young forest or shrub-dominated habitat with moist soils that harbor earthworms and other primary food items (Kelley 2004). The woodcock has declined since 1968 by 2.1 percent per year in eastern U.S. and 1.8 percent per year in the central U.S. (Kelley 2004), and is a popular game species in need of immediate conservation management. Although the cutover and managed forest habitats (especially pole-succession) appear readily suitable as excellent woodcock habitat, relatively few woodcocks were observed in the proposed project area. This is most likely due to the timing of the study (see below), rather than moisture. The clearcuts and young forests within the project area could potential harbor a massive woodcock population, but additional study would be necessary in late-winter and early spring to confirm this.

Field observers searcher for woodcocks at night and with the flush-method while walking transects. Only one woodcock was found along the transects (Table 9). Because woodcocks nest early (March - April) in the proposed project area, this study was outside the time period to record the number of territorial males. Four sets of fledged young (May 10 - 31) and two nests with eggs (May 22 and 25; which were probably re-nesting attempts following a previously failed clutch) were observed. All woodcocks were located in clearcut habitats and were scattered throughout the proposed project area. The location of woodcocks and other early successional species, such as the Golden-winged Warbler is shown in Figure 11.

Table 11 shows the species of birds observed during 12 nights of driving the access roads within the proposed project area in the spring. Because the size and number of natural wetlands are very limited in the proposed project area (see Curry and Kerlinger 2004 for an overview on habitats, including wetlands in the project area), observers did not record species such as the American Bittern or any night-herons. Broadcast calls of nocturnal birds were made in suitable habitat, but no response from bitterns, rails, etc. were noted due to the limited size of the wetlands. A total of five Whip-poor-wills were heard in the proposed project area during the spring (Table 11). No Whip-poor-wills were detected during the fall study. Additional study may be needed on Whip-poor-wills.

Analysis of the nocturnal migrants and especially the flight of Neotropical migrants such as warblers and thrushes has been difficult in modern ornithology. Detection efficiencies using the flight call survey methods of W. Evans (see Applications of Acoustic Bird Monitoring for the Wind Power Industry; http://www.nationalwind.org/publications/avian/avian98/21-evans-acoustics.pdf and Evans and Rosenberg 1999) and others have improved our ability to understand nocturnal migration. Some birders throughout West Virginia (Archives of the WV-Bird List sponsored by the National Audubon Society, WV-Bird@List.Audubon.org) have over the past few years started identifying and counting the nocturnal migrant flights, especially thrushes, in localized areas across the state. During the present study, almost 11,000 birds were detected during 4-5 hr. observations periods over 12 nights and at stationary points within the proposed project area (Table 11). Results are similar to those listed on the WV-Bird List in that the project site appears similar to other Appalachian areas such as Morgantown and the Eastern Panhandle with respect to the thrush flight. The most abundant thrushes appeared to be the Swainson's and Gray-cheeked thrushes in the proposed project area. Similarly, banding and count data indicated the proposed project site in terms of fall migration is unlike that of Dolly Sods (Grant County) in terms of the number of migrants coming through the area, but similar to that of Lilly Mountain (Raleigh County) and Ivy Knob (Wyoming County).

Golden-winged and Cerulean Warblers Study

All 100 fixed-point localities were surveyed for Golden-winged and Cerulean Warblers. Two Golden-winged Warblers were tallied during the spring fixed-point surveys (Table 4), while one also was located near Grassy Knob along a transect route (Table 9). Song-playback produced six additional territorial males. Further, three more males were found outside the proposed project area in areas near the border of the project boundaries (e.g., near the Greenbrier and Nicholas counties border), and Golden-winged Warbler localities are mapped in Figure 11. All Golden-winged Warblers were located in clearcut and pole succession habitats. A total of nine territorial males is higher than the two recorded by Michael (1994), and the species may be expanding into clearcut habitats within the area, but the local population is exceedingly small. Golden-winged Warblers were absent from about 85 percent of the suitable successional habitat in the proposed project area. Golden-winged Warblers are an early successional species and respond favorably to most clearcut treatments across the landscape, so wind farm development in the area will most likely not harm the species. Golden-winged Warblers generally only remain in a clearcut area for only about 3-8 years post-logging, where the trees become too dense and shade out the required herbaceous layer needed by the species (Canterbury 2005).

Golden-winged Warblers (n = 9) occupied large territories of about 1.18 ha (3 acres) and were highly widespread throughout the proposed project area. The small population size allowed for larger territories, where the average in southern West Virginia coalfields is about 0.82 ha. (Canterbury et al. 1993, 1996). No pattern similar to that within the southern West Virginia coalfields (where 1-2 mi. contour mine routes along roads yield about 8-12 territorial males; Canterbury, unpubl. data; Shapiro et al. 2004) was observed in the proposed project area. The vegetation of occupied territories and unoccupied areas of similar size and topography were not significantly different, e.g., had similar shrub density, herb density, etc. Golden-winged Warblers most likely respond to landscape variables, where large populations occur in the upland oak-dominated forest ridges of the southern West Virginia coalfields and excess males are forced into less suitable habitat (such as the beech-maple forest in the proposed project area) (Canterbury 2002). The low population density, large amount of unoccupied clear-cut habitats by Golden-winged Warblers, and the forest type within the proposed project area indicate the site is rather unsuitable for sustainment of large Golden-winged Warbler populations.

No Cerulean Warblers were observed during the study. The elevation and habitat (beech-maple forest) may be outside that preferred by the species. Cerulean Warblers are found only in very small numbers in the high Alleghenies of West Virginia (Hall 1983; Buckelew and Hall 1994), and typically do not occur above 3200 feet in the Allegheny Mountains Physiographic Province (Canterbury unpubl. data).

Mist-Netting and Banding Data

Table 12 shows the results of banding operations within the proposed project area for the fall 2005 season and in comparison with TRMO. A total of 75 species were tagged within the proposed project area compared to 92 at TRMO. A total of 1,612 individuals were captured within the proposed project area compared to 2,936 at TRMO and these are corrected for net effort (see Table 12). The proposed project area did not produce as many captures of migrants as that found at TRMO. Some species such as the Golden-winged and Kentucky warblers were captured but not seen on point counts, while the opposite was also true. For example, observers saw eight Wilson's Warblers, but none were captured during banding operations.

The most numerous species captured within the proposed project area during the fall were the Dark-eyed Junco and Cape May Warbler, while the most numerous species captured at TRMO were the Tennessee Warbler and American Goldfinch (which is typical of that station based on 10 years of data).

SUMMARY AND CONCLUSIONS

The Public Service Commission requires assessments of impacts and studies before wind farm development, and the U.S. Fish and Wildlife Service and state agencies require an examination of proposed site for threatened and endangered species. This report is an analysis of bird populations that provides baseline data and detailed spring and fall studies that are necessary before any site-development permitting.

This study estimates the potential risks of wind turbines on populations in the proposed project area. Appropriate risk assessments studies are needed for species such as bats and birds on proposed wind farm sites. In this study, avian species composition, relative frequency, mean use, flight characteristics of birds were assessed, as well as a raptor study, a nocturnal bird survey, and an analysis of species of concern (such as the Golden-winged and Cerulean warblers) were completed.

The spring and fall studies combined for this report disclosed no outstanding risks to bird populations within the proposed project area. Results suggest minimal risk to migrants and breeding birds, as well as species of critical concern. Potential risks may differ between the fall and spring migration periods within the Appalachians and the proposed project area. This study found no major flyways or key concentration areas of spring migrants. Some concern was noted, especially for raptors, in the fall, and for a few specific localities within the proposed project area. Continued monitoring of Cold and Grassy knobs for eagles during the fall may be useful. Migratory birds and eagles are federally protected and projects that impact eagle habitat or migratory pathways merit detailed study and continued monitoring.

Avian Use and Species Diversity

Use estimates (number of observations per 10-minute point count survey) were used as a relative measure of abundance of species or groups of species. The data provide an index of how often a species occurs in the project (study) area and the potential relative magnitude of risk to the wind project development and turbines. Measures such as mean use and percent frequency provide only an indirect indication of each species risk of being affected by the proposed project. Direct measures will require post-construction mortality studies.

Mean use was relative low for most species observed in May - June in the proposed project area. The five most abundant species based on mean use from spring point-count surveys were the Red-eyed Vireo, American Crow, Yellow-rumped Warbler, American Robin, and the Dark-eyed Junco. The five most abundant species during transect surveys were Red-eyed Vireo, Chestnut-sided Warbler, Black-throated Green Warbler, Veery, and Dark-eyed Junco. Point-count surveys tended to survey more roads and edge habitats than transects, which transverse through more interior habitats (e.g., middle of a cutover). The most abundant fall migrants included the Turkey Vulture, Broad-winged Hawk, Blue Jay, American Crow, Gray-cheeked Thrush, American Robin, European Starling, Cedar Waxwing, Eastern Towhee, Chipping Sparrow, Dark-eyed Junco, and Common Grackle.

A total of 124 species were observed in this study. More species were observed during the fall than during the spring within the proposed project area. The low individual species use, but higher overall group use and estimates reflect the high species diversity of the proposed project area. On average, nearly 4 passerines were observed per 10-minute survey, while most species had a mean use below 1.

The habitats of the area consist mostly of beech, maple, cheery dominated forest with forest fragments, patches of clearcuts and small log-landing clearings, and reclaimed mine lands. Species diversity and relative abundance were slightly higher in open and successional habitats than forested areas, but most species tended to occur in low numbers and were widely distributed throughout the area. The diurnal avian spatial-use study during the spring did not suggest any key or critical migration and specialized habitat areas, where impacts would result in greater risk than other areas of the project site. No key spring migration corridor (in terms of bird numbers) was noted in the spring or fall. Raptor passage rates were similar across the proposed project area, but a few eagles were noted mainly along Cold Knob and Grassy Knob, and slightly more passerines were captured at these localities than at other sites within the proposed project area in the fall. Like the Mount Storm area in Grant County, the proposed MeadWestvaco wind project area does not appear to offer any specialized and unique bird communities, and appears to be typical of the higher elevations of the Western Hills Physiographic Province and the southern edge of the Allegheny Mountains in West Virginia. The only major exception to this is the possible impact on Golden-winged Warbler populations. The Golden-winged Warbler is a species of major national concern (Rich et al. 2004) and in need of immediate conservation action.

Permitting generally requires studies throughout the daily time periods as well as an assessment of weather. Fewer birds were observed during the afternoon and evening periods than during the morning. Passerines tended to be more active in morning surveys, while raptors peaked around mid-day and early afternoon. Variation in diurnal use was low, but passerines peaked around late-May, woodpeckers in early June, and raptors in late May and early June. Peak migration in the fall appeared to be mid-September for both passerines and raptors. Numbers fluctuated, however, with other peaks for passerines in the fall being early September and late September. September appeared to be more critical for passerines at the site than other fall months. However, it must be noted that peak fall migration time varies from year-to-year within the Appalachians as noted at Three Rivers Migration Observatory in Raleigh County, West Virginia and at Dolly Sods. At the Three Rivers Migration Observatory peak passerine flight is generally mid-September, but may occur as early as the first week of September or as late as the end of the month and into early October (Canterbury, unpubl. data).

Birds appeared to be more active during moderate cloud cover and less active during precipitation events, and use varied by species and avian group. The season (except maybe early to mid September) and temporal use patterns for the site do not suggest a period of time that should be avoided during development and on-site construction.

Flight Height Characteristics

Data disclosed that passerines in the spring and fall generally do not fly at the “level zone of risk”, except for a few species such as corvids, waxwings, blackbirds, and finches. There is probably a higher risk for resident passerines than migratory species that move farther north as they travel through the area. Overall, risk is believed to be minimal for most groups. However, raptors (> 79 percent of flying birds occurred in the "zone of risk" during the spring and fall) and larger birds such as waterfowl may be at higher risks than passerines. Populations of both these species groups are relatively low and widely dispersed. Young et al. (2004) provided a synopsis of risk of turbine collisions by birds (especially raptors), along with a summary of some of the wind farm studies and the extent of their avian mortalities. Young et al. (2004) completed a nocturnal and radar study and concluded, for the Mount Storm wind project in Grant County, West Virginia, that risk to raptors was minimal, passerines followed a broadfront migration pattern, and estimated the number of birds that passed over the area. Results are likely to be similar at this Greenbrier County site, because of the similarity in avian use and passerine numbers (see below for a comparison between this study and the results of the Mount Storm and other wind projects).

Raptor and Observational Surveys

A diverse array of raptor species breed in the proposed project area with the most abundant species being Turkey Vulture, Red-shouldered and Red-tailed hawks, and the Sharp-shinned Hawk. Habitat use was variable, but definitely pockets of forest habitat should remain for nesting success. Birds were widely dispersed, and no key-raptor area was noted in the spring. Lipton and White (1995) provided a detailed analysis of resident raptors and a fall raptor study. Additional data are provided in Michael (1994). The Lipton and White (1995) study also provided passage rates for raptors in the study area.

Passage rates did not vary during the fall study. Key areas may include Grassy and Cold Knob due to the passage of Ospreys, eagles, and a goshawk. Lipton and White (1995) also found Cold Knob to be important for eagle migration and reported only a single Bald Eagle and seven Golden Eagles during their study. All three goshawks reported by Lipton and White (1995) came from Cold Knob. The numbers of all these groups/species, except the Northern Goshawk, were relatively low, however, when compared to Peters Mountain. It must be pointed out that the fall data used in this report and that used by investigators at Peters Mountain differ by methodologies and are, thus, not standardized by methods and survey time.

Of the 18 Northern Saw-whet Owls discovered, one was banded at Cold Knob and one at Grassy Knob and the other 16 owls were widely dispersed throughout the proposed project area. Four owls, however, were observed on Nunly Mountain, six were noted along Beech Ridge and Pole roads. Single birds (n = 6 saw-whets) were observed throughout the proposed project area. Similarly, Broad-winged Hawks were fairly evenly reported across the proposed project area. The number of Broad-winged Hawks recorded during the fall raptor study and during 12.5 hr observations at eight localities within the proposed project area are shown in Figure 12. This study disclosed 4.8 Broad-wings per hr. observation, while that of Lipton and White (1995) reported 0.69 Broad-wings per hr. of observation.

Nocturnal Bird Surveys

Nocturnal bird surveys and broadcast call surveys disclosed a sizeable population of species such as the Eastern Screech-Owl and the Barred Owl. These species may be highly vulnerable to the wind-swept rotator areas due to their hunting behavior. The proposed project area does support Whip-poor-wills during the spring, a highly vulnerable and declining species of concern. Flight call analysis and nocturnal bird surveys during the fall disclosed at least 11 species that comprised almost 11,000 individuals during 12 nights of surveys. Thrushes and warblers appeared to be the most numerous nocturnal migrants. The bulk of the thrushes were Swainson's and Gray-cheeked thrushes.

Species of Concern and the Golden-winged Warbler

A list of species with global and Partners in Flight conservation concern (Rich et al. 2004) that occur in the proposed project area are provided in this report. Most of these just warrant monitoring at this time, but immediate action is needed for the Golden-winged Warbler. The most common northern/boreal migrants that did not breed in the area were the Swainson's Thrush and Yellow-rumped Warbler. Both these species do breed locally in higher elevations of the Allegheny Mountains Physiographic Province of West Virginia (Hall 1983; Buckelew and Hall 1994). Other species of concern include the Red-headed Woodpecker, Yellow-bellied Flycatcher and Whip-poor-will, and all species of concern occurring in the proposed project area are listed in the report along with their relative numbers. A total of 18 Northern Saw-whet Owls, which is a species of concern in West Virginia was noted during the fall migration study. No federally threatened or endangered bird species were noted in the proposed project area during the spring 2005 season. However, passage through the area by Bald and Golden eagles (both species protected by the Eagle Protection Act of 1940 and the Bald Eagle is federally protected under the Endangered Species Act of 1973) during the fall may merit continued monitoring at the site. It is understood that the developer is in compliance with these regulations.

American Woodcocks at the site may be in need of further study, and despite the large amount of clearcut habitats present in the proposed project area, the area may be too dry to support large woodcock populations. No woodcocks were observe during the fall study. This species is in need of conservation action because of its steep and long-term and range-wide declines.

The proposed MeadWestvaco (Beech Ridge) wind project does not appear to be a major threat to Golden-winged Warblers, and ample cutover and successional habitat occurs in the proposed project area. The species, because of its continental population status, should be monitored at the proposed project site during and following turbine construction. Continued logging practices by the landowner in the proposed project area will most likely provide additional Golden-winged Warbler habitat, but the beech-maple forest areas within the project site may never harbor populations large enough to manage as viable, source populations.

No Cerulean Warblers and Loggerhead Shrikes were observed within the proposed project area during the spring and fall 2005 studies. In addition to the eagles and Northern Saw-whet Owl, other species of concern within the proposed project area during the fall included the Black Vulture, Osprey, Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk, Black-billed Cuckoo, Common Nighthawk, Red-headed Woodpecker, Yellow-bellied Sapsucker, Yellow-bellied Flycatcher, Alder Flycatcher, Brown Creeper, Swainson's Thrush, Yellow-rumped Warbler, Blackburnian Warbler, Northern Waterthrush, and Vesper Sparrow. Most of these species of concern were noted in very low numbers (Table 4). Fall fixed-point count surveys indicated the most abundant of these to be the Common Nighthawk and Swainson's Thrush.

Comparison with Local Wind Projects

Many of the results of this phase I avian assessment are similar to the results obtained from the Mount Storm wind project (Young et al. 2004) in Grant County. Yet, there are some basic differences with reference to local bird populations at each site, but none that would preclude project development (as long as all required studies and Public Service Commission approval and guidelines are met). Unlike the Mount Storm wind project area (Young et al. 2004), which has more extensive wetland systems, the MeadWestvaco (Beech Ridge) proposed wind project area has few waterfowl and wetland species.

The number and species composition of blackbirds was less than that found at Mount Storm (Young et al. 2004) as well. No territorial and breeding Golden-winged Warblers were observed at the Mount Storm site, but a few birds do breed locally nearby the site and the species migrates through the area. A small breeding Golden-winged Warbler population occurs at the MeadWestvaco project site. Slightly more species of concern and higher species diversity were observed at the the Mount Storm project site than at the MeadWestvaco project site. The Mount Storm project had wetland-affinity species and waterbirds, as well as species such as Olive-sided Flycatcher, American Pipit, Horned Lark, and Lark Sparrow. In addition, some species of concern were in higher numbers at Mount Storm than at the MeadWestvaco site, such as the Northern Harrier and Vesper Sparrow. A larger thrush flight was observed at the MeadWestvaco project site than at the Mount Storm project site, but the warbler migration was similar despite differences in relative abundances among some species.

The number of vireos was higher at the MeadWestvaco project site, but the diversity of vireo species was higher at Mount Storm. Both sites had an abundance of American Crows, Blue Jays, and Cedar Waxwings. The Northern Saw-whet Owl population (fall migrants and most likely overwintering individuals) is higher at the MeadWestvaco site than Mount Storm.

Prior to the baseline avian study at Mount Storm, Canterbury (2002) conducted a phase I risk assessment which documented higher avian species diversity at the extreme southern part of the Mount Storm project area, namely Stony River Reservoir area. Therefore, this southern part was abandoned for site development. During the Young et al. (2004) study, species richness along the Allegheny Front Mount Storm study area was slightly higher in the northern and central part of the study area and lowest in the southern portion (Young et al. 2004). No similar trend was noted in this study, which may be due to the size and habitats along the large ridges of the areas (Allegheny Front is much larger and more heavily forested than Beech Ridge). There was little variation in avian spatial use at the MeadWestvaco wind project site. In the fall 2005 study at the MeadWestvaco (Beech Ridge) wind project site, a few localities (Grassy and Cold knobs) harbored higher species composition with the passage of species such as Osprey, Bald Eagle, Northern Goshawk, and Merlin through these areas. No difference in raptor passage rates were noted at localities throughout the MeadWestvaco project site.

At both sites, raptor use is generally low to moderate. Taking observer effort time and methodologies into account, the raptor use in the fall at the MeadWestvaco project site appears to be lower than at Peters Mountain (Hanging Rock Raptor Observatory in Monroe County), but slightly higher than that at Mount Storm. The number of flying raptors observed was also higher for the MeadWestvaco project site than at Mount Storm. Because of the comparison of studies conducted in different times, yearly variation may influence this conclusion.

The present study also showed higher abundance of raptors and passerines than that observed on the Backbone Mountain wind project site during a 2000 fall study by field technicians of P. Kerlinger. Again, however, there were some major differences in methodologies and observer effort, where the present study at the MeadWestvaco project site had more extensive coverage and methodologies than that used at the Backbone Mountain site. The most abundant raptors observed by Kelinger (2002) were Turkey Vulture, Sharp-shinned Hawk, and Red-tailed Hawk at the Backbone site. Including vultures, the number of birds per hour observed at the Backbone Mountain site in the fall 2000 was 1.88, while at the MeadWestvaco project site during the fall study of 2005 it was 11.9. In general, results obtained during the present study are similar to those at the Mount Storm project and to the studies conducted by Michael (1994) and Lipton and White (1995).

Passerine use was generally higher in areas with lowest canopy (0-20 percent) and like that reported by Young et al. (2004). There was considerable variability with mean use and habitat cover among the passerine subgroups with forest-affinity species (such as titmice and chickadees) found more often in areas with greater than 70 percent forest cover. There was also a higher percentage of birds in flight at the Beech Ridge site and along the crest of the mountains than that noted during the Mount Storm and Backbone Mountain avian studies. Other differences include a winter population of Bald Eagles at Mount Storm, which is highly unlikely at the Beech Ridge project area due to lack of eagle habitat for overwintering. A few Bald Eagles migrated through the MeadWestvaco project site, but, overall, the site is not considered a key raptor migration site (Zalles and Bildstein 2000). The Mount Storm site also had breeding Ospreys in the project area.

Turbine Setting and Recommendations

A goal of this study was to provide information about turbine microsetting that would reduce the avian risk to exposure. In general, the studies within did not indicate any special restrictions or presence of high migratory concentrations, or key habitats. There is some concern during fall migration at Grassy and Cold Knobs due to the passage of migrant eagles and the slightly higher concentration of migrant passerines.

Vegetation types in the study area are highly disturbed and are not unique. The areas with highest bird abundance and species diversity were edge habitats and cutover areas that are common in the proposed project landscape. Breeding raptors, Golden-winged Warblers, and species of concern such as Whip-poor-will and American Woodcock may warrant further study and post-construction monitoring. Pockets of early successional habitat have been maintained by land use practices within the proposed project area. The developer plans to utilize existing roads with little development of new access roads. These will help protect shrubland species such as the Golden-winged Warbler and American Woodcock, which are among the most vulnerable of any bird guild.

Risks posed by wind farm development should be minimal to moderate, but the developer should consider recommendations for post-construction studies outlined below. What is especially needed in the Appalachians is post-construction mortality studies at wind farm sites. Below is a list of recommendations that merit careful consideration for post-construction studies.

(1) Consider a post-construction mortality study.

(2) Monitor highly vulnerable species during the spring migration and breeding season such as the American Woodcock and Golden-winged Warbler. Traditional and current land use practices by the landowner will maintain pockets of early successional habitat.

(3) Consider a post-construction study to expand our knowledge of species of concern within the project area and adjacent areas near the proposed project site. For example, no Loggerhead Shrikes were noted in the proposed project area during the 2005 study, but a shrike was observed nearby in Trout, West Virginia.

(4) Monitor raptor populations within the proposed project area. Continue to study raptors within the proposed project area, especially in reference to

the "zone of risk", breeding habitat of species of concern, Accipiters, and the Red-shouldered Hawk. Consider post-construction studies that will help to minimize raptor-turbine interactions.

(5) Monitor eagles and Ospreys during fall migration at Cold and Grassy knobs. Because the Bald Eagle has recovered from its low population size before ESA listing and is increasing within the continental US, the species is being proposed to be removed from the list of endangered and threatened species (http://www.fws.gov/migratorybirds/baldeagle.htm). Therefore, additional monitoring is recommended, but not required. It is understood that the developer is in compliance with the Endangered Species Act, Neotropical Migratory Bird Conservation Act and Eagle Act within the proposed project area. Further, the developer has met the requirements and guidelines of the regulatory agencies. However, the developer may want to consider post-construction methods that will foster on-site avian conservation and develop procedures that will facilitate avian conservation on wind farm sites. This latter consideration or recommendation should be important to environmental and avian conservation communities and to the wind industry.

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APPENDIX A

TABLE 1

Avian species observed in the proposed MeadWestvaco wind farm project area, Greenbrier Count, West Virginia.

Common Name	Scientific Name
Wood Duck	*Aix sponsa*
Mallard	*Anas platyrhynchos*
Ruffed Grouse	*Bonasa umbellus*
Wild Turkey	*Meleagris gallopavo*
Black Vulture *	*Coragyps atratus*
Turkey Vulture	*Cathartes aura*
Osprey *	*Pandion haliaetus*
Bald Eagle *	***Haliaeetus leucocephalus***
Northern Harrier *	*Circus cyaneus*
Sharp-shinned Hawk *	*Accipiter striatus*
Cooper’s Hawk *	*Accipiter cooperii*
Northern Goshawk *	*Accipiter gentilis*
Red-shouldered Hawk	*Buteo lineatus*
Broad-winged Hawk	*Buteo platypterus*
Red-tailed Hawk	*Buteo jamaicensis*
Golden Eagle	*Aquila chrysaetos*
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
American Woodcock	*Scolopax minor*
Mourning Dove	*Zenaida macroura*
Black-billed Cuckoo *	*Coccyzus erythropthalmus*

Common Name	Scientific Name
Yellow-billed Cuckoo	*Coccyzus americanus*
Eastern Screech-Owl	*Megascops asio*
Great Horned Owl	*Bubo virginianus*
Barred Owl	*Strix varia*
Northern Saw-whet Owl *	*Aegolius acadicus*
Common Nighthawk *	*Chordeiles minor*
Whip-poor-will *	*Caprimulgus vociferus*
Chimney Swift	*Chaetura pelagica*
Ruby-throated Hummingbird	*Archilochus colubris*
Red-headed Woodpecker *	*Melanerpes erythrocephalus*
Red-bellied Woodpecker	*Melanerpes carolinus*
Yellow-bellied Sapsucker *	*Sphyrapicus varius*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Northern Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
Eastern Wood-Pewee	*Contopus virens*
Yellow-bellied Flycatcher *	*Empidonax flaviventris*
Acadian Flycatcher	*Empidonax virescens*
Alder Flycatcher *	*Empidonax alnorum*
Willow Flycatcher	*Empidonax traillii*
Least Flycatcher	*Empidonax minimus*
Eastern Phoebe	*Sayornis phoebe*
Great Crested Flycatcher	*Myiarchus crinitus*

Common Name	Scientific Name
Eastern Kingbird	*Tyrannus tyrannus*
White-eyed Vireo	*Vireo griseus*
Blue-headed Vireo	*Vireo solitarius*
Red-eyed Vireo	*Vireo olivaceus*
Blue Jay	*Cyanocitta cristata*
American Crow	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Tree Swallow	*Tachycineta bicolor*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Barn Swallow	*Hirundo rustica*
Black-capped Chickadee	*Poecile atricapillus*
Tufted Titmouse	*Baeolophus bicolor*
Red-breasted Nuthatch	*Sitta canadensis*
White-breasted Nuthatch	*Sitta carolinensis*
Brown Creeper *	*Certhia americana*
Carolina Wren	*Thryothorus ludovicianus*
House Wren	*Troglodytes aedon*
Winter Wren	*Troglodytes troglodytes*
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Eastern Bluebird	*Sialia sialis*
Veery	*Catharus fuscescens*
Gray-cheeked Thrush	*Catharus minimus*

Common Name	Scientific Name
Swainson's Thrush *	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
Wood Thrush	*Hylocichla mustelina*
American Robin	*Turdus migratorius*
Gray Catbird	*Dumetella carolinensis*
Brown Thrasher	*Toxostoma rufum*
European Starling	*Sturnus vulgaris*
Cedar Waxwing	*Bombycilla cedrorum*
Blue-winged Warbler	*Vermivora pinus*
Golden-winged Warbler *	*Vermivora chrysoptera*
Tennessee Warbler	*Vermivora peregrina*
Orange-crowned Warbler	*Vermivora celata*
Nashville Warbler	*Vermivora ruficapilla*
Northern Parula	*Parula americana*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Magnolia Warbler	*Dendroica magnolia*
Cape May Warbler	*Dendroica tigrina*
Black-throated Blue Warbler	*Dendroica caerulescens*
Yellow-rumped Warbler *	*Dendroica coronata*
Black-throated Green Warbler	*Dendroica virens*
Blackburnian Warbler *	*Dendroica fusca*
Prairie Warbler	*Dendroica discolor*
Palm Warbler	*Dendroica palmarum*
Bay-breasted Warbler	*Dendroica castanea*

Common Name	Scientific Name
Blackpoll Warbler	*Dendroica striata*
Black-and-white Warbler	*Mniotilta varia*
American Redstart	*Setophaga ruticilla*
Worm-eating Warbler	*Helmitheros vermivorus*
Ovenbird	*Seiurus aurocapilla*
Northern Waterthrush *	*Seiurus noveboracensis*
Kentucky Warbler	*Oporornis formosus*
Mourning Warbler	*Oporornis philadelphia*
Common Yellowthroat	*Geothlypis trichas*
Hooded Warbler	*Wilsonia citrina*
Wilson's Warbler	*Wilsonia pusilla*
Canada Warbler	*Wilsonia canadensis*
Yellow-breasted Chat	*Icteria virens*
Scarlet Tanager	*Piranga olivacea*
Eastern Towhee	*Pipilo erythrophthalmus*
Chipping Sparrow	*Spizella passerina*
Field Sparrow	*Spizella pusilla*
Vesper Sparrow *	*Pooecetes gramineus*
Song Sparrow	*Melospiza melodia*
Swamp Sparrow	*Melospiza georgiana*
White-throated Sparrow	*Zonotrichia albicollis*
White-crowned Sparrow	*Zonotrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*
Northern Cardinal	*Cardinalis cardinalis*

Common Name	Scientific Name
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Indigo Bunting	*Passerina cyanea*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
Purple Finch	Carpodacus *purpureus*
American Goldfinch	*Carduelis tristis*

Those species with an asterisk are species of concern in West Virginia or monitored by the WVDNR. Vernacular names of federally listed species have been bolded.

TABLE 2

Species observed on point counts in the spring study, but did not breed in the project area.

Common Name	Scientific Name
Yellow-bellied Flycatcher	*Empidonax flaviventris*
Ruby-crowned Kinglet	*Regulus calendula*
Swainson’s Thrush	*Catharus ustulatus*
Magnolia Warbler	*Dendroica magnolia*
Cape May Warbler	*Dendroica tigrina*
Yellow-rumped Warbler	*Dendroica coronata*
Bay-breasted Warbler	*Dendroica castanea*

TABLE 3

Species observed in the Fall, but not during the Spring in the project area.

Common Name	Common Name
Osprey	Orange-crowned Warbler
Bald Eagle	Nashville Warbler
Northern Goshawk	Palm Warbler
Golden Eagle	Blackpoll Warbler
Merlin	Worm-eating Warbler
Northern Saw-whet Owl	Northern Water thrush
Common Nighthawk *	Wilson’s Warbler
Yellow-bellied Sapsucker *	Swamp Sparrow *
Acadian Flycatcher	White-throated Sparrow *
Red-breasted Nuthatch *	White-crowned Sparrow
Gray-cheeked Thrush	Common Grackle
Blue-winged Warbler	Purple Finch *

** Spring study started after these species’ migration period or near end of their migration.*

TABLE 4

Avian species observed during fixed-point surveys.

Species/Group	Spring		Fall		Total	
	# of Birds	# of Groups	# of Birds	# of Groups	# of Birds	# of Groups
Waterfowl	**15**	**6**	**10**	**3**	**25**	**9**
Wood Duck	6	2	0	0	6	2
Mallard	9	4	10	3	19	7
Upland Gamebirds	**74**	**51**	**201**	**61**	**275**	**112**
Ruffed Grouse	45	37	29	21	74	58
Wild Turkey	29	14	172	40	201	54
Raptors	**366**	**171**	**1390**	**697**	**1756**	**868**
Vultures	**300**	**116**	**829**	**264**	**1129**	**380**
Black Vulture	15	4	30	9	45	13
Turkey Vulture	285	112	799	255	1084	367
Osprey	**0**	**0**	**6**	**6**	**6**	**6**
Osprey	0	0	6	6	6	6
Harrier and Eagles	**3**	**3**	**10**	**10**	**13**	**13**
Northern Harrier	3	3	8	8	11	11
Bald Eagle	0	0	1	1	1	1
Golden Eagle	0	0	1	1	1	1
Accipiters	**28**	**25**	**57**	**53**	**85**	**78**
Sharp-shinned Hawk	20	17	42	38	62	55
Cooper's Hawk	8	8	15	15	23	23
Buteos	**32**	**24**	**478**	**354**	**510**	**378**
Red-shouldered Hawk	10	7	8	5	18	12

Species/Group	Spring		Fall		Total	
	# of Birds	# of Groups	# of Birds	# of Groups	# of Birds	# of Groups
Broad-winged Hawk	13	10	415	300	428	310
Red-tailed Hawk	9	7	55	49	64	56
Unidentified Hawks	**0**	**0**	**4**	**4**	**4**	**4**
Falcons	**0**	**0**	**4**	**4**	**4**	**4**
American Kestrel	0	0	4	4	4	4
Owls	**3**	**3**	**2**	**2**	**5**	**5**
Barred Owl	3	3	2	2	5	5
Doves	**49**	**31**	**40**	**19**	**89**	**50**
Mourning Dove	49	31	40	19	89	50
Cuckoos	**27**	**27**	**12**	**12**	**39**	**39**
Black-billed Cuckoo	5	5	2	2	7	7
Yellow-billed Cuckoo	22	22	10	10	32	32
Nightjars	**2**	**2**	**94**	**15**	**96**	**17**
Common Nighthawk	0	0	94	15	94	15
Whip-poor-will	2	2	0	0	2	2
Swifts/ Hummingbirds	**14**	**10**	**35**	**19**	**49**	**29**
Chimney Swift	6	2	20	4	26	6
Ruby-throated Hummingbird	8	8	15	15	23	23
Woodpeckers	**188**	**170**	**352**	**245**	**540**	**415**
Red-headed Woodpecker	2	2	4	4	6	6
Red-bellied Woodpecker	24	20	18	13	42	33

Species/Group	Spring		Fall		Total	
	# of Birds	# of Groups	# of Birds	# of Groups	# of Birds	# of Groups
Yellow-bellied Sapsucker	0	0	10	8	10	8
Downy Woodpecker	69	63	75	57	144	120
Hairy Woodpecker	22	20	51	43	73	63
Northern Flicker	61	55	165	100	226	155
Pileated Woodpecker	10	10	29	20	39	30
Passerines	**5046**	**3921**	**13252**	**4742**	**18298**	**8663**
Flycatchers	**186**	**171**	**354**	**312**	**540**	**483**
Eastern Wood-Pewee	90	80	93	79	183	159
Yellow-bellied Flycatcher	3	3	10	10	13	13
Alder Flycatcher	8	8	2	2	10	10
Willow Flycatcher	15	14	0	0	15	14
Traill's Flycatcher	0	0	5	5	5	5
Least Flycatcher	28	28	31	28	59	56
Eastern Phoebe	20	16	210	185	230	201
Great Crested Flycatcher	20	20	3	3	23	23
Eastern Kingbird	2	2	0	0	2	2
Vireos	**537**	**426**	**314**	**275**	**851**	**701**
White-eyed Vireo	7	7	5	5	12	12
Blue-headed Vireo	129	120	99	90	228	210
Red-eyed Vireo	401	299	210	180	611	479
Corvids	**559**	**409**	**1904**	**1138**	**2463**	**1547**
Blue Jay	204	160	1207	795	1411	955
American Crow	290	200	600	275	890	475

Species/Group	Spring		Fall		Total	
	# of Birds	# of Groups	# of Birds	# of Groups	# of Birds	# of Groups
Common Raven	65	49	97	68	162	117
Swallows	**29**	**14**	**25**	**4**	**54**	**18**
Tree Swallow	10	3	10	2	20	5
Northern Rough-winged Swallow	3	1	8	1	11	2
Barn Swallow	16	10	7	1	23	11
Titmice/Chickadees	**295**	**232**	**300**	**165**	**595**	**397**
Black-capped Chickadee	169	133	228	115	397	248
Tufted Titmouse	126	99	72	50	198	149
Nuthatches/Creepers	**105**	**93**	**148**	**103**	**253**	**196**
Red-breasted Nuthatch	0	0	16	10	16	10
White-breasted Nuthatch	100	88	112	73	212	161
Brown Creeper	5	5	20	20	25	25
Wrens	**64**	**54**	**62**	**45**	**126**	**99**
Carolina Wren	15	11	9	4	24	15
House Wren	46	40	18	12	64	52
Winter Wren	3	3	35	29	38	32
Kinglets/Gnatcatchers	**35**	**28**	**160**	**89**	**195**	**117**
Golden-crowned Kinglet	8	8	51	30	59	38
Ruby-crowned Kinglet	20	14	99	52	119	66
Blue-gray Gnatcatcher	7	6	10	7	17	13
Thrushes	**602**	**458**	**1300**	**429**	**1902**	**887**
Eastern Bluebird	24	14	128	22	152	36

Species/Group	Spring		Fall		Total	
	# of Birds	# of Groups	# of Birds	# of Groups	# of Birds	# of Groups
Veery	116	106	81	73	197	179
Gray-cheeked Thrush	0	0	268	188	268	188
Swainson's Thrush	61	49	90	33	151	82
Hermit Thrush	40	40	85	71	125	111
Wood Thrush	100	94	44	20	144	114
American Robin	261	155	604	22	865	177
Mimids	**134**	**125**	**216**	**180**	**350**	**305**
Gray Catbird	94	88	200	169	294	257
Brown Thrasher	40	37	16	11	56	48
Starlings	**12**	**5**	**3009**	**14**	**3021**	**19**
European Starling	12	5	3009	14	3021	19
Waxwings	**199**	**112**	**709**	**137**	**908**	**249**
Cedar Waxwing	199	112	709	137	908	249
Warblers	**1025**	**792**	**1523**	**769**	**2548**	**1561**
Blue-winged Warbler	0	0	1	1	1	1
Golden-winged Warbler	2	2	0	0	2	2
Tennessee Warbler	90	69	151	19	241	88
Nashville Warbler	0	0	14	14	14	14
Northern Parula	18	18	10	10	28	28
Chestnut-sided Warbler	185	164	21	18	206	182
Magnolia Warbler	41	33	83	45	124	78
Cape May Warbler	0	0	350	90	350	90

Species/Group	Spring		Fall		Total	
	# of Birds	# of Groups	# of Birds	# of Groups	# of Birds	# of Groups
Black-throated Blue Warbler	31	26	52	40	83	66
Yellow-rumped Warbler	206	71	46	11	252	82
Black-throated Green Warbler	138	122	205	159	343	281
Blackburnian Warbler	5	5	55	31	60	36
Prairie Warbler	6	6	0	0	6	6
Palm Warbler	0	0	60	41	60	41
Bay-breasted Warbler	0	0	54	28	54	28
Blackpoll Warbler	0	0	170	63	170	63
Black-and-white Warbler	14	14	31	24	45	38
American Redstart	61	55	20	12	81	67
Ovenbird	89	71	30	30	119	101
Worm-eating Warbler	0	0	2	2	2	2
Kentucky Warbler	10	10	0	0	10	10
Mourning Warbler	44	44	5	5	49	49
Common Yellowthroat	25	25	61	49	86	74
Hooded Warbler	35	32	85	60	120	92
Wilson's Warbler	0	0	8	8	8	8
Canada Warbler	9	9	1	1	10	10
Yellow-breasted Chat	13	13	4	4	17	17
Unidentified Warblers	**3**	**3**	**4**	**4**	**7**	**7**
Tanagers	**97**	**90**	**22**	**15**	**119**	**105**

Species/Group	Spring		Fall		Total	
	# of Birds	# of Groups	# of Birds	# of Groups	# of Birds	# of Groups
Scarlet Tanager	97	90	22	15	119	105
Grassland/Sparrows	**929**	**729**	**1817**	**987**	**2746**	**1716**
Eastern Towhee	107	84	312	228	419	312
Chipping Sparrow	95	83	400	168	495	251
Field Sparrow	81	72	71	44	152	116
Vesper Sparrow	0	0	41	26	41	26
Song Sparrow	130	111	111	65	241	176
Swamp Sparrow	0	0	6	6	6	6
White-throated Sparrow	0	0	188	94	188	94
White-crowned Sparrow	0	0	15	9	15	9
Dark-eyed Junco	169	129	512	261	681	390
Northern Cardinal	33	26	21	9	54	35
Rose-breasted Grosbeak	145	119	64	29	209	148
Indigo Bunting	169	105	75	47	244	152
Unidentified Sparrow	**0**	**0**	**1**	**1**	**1**	**1**
Blackbirds	**89**	**63**	**1068**	**14**	**1157**	**77**
Red-winged Blackbird	28	18	40	3	68	21
Common Grackle	0	0	1004	6	1004	6
Brown-headed Cowbird	61	45	24	5	85	50
Finches	**149**	**120**	**321**	**66**	**470**	**186**
Purple Finch	0	0	33	5	33	5
American Goldfinch	149	120	288	61	437	181
Total	**5781**	**4389**	**15386**	**5813**	**21167**	**10202**

TABLE 5

Estimated mean use (number of observations per 10-minute survey) for each species observed within 50 m of the survey point. Values are mean ± 1 standard deviation (S.D.).

Species/Group	Spring Use		Fall Use		Overall Use	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Waterfowl	**0.009**	**0.017**	**0.004**	**0.008**	**0.005**	**0.011**
Wood Duck	0.004	0.011	--	--	0.001	0.008
Mallard	0.005	0.016	0.004	0.008	0.004	0.009
Upland Gamebirds	**0.039**	**0.035**	**0.048**	**0.025**	**0.055**	**0.051**
Ruffed Grouse	0.009	0.015	0.007	0.010	0.015	0.020
Wild Turkey	0.030	0.041	0.041	0.018	0.040	0.033
Raptors	**0.207**	**0.177**	**0.418**	**0.488**	**0.349**	**0.248**
Vultures	**0.164**	**0.203**	**0.248**	**0.325**	**0.224**	**0.245**
Black Vulture	0.005	0.009	0.008	0.021	0.007	0.015
Turkey Vulture	0.159	0.225	0.240	0.323	0.217	0.239
Ospreys	**--**	**--**	**0.002**	**0.005**	**0.002**	**0.006**
Osprey	--	--	0.002	0.005	0.002	0.006
Harrier and Eagles	**0.004**	**0.008**	**0.002**	**0.009**	**0.003**	**0.009**
Northern Harrier	0.004	0.008	0.002	0.006	0.003	0.008
Bald Eagle	--	--	0.00	0.002	0.00	0.002
Golden Eagle	--	--	0.00	0.002	0.00	0.002
Accipiters	**0.024**	**0.01**	**0.021**	**0.026**	**0.016**	**0.019**
Sharp-shinned Hawk	0.021	0.009	0.018	0.025	0.012	0.019
Cooper's Hawk	0.003	0.005	0.003	0.006	0.004	0.006
Buteos	**0.014**	**0.046**	**0.144**	**0.209**	**0.104**	**0.211**

Species/Group	Spring Use		Fall Use		Overall Use	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Red-shouldered Hawk	0.005	0.02	0.002	0.005	0.003	0.007
Broad-winged Hawk	0.003	0.005	0.122	0.208	0.086	0.185
Red-tailed Hawk	0.006	0.009	0.02	0.016	0.015	0.027
Falcons	**0**	**0**	**0.001**	**0.005**	**0.00**	**0.004**
American Kestrel	--	--	0.001	0.005	0.00	0.004
Owls	**0.001**	**0.004**	**0.00**	**0.003**	**0.00**	**0.002**
Barred Owl	0.001	0.004	0.00	0.003	0.00	0.002
Doves	**0.045**	**0.062**	**0.018**	**0.029**	**0.017**	**0.042**
Mourning Dove	0.045	0.062	0.018	0.029	0.017	0.042
Cuckoos	**0.032**	**0.011**	**0.003**	**0.008**	**0.006**	**0.013**
Black-billed Cuckoo	0.004	0.029	0.00	0.003	0.00	0.002
Yellow-billed Cuckoo	0.028	0.055	0.003	0.006	0.006	0.010
Nightjars	**0.001**	**0.006**	**0.028**	**0.04**	**0.018**	**0.025**
Common Nighthawk	--	--	0.028	0.03	0.018	0.024
Whip-poor-will	0.001	0.006	--	--	0.00	0.003
Swifts/Hummingbirds	**0.012**	**0.042**	**0.010**	**0.022**	**0.009**	**0.015**
Chimney Swift	0.006	0.022	0.006	0.012	0.005	0.01
Ruby-throated Hummingbird	0.006	0.031	0.004	0.007	0.004	0.009
Woodpeckers	**0.156**	**0.095**	**0.104**	**0.085**	**0.097**	**0.078**
Red-headed Woodpecker	0.003	0.004	0.001	0.004	0.001	0.004
Red-bellied Woodpecker	0.03	0.063	0.005	0.013	0.008	0.023
Yellow-bellied Sapsucker	--	--	0.003	0.006	0.002	0.005
Downy Woodpecker	0.055	0.073	0.022	0.036	0.023	0.051

Species/Group	Spring Use		Fall Use		Overall Use	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Hairy Woodpecker	0.019	0.045	0.015	0.040	0.014	0.040
Northern Flicker	0.045	0.062	0.049	0.055	0.042	0.056
Pileated Woodpecker	0.004	0.007	0.009	0.185	0.007	0.012
Passerines	**4.29**	**2.577**	**3.69**	**2.03**	**3.47**	**1.88**
Flycatchers	**0.135**	**0.129**	**0.102**	**0.158**	**0.103**	**0.156**
Eastern Wood-Pewee	0.059	0.063	0.027	0.041	0.034	0.045
Yellow-bellied Flycatcher	0.002	0.006	0.003	0.006	0.002	0.005
Alder Flycatcher	0.005	0.009	0.00	0.003	0.004	0.007
Willow Flycatcher	0.014	0.028	--	--	0.003	0.007
Least Flycatcher	0.03	0.04	0.009	0.019	0.011	0.027
Eastern Phoebe	0.009	0.015	0.062	0.09	0.045	0.085
Great Crested Flycatcher	0.015	0.103	0.001	0.003	0.004	0.007
Eastern Kingbird	0.001	0.003	--	--	0.00	0.002
Vireos	**0.374**	**0.295**	**0.092**	**0.131**	**0.160**	**0.250**
White-eyed Vireo	0.006	0.01	0.001	0.004	0.002	0.005
Blue-headed Vireo	0.112	0.175	0.029	0.045	0.043	0.112
Red-eyed Vireo	0.256	0.201	0.062	0.123	0.115	0.164
Corvids	**0.424**	**0.289**	**0.556**	**0.284**	**0.464**	**0.302**
Blue Jay	0.157	0.233	0.356	0.248	0.267	0.239
American Crow	0.226	0.301	0.177	0.153	0.167	0.224
Common Raven	0.041	0.055	0.023	0.040	0.030	0.058
Swallows	**0.018**	**0.032**	**0.005**	**0.009**	**0.010**	**0.011**
Tree Swallow	0.007	0.02	0.003	0.006	0.004	0.008

Species/Group	Spring Use		Fall Use		Overall Use	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Northern Rough-winged Swallow	0.001	0.003	0.001	0.003	0.002	0.003
Barn Swallow	0.01	0.034	0.001	0.003	0.004	0.007
Titmice/Chickadees	**0.216**	**0.16**	**0.086**	**0.131**	**0.115**	**0.159**
Black-capped Chickadee	0.135	0.306	0.065	0.12	0.075	0.154
Tufted Titmouse	0.081	0.058	0.021	0.09	0.04	0.083
Nuthatches/Creepers	**0.089**	**0.056**	**0.044**	**0.127**	**0.047**	**0.065**
Red-breasted Nuthatch	--	--	0.005	0.009	0.003	0.006
White-breasted Nuthatch	0.087	0.062	0.033	0.065	0.04	0.063
Brown Creeper	0.002	0.007	0.006	0.10	0.004	0.008
Wrens	**0.06**	**0.095**	**0.016**	**0.190**	**0.023**	**0.125**
Carolina Wren	0.007	0.028	0.003	0.006	0.005	0.10
House Wren	0.051	0.083	0.004	0.008	0.012	0.03
Winter Wren	0.002	0.005	0.009	0.180	0.006	0.120
Kinglets/Gnatcatchers	**0.035**	**0.06**	**0.041**	**0.052**	**0.038**	**0.102**
Golden-crowned Kinglet	0.007	0.015	0.012	0.020	0.011	0.018
Ruby-crowned Kinglet	0.023	0.10	0.026	0.05	0.024	0.080
Blue-gray Gnatcatcher	0.005	0.009	0.003	0.005	0.003	0.006
Thrushes	**0.531**	**0.215**	**0.388**	**0.206**	**0.353**	**0.189**
Eastern Bluebird	0.034	0.054	0.038	0.076	0.029	0.061
Veery	0.103	0.222	0.022	0.050	0.034	0.110
Gray-cheeked Thrush	--	--	0.079	0.128	0.050	0.10
Swainson’s Thrush	0.071	0.312	0.034	0.100	0.024	0.150
Hermit Thrush	0.05	0.064	0.025	0.041	0.021	0.048

Species/Group	Spring Use		Fall Use		Overall Use	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Wood Thrush	0.09	0.188	0.012	0.024	0.029	0.10
American Robin	0.183	0.255	0.178	0.200	0.166	0.233
Mimids	**0.146**	**0.14**	**0.059**	**0.109**	**0.067**	**0.116**
Gray Catbird	0.085	0.123	0.055	0.108	0.056	0.115
Brown Thrasher	0.061	0.2	0.004	0.007	0.011	0.014
Starlings	**0.006**	**0.013**	**0.886**	**0.429**	**0.568**	**0.302**
European Starling	0.006	0.013	0.886	0.429	0.568	0.302
Waxwings	**0.147**	**0.108**	**0.209**	**0.165**	**0.173**	**0.133**
Cedar Waxwing	0.147	0.108	0.209	0.165	0.173	0.133
Warblers	**1.091**	**0.305**	**0.450**	**0.226**	**0.495**	**0.241**
Blue-winged Warbler	--	--	0.00	0.002	0.00	0.002
Golden-winged Warbler	0.001	0.003	--	--	0.00	0.002
Tennessee Warbler	0.084	0.233	0.044	0.071	0.045	0.156
Nashville Warbler	--	--	0.004	0.007	0.003	0.006
Northern Parula	0.031	0.066	0.003	0.006	0.005	0.020
Chestnut-sided Warbler	0.148	0.266	0.006	0.120	0.039	0.185
Magnolia Warbler	0.056	0.199	0.024	0.040	0.026	0.115
Cape May Warbler	--	--	0.103	0.185	0.065	0.130
Black-throated Blue Warbler	0.041	0.109	0.015	0.050	0.020	0.074
Yellow-rumped Warbler	0.201	0.304	0.014	0.020	0.047	0.109
Black-throated Green Warbler	0.133	0.179	0.060	0.095	0.075	0.125
Blackburnian Warbler	0.003	0.008	0.016	0.049	0.011	0.025
Prairie Warbler	0.004	0.005	--	--	0.001	0.003

Species/Group	Spring Use		Fall Use		Overall Use	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Palm Warbler	--	--	0.019	0.044	0.011	0.038
Bay-breasted Warbler	--	--	0.016	0.050	0.010	0.040
Blackpoll Warbler	--	--	0.050	0.085	0.032	0.065
Black-and-white Warbler	0.006	0.102	0.009	0.130	0.008	0.120
American Redstart	0.08	0.147	0.006	0.012	0.015	0.090
Ovenbird	0.12	0.159	0.009	0.019	0.022	0.066
Worm-eating Warbler	--	--	0.00	0.003	0.00	0.002
Kentucky Warbler	0.008	0.09	--	--	0.002	0.05
Mourning Warbler	0.065	0.106	0.001	0.004	0.009	0.060
Common Yellowthroat	0.042	0.108	0.018	0.050	0.020	0.075
Hooded Warbler	0.057	0.099	0.030	0.080	0.023	0.055
Wilson's Warbler	--	--	0.002	0.005	0.001	0.003
Canada Warbler	0.005	0.009	0.00	0.003	0.002	0.004
Yellow-breasted Chat	0.006	0.007	0.001	0.003	0.003	0.005
Unidentified Warblers	**0.001**	**0.021**	**0.001**	**0.024**	**0.001**	**0.019**
Tanagers	**0.094**	**0.166**	**0.006**	**0.015**	**0.022**	**0.086**
Scarlet Tanager	0.094	0.166	0.006	0.015	0.022	0.086
Grassland/Sparrows	**0.723**	**0.204**	**0.543**	**0.288**	**0.523**	**0.275**
Eastern Towhee	0.069	0.127	0.092	0.159	0.080	0.135
Chipping Sparrow	0.045	0.105	0.120	0.200	0.093	0.168
Field Sparrow	0.038	0.097	0.021	0.057	0.030	0.061
Vesper Sparrow	--	--	0.012	0.038	0.008	0.016
Song Sparrow	0.135	0.156	0.033	0.065	0.050	0.103

Species/Group	Spring Use		Fall Use		Overall Use	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Swamp Sparrow	--	--	0.002	0.004	0.001	0.003
White-throated Sparrow	--	--	0.060	0.128	0.035	0.085
White-crowned Sparrow	--	--	0.004	0.009	0.003	0.007
Dark-eyed Junco	0.151	0.206	0.151	0.231	0.128	0.199
Northern Cardinal	0.015	0.20	0.006	0.012	0.010	0.09
Rose-breasted Grosbeak	0.125	0.195	0.019	0.040	0.039	0.089
Indigo Bunting	0.145	0.237	0.023	0.051	0.046	0.100
Blackbirds	**0.087**	**0.119**	**0.319**	**0.249**	**0.218**	**0.205**
Red-winged Blackbird	0.03	0.047	0.012	0.039	0.013	0.040
Common Grackle	--	--	0.300	0.233	0.189	0.201
Brown-headed Cowbird	0.057	0.111	0.007	0.014	0.016	0.049
Finches	**0.113**	**0.18**	**0.094**	**0.165**	**0.088**	**0.160**
Purple Finch	--	--	0.009	0.154	0.006	0.012
American Goldfinch	0.113	0.18	0.085	0.159	0.082	0.162

TABLE 6

Estimated percent composition (mean use divided by total use for all species) and frequency of occurrence (percent of surveys species is recorded) for each species observed within 50 m of the survey point.

Species/Group	% Composition			% Frequency		
	Spring	Fall	Overall	Spring	Fall	Overall
Waterfowl	**0.18**	**0.09**	**0.12**	**0.31**	**0.09**	**0.17**
Wood Duck	0.08	--	0.02	0.10	--	0.04
Mallard	0.10	0.09	0.10	0.21	0.09	0.13
Upland Gamebirds	**0.81**	**1.11**	**1.37**	**2.65**	**1.80**	**2.11**
Ruffed Grouse	0.19	0.16	0.37	1.92	0.62	1.09
Wild Turkey	0.63	0.95	1.00	0.73	1.18	1.02
Raptors	**4.32**	**9.67**	**8.67**	**8.90**	**20.53**	**16.32**
Vultures	**3.42**	**5.74**	**5.56**	**6.03**	**7.78**	**7.14**
Black Vulture	0.10	0.19	0.17	0.21	0.27	0.24
Turkey Vulture	3.32	5.55	5.39	5.82	7.51	6.90
Ospreys	**--**	**0.05**	**0.05**	**--**	**0.18**	**0.11**
Osprey	--	0.05	0.05	--	0.18	0.11
Harrier and Eagles	**0.08**	**0.05**	**0.07**	**0.16**	**0.30**	**0.24**
Northern Harrier	0.08	0.05	0.07	0.16	0.24	0.21
Bald Eagle	--	0.00	0.00	--	0.03	0.02
Golden Eagle	--	0.00	0.00	--	0.03	0.02
Accipiters	**0.50**	**0.49**	**0.40**	**1.30**	**1.56**	**1.47**
Sharp-shinned Hawk	0.44	0.42	0.30	0.88	1.12	1.03
Cooper’s Hawk	0.06	0.07	0.10	0.42	0.44	0.43
Buteos	**0.29**	**3.33**	**2.58**	**1.25**	**10.43**	**7.11**

Species/Group	% Composition			% Frequency		
	Spring	Fall	Overall	Spring	Fall	Overall
Red-shouldered Hawk	0.10	0.05	0.07	0.36	0.15	0.23
Broad-winged Hawk	0.06	2.82	2.14	0.52	8.84	5.83
Red-tailed Hawk	0.13	0.46	0.37	0.36	1.44	1.05
Falcons	**0**	**0.02**	**0.00**	**0**	**0.12**	**0.08**
American Kestrel	--	0.02	0.00	--	0.12	0.08
Owls	**0.02**	**0.00**	**0.00**	**0.16**	**0.06**	**0.09**
Barred Owl	0.02	0.00	0.00	0.16	0.06	0.09
Doves	**0.94**	**0.42**	**0.42**	**1.61**	**0.56**	**0.94**
Mourning Dove	0.94	0.42	0.42	1.61	0.56	0.94
Cuckoos	**0.67**	**0.07**	**0.15**	**1.40**	**0.35**	**0.73**
Black-billed Cuckoo	0.08	0.00	0.00	0.26	0.06	0.13
Yellow-billed Cuckoo	0.58	0.07	0.15	1.14	0.29	0.60
Nightjars	**0.02**	**0.65**	**0.45**	**0.10**	**0.44**	**0.32**
Common Nighthawk	--	0.65	0.45	--	0.44	0.28
Whip-poor-will	0.02	--	0.00	0.10	--	0.04
Swifts/ Hummingbirds	**0.25**	**0.23**	**0.22**	**0.52**	**0.56**	**0.55**
Chimney Swift	0.12	0.14	0.12	0.10	0.12	0.11
Ruby-throated Hummingbird	0.13	0.09	0.10	0.42	0.44	0.43
Woodpeckers	**3.26**	**2.41**	**2.41**	**8.83**	**7.22**	**7.80**
Red-headed Woodpecker	0.06	0.02	0.03	0.10	0.12	0.11

Species/Group	% Composition			% Frequency		
	Spring	Fall	Overall	Spring	Fall	Overall
Red-bellied Woodpecker	0.63	0.12	0.20	1.04	0.38	0.62
Yellow-bellied Sapsucker	--	0.07	0.05	--	0.24	0.15
Downy Woodpecker	1.04	0.51	0.57	3.27	1.68	2.26
Hairy Woodpecker	0.40	0.35	0.35	1.04	1.27	1.18
Northern Flicker	0.94	1.13	1.04	2.86	2.95	2.91
Pileated Woodpecker	0.08	0.21	0.17	0.52	0.59	0.56
Passerines	**89.5**	**85.36**	**86.19**	**97.4**	**93.7**	**96.2**
Flycatchers	**2.82**	**2.36**	**2.56**	**8.88**	**9.19**	**9.08**
Eastern Wood-Pewee	1.23	0.62	0.84	4.16	2.33	2.99
Yellow-bellied Flycatcher	0.04	0.07	0.05	0.16	0.29	0.24
Alder Flycatcher	0.11	0.00	0.10	0.42	0.06	0.19
Willow Flycatcher	0.29	--	0.07	0.73	--	0.26
Least Flycatcher	0.63	0.21	0.27	1.45	0.82	1.05
Eastern Phoebe	0.19	1.43	1.12	0.83	5.45	3.78
Great Crested Flycatcher	0.31	0.02	0.10	1.05	0.09	0.43
Eastern Kingbird	0.02	--	0.00	0.10	--	0.04
Vireos	**7.81**	**2.13**	**3.97**	**22.13**	**8.10**	**13.18**
White-eyed Vireo	0.13	0.02	0.05	0.36	0.15	0.23
Blue-headed Vireo	2.34	0.67	1.07	6.23	2.65	3.95
Red-eyed Vireo	5.34	1.43	2.86	15.53	5.30	9.00
Corvids	**8.85**	**12.86**	**11.52**	**21.25**	**33.52**	**29.08**

Species/Group	% Composition			% Frequency		
	Spring	Fall	Overall	Spring	Fall	Overall
Blue Jay	3.28	8.23	6.63	8.31	23.42	17.95
American Crow	4.72	4.09	4.15	10.39	8.10	8.93
Common Raven	0.86	0.53	0.75	2.55	2.00	2.20
Swallows	**0.38**	**0.12**	**0.25**	**0.73**	**0.12**	**0.34**
Tree Swallow	0.15	0.07	0.10	0.16	0.06	0.09
Northern Rough-winged Swallow	0.02	0.02	0.05	0.05	0.03	0.04
Barn Swallow	0.21	0.02	0.10	0.52	0.03	0.21
Titmice/Chickadees	**4.51**	**1.99**	**2.86**	**12.05**	**4.86**	**7.46**
Black-capped Chickadee	2.82	1.50	1.86	6.91	3.39	4.66
Tufted Titmouse	1.69	0.49	0.99	5.14	1.47	0.21
Nuthatches/ Creepers	**1.86**	**1.02**	**1.17**	**4.83**	**3.03**	**3.68**
Red-breasted Nuthatch	--	0.12	0.07	--	0.29	0.19
White-breasted Nuthatch	1.82	0.76	0.99	4.57	2.15	3.03
Brown Creeper	0.04	0.14	0.10	0.26	0.59	0.47
Wrens	**1.25**	**0.37**	**0.57**	**2.80**	**1.33**	**1.86**
Carolina Wren	0.15	0.07	0.12	0.57	0.12	0.28
House Wren	1.06	0.09	0.30	2.08	0.35	0.98
Winter Wren	0.04	0.21	0.15	0.16	0.85	0.60
Kinglets/ Gnatcatchers	**0.73**	**0.95**	**0.94**	**1.45**	**2.62**	**2.20**

Species/Group	% Composition			% Frequency		
	Spring	Fall	Overall	Spring	Fall	Overall
Golden-crowned Kinglet	0.15	0.28	0.27	0.42	1.53	0.71
Ruby-crowned Kinglet	0.48	0.60	0.60	0.73	1.53	1.24
Blue-gray Gnatcatcher	0.10	0.07	0.07	0.31	0.21	0.24
Thrushes	**11.08**	**8.98**	**8.77**	**23.79**	**1.26**	**16.67**
Eastern Bluebird	0.71	0.88	0.72	0.73	0.65	0.68
Veery	2.15	0.51	0.84	5.51	2.15	3.36
Gray-cheeked Thrush	--	1.83	1.24	--	5.54	3.53
Swainson’s Thrush	1.48	0.79	0.60	2.55	0.97	1.54
Hermit Thrush	1.04	0.58	0.52	2.08	2.09	2.09
Wood Thrush	1.88	0.28	0.72	4.88	0.59	2.14
American Robin	3.82	4.12	4.12	8.05	0.65	3.33
Mimids	**3.05**	**1.36**	**1.66**	**6.49**	**5.30**	**5.73**
Gray Catbird	1.77	1.27	1.39	4.57	4.98	4.83
Brown Thrasher	1.27	0.09	0.27	1.92	0.32	0.90
Starlings	**0.13**	**20.50**	**14.11**	**0.26**	**0.41**	**0.36**
European Starling	0.13	20.50	14.11	0.26	0.41	0.36
Waxwings	**3.07**	**4.83**	**4.30**	**5.82**	**4.04**	**4.68**
Cedar Waxwing	3.07	4.83	4.30	5.82	4.04	4.68
Warblers	**22.77**	**10.41**	**12.30**	**40.99**	**22.65**	**29.34**
Blue-winged Warbler	--	0.00	0.00	--	0.03	0.02
Golden-winged Warbler	0.02	--	0.00	0.10	--	0.04

Species/Group	% Composition			% Frequency		
	Spring	Fall	Overall	Spring	Fall	Overall
Tennessee Warbler	1.75	1.02	1.12	3.58	0.56	1.65
Nashville Warbler	--	0.09	0.07	--	0.41	0.26
Northern Parula	0.65	0.07	0.12	0.94	0.29	0.53
Chestnut-sided Warbler	3.09	0.14	0.97	8.52	0.53	3.42
Magnolia Warbler	1.17	0.56	0.65	1.71	1.33	1.47
Cape May Warbler	--	2.38	1.61		2.65	1.69
Black-throated Blue Warbler	0.86	0.35	0.50	1.35	1.18	1.24
Yellow-rumped Warbler	4.20	0.32	1.17	3.69	0.32	1.54
Black-throated Green Warbler	2.78	1.39	1.86	6.34	4.68	5.28
Blackburnian Warbler	0.06	0.37	0.27	0.26	0.91	0.68
Prairie Warbler	0.08	--	0.02	0.31	--	0.11
Palm Warbler	--	0.44	0.27	--	1.21	0.77
Bay-breasted Warbler	--	0.37	0.25	--	0.82	0.53
Blackpoll Warbler	--	1.16	0.80	--	1.86	1.18
Black-and-white Warbler	0.13	0.21	0.20	0.73	0.71	0.71
American Redstart	1.67	0.14	0.37	2.86	0.35	1.26
Ovenbird	2.50	0.21	0.55	3.69	0.88	1.90
Worm-eating Warbler	--	0.00	0.00	--	0.06	0.04
Kentucky Warbler	0.17	--	0.05	0.52	--	0.19
Mourning Warbler	1.36	0.02	0.22	2.29	0.15	0.92

Species/Group	% Composition			% Frequency		
	Spring	Fall	Overall	Spring	Fall	Overall
Common Yellowthroat	0.88	0.42	0.50	1.30	1.44	1.39
Hooded Warbler	1.19	0.70	0.57	1.66	1.77	1.73
Wilson's Warbler	--	0.05	0.02	--	0.24	0.15
Canada Warbler	0.10	0.00	0.05	0.47	0.03	0.19
Yellow-breasted Chat	0.13	0.02	0.07	0.68	0.12	0.32
Unidentified Warblers	0.02	0.02	0.02	0.16	0.12	0.13
Tanagers	**1.96**	**0.14**	**0.55**	**4.68**	**0.44**	**1.97**
Scarlet Tanager	1.96	0.14	0.55	4.68	0.44	1.97
Grassland/Sparrows	**15.09**	**12.56**	**12.99**	**37.87**	**29.07**	**32.26**
Eastern Towhee	1.44	2.13	1.99	4.36	6.72	5.86
Chipping Sparrow	0.94	2.78	2.31	4.31	4.95	4.72
Field Sparrow	0.79	0.49	0.75	3.74	1.30	2.18
Vesper Sparrow	--	0.28	0.20	--	0.77	0.49
Song Sparrow	2.82	0.76	1.24	5.77	1.91	3.31
Swamp Sparrow	--	0.05	0.02	--	0.18	0.11
White-throated Sparrow	--	1.39	0.87	--	2.77	1.77
White-crowned Sparrow	--	0.09	0.07	--	0.27	0.17
Dark-eyed Junco	3.15	3.49	3.18	6.70	7.69	7.33
Northern Cardinal	0.31	0.14	0.25	1.35	0.27	0.66
Rose-breasted Grosbeak	2.61	0.44	0.97	6.18	0.85	2.78
Indigo Bunting	3.03	0.53	1.14	5.45	1.38	2.86

Species/Group	% Composition			% Frequency		
	Spring	Fall	Overall	Spring	Fall	Overall
Blackbirds	**1.82**	**7.38**	**5.41**	**3.27**	**0.41**	**1.45**
Red-winged Blackbird	0.63	0.28	0.32	0.94	0.09	0.39
Common Grackle	--	6.94	4.70	--	0.18	0.11
Brown-headed Cowbird	1.19	0.16	0.40	2.34	0.15	0.94
Finches	**2.36**	**2.17**	**2.19**	**6.23**	**1.94**	**3.50**
Purple Finch	--	0.21	0.15	--	0.15	0.09
American Goldfinch	2.36	1.97	2.04	6.23	1.80	3.40

TABLE 7

Flight height characteristics of bird species/groups observed during fixed-point surveys in the spring 2005 season.

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Waterfowl	**15**	**6**	**100.00**	**0.00**	**80.00**	**20.00**
Wood Duck	6	2	100.00	0.00	50.00	50.00
Mallard	9	4	100.00	0.00	100.00	0.00
Upland Gamebirds	**5**	**3**	**6.76**	**100.00**	**0.00**	**0.00**
Ruffed Grouse	2	2	4.44	100.00	0.00	0.00
Wild Turkey	3	1	10.34	100.00	0.00	0.00
Raptors	**282**	**136**	**77.05**	**14.18**	**79.08**	**6.74**
Vultures	**251**	**109**	**83.67**	**13.94**	**79.28**	**6.77**
Black Vulture	15	4	100.00	0.00	100.00	0.00
Turkey Vulture	236	105	82.81	14.83	77.97	7.20
Harrier and Eagles	**3**	**3**	**100.00**	**0.00**	**66.67**	**33.33**
Northern Harrier	3	3	100.00	0.00	66.67	33.33
Accipiters	**15**	**13**	**53.57**	**26.67**	**73.33**	**0.00**
Sharp-shinned Hawk	12	10	60.00	16.67	83.33	0.00
Cooper's Hawk	3	3	37.50	66.67	33.33	0.00
Buteos	**13**	**11**	**40.62**	**7.69**	**76.92**	**15.38**
Red-shouldered Hawk	4	3	40.00	25.00	75.00	0.00
Broad-winged Hawk	6	6	46.15	0.00	83.33	16.67
Red-tailed Hawk	3	2	33.33	0.00	66.67	33.33
Falcons	**0**	**0**	**0.00**	**N/A**	**N/A**	**N/A**

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Owls	**0**	**0**	**0.00**	**N/A**	**N/A**	**N/A**
Barred Owl	**0**	**0**	**0.00**	**N/A**	**N/A**	**N/A**
Doves	**6**	**4**	**12.24**	**50.00**	**50.00**	**0.00**
Mourning Dove	6	4	12.24	50.00	50.00	0.00
Cuckoos	**0**	**0**	**0.00**	**N/A**	**N/A**	**N/A**
Black-billed Cuckoo	0	0	0.00	N/A	N/A	N/A
Yellow-billed Cuckoo	0	0	0.00	N/A	N/A	N/A
Nightjars	**0**	**0**	**0.00**	**N/A**	**N/A**	**N/A**
Whip-poor-will	0	0	0.00	N/A	N/A	N/A
Swifts/ Hummingbirds	**12**	**8**	**85.71**	**50.00**	**50.00**	**0.00**
Chimney Swift	6	2	100.00	0.00	100.00	0.00
Ruby-throated Hummingbird	6	6	75.00	100.00	0.00	0.00
Woodpeckers	**55**	**50**	**29.26**	**74.55**	**25.45**	**0.00**
Red-headed Woodpecker	2	2	100.00	100.00	0.00	0.00
Red-bellied Woodpecker	8	7	33.33	100.00	0.00	0.00
Downy Woodpecker	7	7	10.14	71.43	28.57	0.00
Hairy Woodpecker	2	2	9.10	100.00	0.00	0.00
Northern Flicker	29	25	47.54	82.76	17.24	0.00
Pileated Woodpecker	7	7	70.00	0.00	100.00	0.00
Passerines	**1293**	**879**	**25.62**	**67.90**	**32.10**	**0.00**
Flycatchers	**20**	**19**	**10.75**	100.00	0.00	0.00

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Eastern Wood-Pewee	4	4	4.44	100.00	0.00	0.00
Yellow-bellied Flycatcher	0	0	0.00	N/A	N/A	N/A
Alder Flycatcher	1	1	12.50	100.00	0.00	0.00
Willow Flycatcher	0	0	0.00	N/A	N/A	N/A
Least Flycatcher	0	0	0.00	N/A	N/A	N/A
Eastern Phoebe	8	7	40.00	100.00	0.00	0.00
Great Crested Flycatcher	5	5	25.00	100.00	0.00	0.00
Eastern Kingbird	2	2	100.00	100.00	0.00	0.00
Vireos	**15**	**15**	**2.79**	**93.33**	**6.67**	**0.00**
White-eyed Vireo	0	0	0.00	N/A	N/A	N/A
Blue-headed Vireo	9	9	6.98	88.89	11.11	0.00
Red-eyed Vireo	6	6	1.50	100.00	0.00	0.00
Corvids	**298**	**187**	**53.31**	**43.29**	**56.71**	**0.00**
Blue Jay	71	20	34.80	56.34	43.66	0.00
American Crow	207	155	71.38	40.10	59.90	0.00
Common Raven	20	12	30.77	30.00	70.00	0.00
Swallows	**26**	**13**	**89.66**	**100.00**	**0.00**	**0.00**
Tree Swallow	10	3	100.00	100.00	0.00	0.00
Northern Rough-winged Swallow	3	1	100.00	100.00	0.00	0.00
Barn Swallow	13	9	81.25	100.00	0.00	0.00
Titmice/Chickadees	**15**	**4**	**5.08**	**100.00**	**0.00**	**0.00**

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Black-capped Chickadee	7	2	4.14	100.00	0.00	0.00
Tufted Titmouse	8	2	6.35	100.00	0.00	0.00
Nuthatches/ Creepers	**10**	**7**	**9.52**	**100.00**	**0.00**	**0.00**
White-breasted Nuthatch	10	7	10.00	100.00	0.00	0.00
Brown Creeper	0	0	0.00	N/A	N/A	N/A
Wrens	**4**	**3**	**6.25**	**100.00**	**0.00**	**0.00**
Carolina Wren	4	3	26.67	100.00	0.00	0.00
House Wren	0	0	0.00	N/A	N/A	N/A
Winter Wren	0	0	0.00	N/A	N/A	N/A
Kinglets/ Gnatcatchers	**15**	**11**	**42.86**	**100.00**	**0.00**	**0.00**
Golden-crowned Kinglet	0	0	0.00	N/A	N/A	N/A
Ruby-crowned Kinglet	13	9	65.00	100.00	0.00	0.00
Blue-gray Gnatcatcher	2	2	28.57	100.00	0.00	0.00
Thrushes	**108**	**73**	**17.94**	**88.89**	**11.11**	**0.00**
Eastern Bluebird	15	9	62.50	80.00	20.00	0.00
Veery	0	0	0.00	N/A	N/A	N/A
Swainson’s Thrush	5	2	8.20	100.00	0.00	0.00
Hermit Thrush	7	5	17.50	100.00	0.00	0.00
Wood Thrush	12	12	12.00	100.00	0.00	0.00

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
American Robin	69	45	26.44	86.96	13.04	0.00
Mimids	**18**	**16**	**13.43**	**100.00**	**0.00**	**0.00**
Gray Catbird	10	9	10.64	100.00	0.00	0.00
Brown Thrasher	8	7	20.00	100.00	0.00	0.00
Starlings	**10**	**4**	**83.33**	**60.00**	**40.00**	**0.00**
European Starling	10	4	83.33	60.00	40.00	0.00
Waxwings	**130**	**80**	**65.33**	**44.62**	**55.38**	**0.00**
Cedar Waxwing	130	80	65.33	44.62	55.38	0.00
Warblers	**234**	**129**	**22.90**	**75.64**	**24.36**	**0.00**
Golden-winged Warbler	0	0	0.00	N/A	N/A	N/A
Tennessee Warbler	10	3	11.11	100.00	0.00	0.00
Northern Parula	0	0	0.00	N/A	N/A	N/A
Chestnut-sided Warbler	14	12	7.57	100.00	0.00	0.00
Magnolia Warbler	8	6	19.51	100.00	0.00	0.00
Black-throated Blue Warbler	0	0	0.00	N/A	N/A	N/A
Yellow-rumped Warbler	142	48	68.93	66.90	33.10	0.00
Black-throated Green Warbler	28	28	20.29	67.86	32.14.	0.00
Blackburnian Warbler	0	0	0.00	N/A	N/A	N/A
Prairie Warbler	0	0	0.00	N/A	N/A	N/A

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Black-and-white Warbler	4	4	28.57	100.00	0.00	0.00
American Redstart	7	7	11.48	100.00	0.00	0.00
Ovenbird	0	0	0.00	N/A	N/A	N/A
Kentucky Warbler	0	0	0.00	N/A	N/A	N/A
Mourning Warbler	0	0	0.00	N/A	N/A	N/A
Common Yellowthroat	4	4	16.00	100.00	0.00	0.00
Hooded Warbler	9	9	25.71	100.00	0.00	0.00
Canada Warbler	2	2	22.22	100.00	0.00	0.00
Yellow-breasted Chat	6	6	46.15	50.00	50.00	0.00
Tanagers	**13**	**13**	**13.40**	**53.85**	**46.15**	**0.00**
Scarlet Tanager	13	13	13.40	53.85	46.15	0.00
Grassland/Sparrows	**206**	**169**	**22.17**	**95.63**	**4.37**	**0.00**
Eastern Towhee	9	9	8.41	100.00	0.00	0.00
Chipping Sparrow	15	9	15.79	100.00	0.00	0.00
Field Sparrow	12	12	14.81	100.00	0.00	0.00
Song Sparrow	49	37	37.69	100.00	0.00	0.00
Dark-eyed Junco	51	40	30.18	100.00	0.00	0.00
Northern Cardinal	5	5	15.15	100.00	0.00	0.00
Rose-breasted Grosbeak	59	51	40.69	50.85	49.15	0.00
Indigo Bunting	6	6	3.55	100.00	0.00	0.00
Blackbirds	**45**	**36**	**50.56**	**51.11**	**48.89**	**0.00**

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Red-winged Blackbird	2	1	7.14	100.00	0.00	0.00
Brown-headed Cowbird	43	35	70.49	48.84	51.16	0.00
Finches	**126**	**100**	**84.56**	**50.00**	**50.00**	**0.00**
American Goldfinch	126	100	84.56	50.00	50.00	0.00
Unidentified Warblers	0	0	0.00	N/A	N/A	N/A
Overall	***1668***	***1086***	***28.85***	***58.33***	***40.35***	***1.32***

TABLE 8

Flight height characteristics of bird species/groups observed during fixed-point surveys in the fall 2005 season.

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Waterfowl	**10**	**4**	**100.00**	**0.00**	**100.00**	**0.00**
Mallard	10	4	100.00	0.00	100	0.00
Upland Gamebirds	**19**	**8**	**9.45**	**63.16**	**36.84**	**0.00**
Ruffed Grouse	5	5	17.24	100.00	0.00	0.00
Wild Turkey	14	3	8.14	50.00	50.00	0.00
Raptors	**1299**	**632**	**93.45**	**10.23**	**84.45**	**5.32**
Vultures	**805**	**260**	**97.10**	**14.53**	**85.47**	**0.00**
Black Vulture	26	8	86.67	0.00	100.00	0.00
Turkey Vulture	779	252	97.50	15.02	84.98	0.00
Ospreys	**6**	**6**	**100.00**	**0.00**	**0.00**	**100.00**
Osprey	6	6	100.00	0.00	0.00	100.00
Harrier and Eagles	**10**	**10**	**100.00**	**20.00**	**60.00**	**20.00**
Northern Harrier	8	8	100.00	25.00	75.00	0.00
Bald Eagle	1	1	100.00	0.00	0.00	100.00
Golden Eagle	1	1	100.00	0.00	0.00	100.00
Accipiters	**49**	**46**	**53.57**	**20.41**	**79.59**	**0.00**
Sharp-shinned Hawk	37	34	88.10	10.81	89.19	0.00
Cooper’s Hawk	12	12	80.00	50.00	50.00	0.00
Buteos	**426**	**307**	**40.62**	**20**	**72.66**	**7.34**
Red-shouldered Hawk	6	4	75.00	16.67	83.33	0.00

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Broad-winged Hawk	386	273	93.01	0.00	87.05	12.95
Red-tailed Hawk	34	30	61.82	0.00	67.65	32.35
Falcons	**3**	**3**	**75.00**	**0.00**	**100.00**	**0.00**
American Kestrel	3	3	75.00	0.00	100.00	0.00
Owls	**0**	**0**	**0.00**	**N/A**	**N/A**	**N/A**
Barred Owl	**0**	**0**	**0.00**	**N/A**	**N/A**	**N/A**
Doves	**5**	**4**	**12.50**	**40.00**	**60.00**	**0.00**
Mourning Dove	5	4	12.50	40.00	60.00	0.00
Cuckoos	**0**	**0**	**0.00**	**N/A**	**N/A**	**N/A**
Black-billed Cuckoo	0	0	0.00	N/A	N/A	N/A
Yellow-billed Cuckoo	0	0	0.00	N/A	N/A	N/A
Nightjars	**94**	**15**	**0.00**	**0.00**	**100.00**	**0.00**
Common Nighthawk	94	15	100.00	0.00	100.00	0.00
Swifts/ Hummingbirds	**32**	**16**	**91.43**	**37.50**	**62.50**	**0.00**
Chimney Swift	20	4	100.00	0.00	100.00	0.00
Ruby-throated Hummingbird	12	12	80.00	100.00	0.00	0.00
Woodpeckers	**134**	**101**	**38.07**	**71.64**	**28.36**	**0.00**
Red-headed Woodpecker	1	1	25.00	100.00	0.00	0.00
Red-bellied Woodpecker	9	8	50.00	100.00	0.00	0.00
Yellow-bellied Sapsucker	4	4	50.00	100.00	0.00	0.00
Downy Woodpecker	26	24	34.67	69.23	30.77	0.00

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Hairy Woodpecker	10	9	19.61	100.00	0.00	0.00
Northern Flicker	63	40	38.18	85.71	14.29	0.00
Pileated Woodpecker	21	15	72.41	0.00	100.00	0.00
Passerines	**7606**	**1478**	**57.40**	**35.58**	**64.36**	**0.06**
Flycatchers	**138**	**131**	**38.98**	**100.00**	**0.00**	**0.00**
Eastern Wood-Pewee	10	10	10.75	100.00	0.00	0.00
Yellow-bellied Flycatcher	0	0	0.00	N/A	N/A	N/A
Alder Flycatcher	0	0	0.00	N/A	N/A	N/A
Least Flycatcher	15	15	48.39	100.00	0.00	0.00
Eastern Phoebe	113	106	53.81	100.00	0.00	0.00
Great Crested Flycatcher	0	0	0.00	N/A	N/A	N/A
Vireos	**26**	**22**	**8.28**	**100.00**	**0.00**	**0.00**
White-eyed Vireo	0	0	0.00	N/A	N/A	N/A
Blue-headed Vireo	13	12	13.13	100.00	0.00	0.00
Red-eyed Vireo	13	10	6.02	100.00	0.00	0.00
Corvids	**1060**	**614**	**55.67**	**31.98**	**67.55**	**0.47**
Blue Jay	544	390	45.07	20.04	79.96	0.00
American Crow	480	192	80.00	46.04	53.96	0.00
Common Raven	36	32	37.11	25.00	61.11	13.89
Swallows	**20**	**3**	**80.00**	**100.00**	**0.00**	**0.00**
Tree Swallow	5	1	50.00	100.00	0.00	0.00
Northern Rough-winged Swallow	8	1	100.00	100.00	0.00	0.00

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Barn Swallow	7	1	100.00	100.00	0.00	0.00
Titmice/Chickadees	**25**	**7**	**8.33**	**100.00**	**0.00**	**0.00**
Black-capped Chickadee	16	5	7.02	100.00	0.00	0.00
Tufted Titmouse	9	2	12.50	100.00	0.00	0.00
Nuthatches/ Creepers	**17**	**14**	**11.49**	**100.00**	**0.00**	**0.00**
Red-breasted Nuthatch	2	2	12.50	100.00	0.00	0.00
White-breasted Nuthatch	15	12	13.39	100.00	0.00	0.00
Brown Creeper	0	0	0.00	N/A	N/A	N/A
Wrens	**7**	**6**	**11.29**	**100.00**	**0.00**	**0.00**
Carolina Wren	2	1	22.22	100.00	0.00	0.00
House Wren	0	0	0.00	N/A	N/A	N/A
Winter Wren	5	5	14.29	100.00	0.00	0.00
Kinglets/ Gnatcatchers	**38**	**16**	**23.75**	**100.00**	**0.00**	**0.00**
Golden-crowned Kinglet	12	4	23.53	100.00	0.00	0.00
Ruby-crowned Kinglet	20	8	20.20	100.00	0.00	0.00
Blue-gray Gnatcatcher	6	4	60.00	100.00	0.00	0.00
Thrushes	**582**	**86**	**44.77**	**65.98**	**34.02**	**0.00**
Eastern Bluebird	83	14	64.84	57.83	42.17	0.00
Veery	9	8	11.11	100.00	0.00	0.00
Gray-cheeked Thrush	31	31	11.57	100.00	100.00	0.00
Swainson’s Thrush	11	3	12.22	100.00	0.00	0.00
Hermit Thrush	16	12	18.82	100.00	0.00	0.00

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Wood Thrush	3	3	6.82	100.00	0.00	0.00
American Robin	429	15	71.03	62.00	38.00	0.00
Mimids	**21**	**15**	**9.72**	**100.00**	**0.00**	**0.00**
Gray Catbird	15	12	7.50	100.00	0.00	0.00
Brown Thrasher	6	3	37.5	100.00	0.00	0.00
Starlings	**2856**	**12**	**94.92**	**20.00**	**80.00**	**0.00**
European Starling	2856	12	894.92	20.00	80.00	0.00
Waxwings	**418**	**70**	**58.99**	**29.90**	**70.10**	**0.00**
Cedar Waxwing	418	70	58.99	29.90	70.10	0.00
Warblers	**496**	**200**	**32.57**	**61.29**	**38.71**	**0.00**
Blue-winged Warbler	0	0	0.00	N/A	N/A	N/A
Tennessee Warbler	25	6	16.56	100.00	0.00	0.00
Nashville Warbler	0	0	0.00	N/A	N/A	N/A
Northern Parula	2	2	20.00	100.00	0.00	0.00
Chestnut-sided Warbler	3	3	14.29	100.00	0.00	0.00
Magnolia Warbler	10	6	12.05	100.00	0.00	0.00
Cape May Warbler	289	75	82.57	48.10	51.90	0.00
Black-throated Blue Warbler	20	14	38.46	100.00	0.00	0.00
Yellow-rumped Warbler	29	6	63.04	68.97	31.03	0.00
Black-throated Green Warbler	53	39	25.85	79.25	20.75	0.00
Blackburnian Warbler	9	6	16.36	77.78	22.22	0.00
Palm Warbler	5	2	8.33	100.00	0.00	0.00

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Bay-breasted Warbler	3	3	5.56	100.00	0.00	0.00
Blackpoll Warbler	27	20	15.88	25.93	74.07	0.00
Black-and-white Warbler	1	1	3.23	100.00	0.00	0.00
American Redstart	3	3	15.00	100.00	0.00	0.00
Ovenbird	0	0	0.00	N/A	N/A	N/A
Mourning Warbler	0	0	0.00	N/A	N/A	N/A
Common Yellowthroat	8	8	13.11	100.00	0.00	0.00
Hooded Warbler	9	6	10.59	100.00	0.00	0.00
Wilson's Warbler	0	0	0.00	N/A	N/A	N/A
Canada Warbler	0	0	0.00	N/A	N/A	N/A
Yellow-breasted Chat	0	0	0.00	N/A	N/A	N/A
Unidentified Warbler	0	0	0.00	N/A	N/A	N/A
Tanagers	**4**	**4**	**18.18**	**100.00**	**0.00**	**0.00**
Scarlet Tanager	4	4	18.18	100.00	0.00	0.00
Grassland/Sparrows	**579**	**198**	**54.21**	**94.99**	**5.01**	**0.00**
Eastern Towhee	31	14	9.94	100.00	0.00	0.00
Chipping Sparrow	223	75	55.75	100.00	0.00	0.00
Field Sparrow	6	6	8.45	100.00	0.00	0.00
Vesper Sparrow	26	18	63.41	100.00	0.00	0.00
Song Sparrow	22	16	19.82	100.00	0.00	0.00
Swamp Sparrow	0	0	0.00	N/A	N/A	N/A
White-throated Sparrow	26	7	13.83	100.00	0.00	0.00
White-crowned Sparrow	0	0	0.00	N/A	N/A	N/A

Species/Group	No. Birds Flying	No. Groups Flying	% of Birds Flying	<25m	25-115m	>115m
Dark-eyed Junco	179	22	34.96	100.00	0.00	0.00
Northern Cardinal	13	8	61.90	76.92	23.08	0.00
Rose-breasted Grosbeak	35	26	54.69	25.71	74.29	0.00
Indigo Bunting	18	6	25.35	100.00	0.00	0.00
Blackbirds	**1064**	**24**	**99.63**	**0.00**	**100.00**	**0.00**
Red-winged Blackbird	40	14	100.00	0.00	100.00	0.00
Common Grackle	1004	6	100.00	0.00	100.00	0.00
Brown-headed Cowbird	20	4	83.33	0.00	100.00	0.00
Finches	**255**	**56**	**79.44**	**53.73**	**46.27**	**0.00**
Purple Finch	28	4	84.85	100.00	0.00	0.00
American Goldfinch	227	53	78.82	48.02	51.98	0.00
Overall	***9199***	***2258***	***59.79***	***32.19***	***67.01***	***0.80***

TABLE 9

Relative abundance of resident birds recorded along transects during the 2005 spring study. Birds are listed in descending order starting with the most abundant species. N = five 500-m transects sampled in mid-June.

Species	Number
Red-eyed Vireo	63
Chestnut-sided Warbler	51
Black-throated Green Warbler	45
Veery	41
Dark-eyed Junco	38
Ovenbird	38
Eastern Towhee	33
Indigo Bunting	32
Rose-breasted Grosbeak	27
American Robin	22
Brown-headed Cowbird	19
American Crow	15
Blue-headed Vireo	12
Cedar Waxwing	12
Song Sparrow	11
Least Flycatcher	10
Scarlet Tanager	10
Chipping Sparrow	9
Eastern Wood-Pewee	9
Mourning Warbler	8
American Goldfinch	8
Hermit Thrush	8
Black-capped Chickadee	6
American Redstart	6

Species	Number
House Wren	6
Blue Jay	6
Wood Thrush	6
Gray Catbird	5
Hooded Warbler	5
Downy Woodpecker	4
Mourning Dove	4
Canada Warbler	4
Brown Thrasher	3
Kentucky Warbler	3
Black-throated Blue Warbler	3
Field Sparrow	3
Turkey Vulture	3
Willow Flycatcher	3
Common Yellowthroat	3
Common Raven	3
White-breasted Nuthatch	2
Tufted Titmouse	2
Cooper's Hawk	2
Ruby-throated Hummingbird	2
Tree Swallow	2
Red-tailed Hawk	2
Hairy Woodpecker	2
Northern Flicker	2
Wild Turkey	2
Ruffed Grouse	2
Yellow-billed Cuckoo	2

Species	Number
Barn Swallow	2
Black-and-white Warbler	2
Vesper Sparrow	2
Mallard	1
American Woodcock	1
American Kestrel	1
Pileated Woodpecker	1
Red-shouldered Hawk	1
Mallard	1
Alder Flycatcher	1
Eastern Phoebe	1
Great Crested Flycatcher	1
White-eyed Vireo	1
Golden-winged Warbler	1
Northern Parula	1
Prairie Warbler	1
Yellow-breasted Chat	1
Northern Cardinal	1

69 species, 640 individuals.

TABLE 10

Results of the raptor study during the spring and fall 2005 seasons.
N = number of surveys conducted.

Species	Spring		Fall	
	Broadcast Method (N = 50)	1-Hr. Observ. Method & #/hr. (N = 32)	Broadcast Method (N = 50)	1-Hr. Observ. Method & #/hr. (N = 100) *
Osprey	--	--	--	2 (0.02/hr)
Bald Eagle	--	--	--	2 (0.02/hr)
Golden Eagle	--	--	--	3 (0.03/hr)
Northern Harrier	5	4 (0.12/hr)	3	3 (0.03/hr)
Sharp-shinned Hawk	6	3 (0.09/hr)	0	88 (0.88/hr)
Cooper's Hawk	8	4 (0.12/hr)	1	20 (0.20/hr)
Northern Goshawk	--	--	--	2 (0.02/hr)
Red-shouldered Hawk	10	6 (0.19/hr)	4	5 (0.05/hr)
Broad-winged Hawk	6	3 (0.09/hr)	0	481 (4.81/hr)
Red-tailed Hawk	9	5 (0.16/hr)	2	63 (0.63/hr)
American Kestrel	1	3 (0.09/hr)	1	15 (0.15/hr)
Merlin	--	--	--	1 (0.01/hr)
Eastern Screech-Owl	6	2 (0.06/hr)	4	--
Great Horned Owl	3	1 (0.03/hr)	0	--
Barred Owl	14	2 (0.06/hr)	5	--
Northern Saw-whet Owl	--	--	10	--
Total	***68***	***39***	***30***	***685***

The broadcast method indicates the possible number of territorial pairs during the spring.
** 499 Turkey Vultures and 6 Black Vultures were also seen during these observations.*

TABLE 11

Species recorded during 12 nighttime driving routes along Beech-Ridge Pole Road, Cold Knob Road, and Grassy Knob and Nunly Mountain Roads during spring and at 12 stationary points during the fall 2005. Data collected May 13 - 31, 2005 and from September 9 - October 5, 2005. *

Species	Spring Number	Fall Number
Eastern Screech-Owl	4	2
Great Horned Owl	1	1
Barred Owl	13	3
Common Nighthawk	--	1005
Whip-poor-will	5	--
Eastern Wood-Pewee	2	--
Great Crested Flycatcher	1	--
Veery	40	29
Gray-cheeked Thrush	--	301
Swainson's Thrush	100	2100
Thrush spp.	26	6008
Wood Thrush	11	5
American Robin	8	211
Black-throated Blue Warbler	--	4
Common Yellowthroat	4	9
Unidentified warblers and other songbirds, except thrushes	27	1205
Total	***242***	***10,883***

** Additional raptors noted while driving between stationary nocturnal bird routes and with playback at stops every ½ mile were: 8 Barred Owls, 1 Eastern Screech-Owl, and 6 Northern Saw-whet Owls.*

TABLE 12

Fall 2005 banding data for the project area and the Lilly Mountain site of the Three Rivers Migration Observatory (TRMO) in Raleigh County, West Virginia. Banding data were collected from September 1 - November 15, 2005.

Species	Number captured at the Beech Ridge wind site	Number captured at TRMO
Sharp-shinned Hawk	2	2
Mourning Dove	0	12
Eastern Screech-Owl	1	1
Northern Saw-whet Owl	0	2
Ruby-throated Hummingbird	9	28
Red-bellied Woodpecker	0	4
Yellow-bellied Sapsucker	3	1
Downy Woodpecker	2	4
Hairy Woodpecker	1	3
Northern (Yellow-shafted) Flicker	3	1
Eastern Wood-Pewee	3	8
Yellow-bellied Flycatcher	1	6
Acadian Flycatcher	0	2
Traill’s Flycatcher	2	4
Least Flycatcher	6	2
Eastern Phoebe	3	14
White-eyed Vireo	1	6
Yellow-throated Vireo	0	5
Blue-headed Vireo	20	19
Red-eyed Vireo	11	11

Species	Number captured at the Beech Ridge wind site	Number captured at TRMO
Blue Jay	31	20
Carolina Chickadee	0	24
Black-capped Chickadee	33	0
Tufted Titmouse	5	34
Red-breasted Nuthatch	12	0
White-breasted Nuthatch	19	10
Brown Creeper	3	3
Carolina Wren	3	17
House Wren	2	9
Winter Wren	13	13
Golden-crowned Kinglet	60	20
Ruby-crowned Kinglet	81	57
Blue-gray Gnatcatcher	0	3
Eastern Bluebird	13	8
Veery	20	5
Gray-cheeked Thrush	85	18
Bicknell’s Thrush	0	1
Swainson’s Thrush	15	67
Hermit Thrush	23	8
Wood Thrush	1	10
American Robin	3	7
Gray Catbird	15	123
Brown Thrasher	2	2

Species	Number captured at the Beech Ridge wind site	Number captured at TRMO
European Starling	0	3
Cedar Waxwing	22	69
Blue-winged Warbler	0	3
Golden-winged Warbler	1	0
Tennessee Warbler	112	436
Orange-crowned Warbler	4	2
Nashville Warbler	3	10
Northern Parula	7	2
Chestnut-sided Warbler	20	20
Magnolia Warbler	61	111
Cape May Warbler	150	28
Black-throated Blue Warbler	29	32
Yellow-rumped Warbler	8	23
Black-throated Green Warbler	132	9
Blackburnian Warbler	23	12
Pine Warbler	0	1
Prairie Warbler	0	2
Palm Warbler	4	16
Bay-breasted Warbler	5	19
Blackpoll Warbler	29	14
Black-and-white Warbler	2	8
American Redstart	6	12
Worm-eating Warbler	3	9

Species	Number captured at the Beech Ridge wind site	Number captured at TRMO
Ovenbird	3	54
Northern Waterthrush	1	5
Kentucky Warbler	1	1
Mourning Warbler	0	4
Common Yellowthroat	13	300
Hooded Warbler	1	69
Wilson’s Warbler	0	8
Canada Warbler	1	2
Yellow-breasted Chat	1	1
Scarlet Tanager	5	11
Eastern Towhee	9	41
Chipping Sparrow	99	33
Field Sparrow	10	14
Vesper Sparrow	7	1
Fox Sparrow	0	1
Song Sparrow	27	100
Lincoln’s Sparrow	0	8
Swamp Sparrow	0	40
White-throated Sparrow	48	53
White-crowned Sparrow	4	1
Dark-eyed Junco	205	47
Northern Cardinal	6	69
Rose-breasted Grosbeak	18	10

Species	Number captured at the Beech Ridge wind site	Number captured at TRMO
Indigo Bunting	10	38
Red-winged Blackbird	0	5
Common Grackle	0	8
Purple Finch	6	22
House Finch	0	210
American Goldfinch	9	345
Total Banding Days	***40***	***53***
Total Species	***75***	***92***
Total Number per 100 net hours	***44.91***	***56.04***
Total Individuals	***1612***	***2936***

APPENDIX B

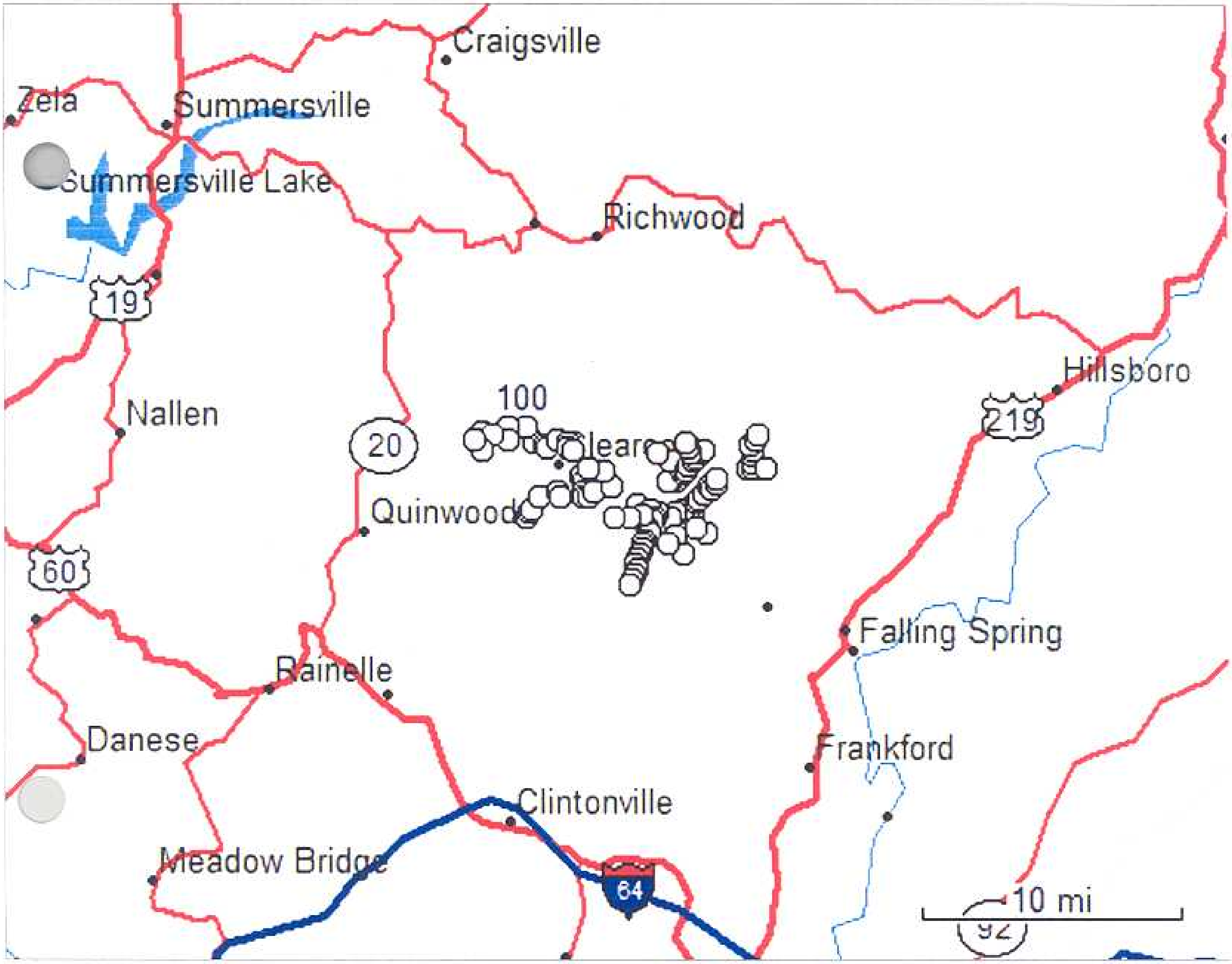


Figure 1. Location of the proposed MeadWestvaco Wind Project (Circles represent localities of bird fixed-point surveys).

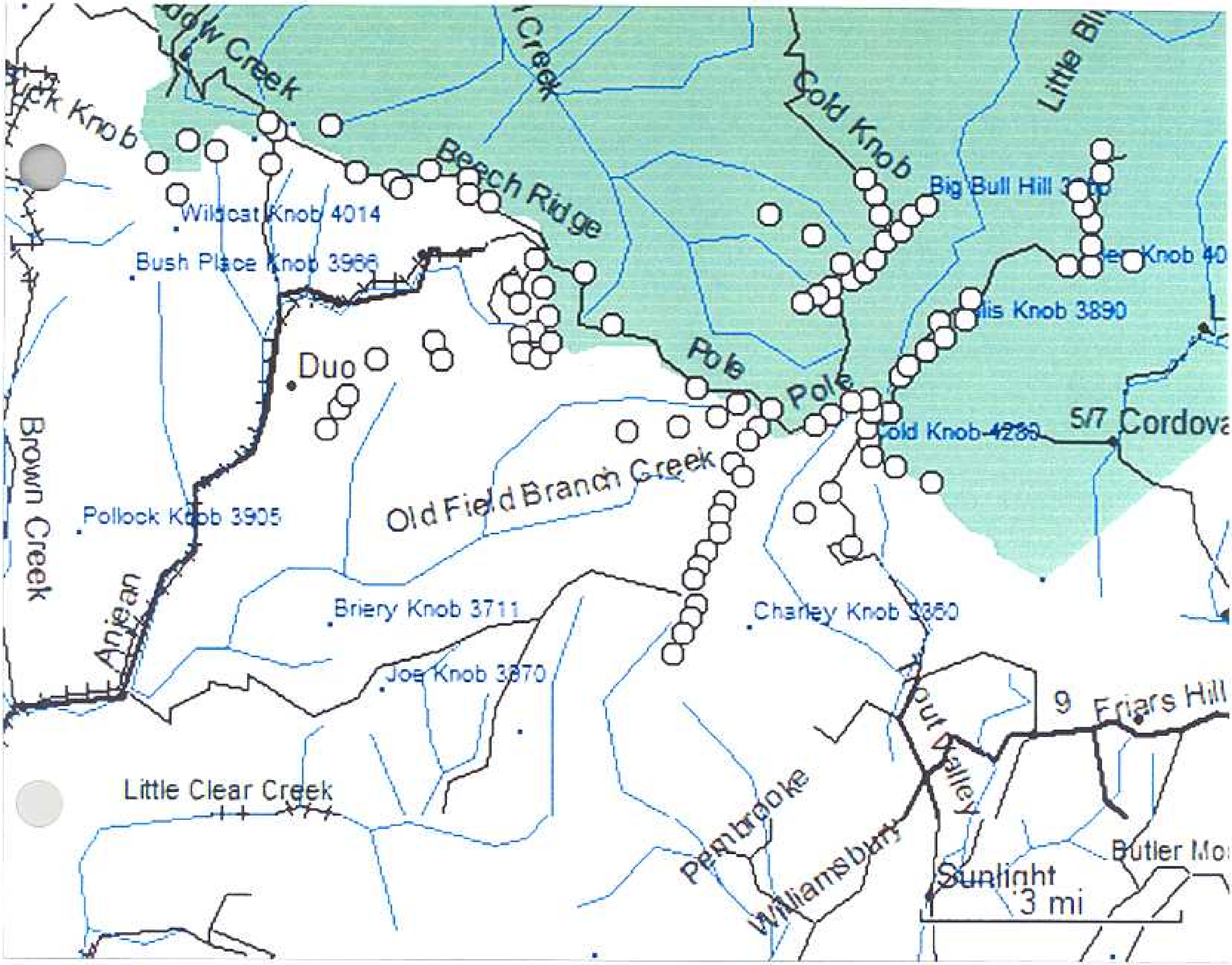


Figure 2. Location of the avian fixed-point surveys.

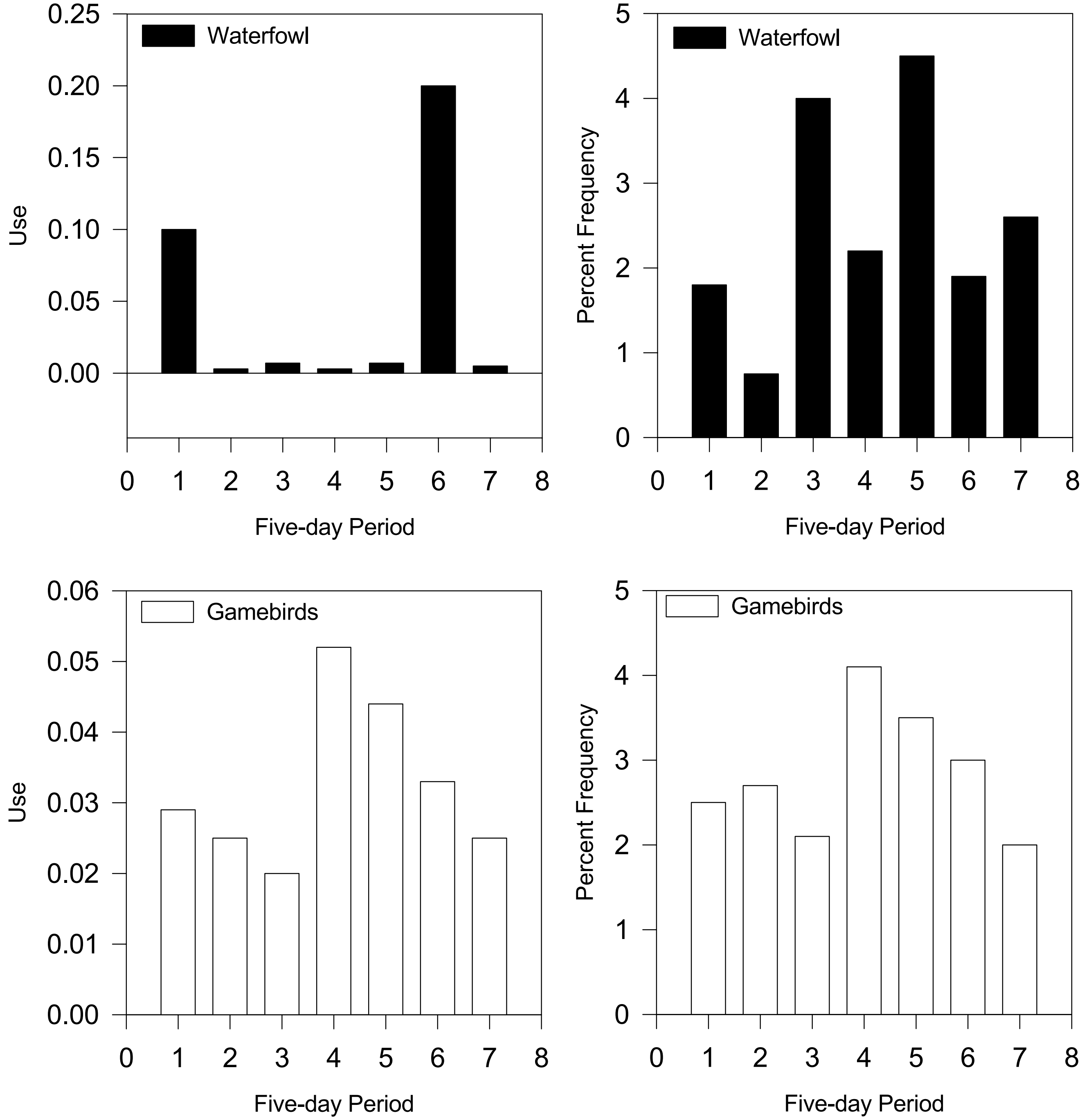


Figure 3. Mean use and frequency of occurrence for avian groups by 5-day periods from May 12 to June 15.

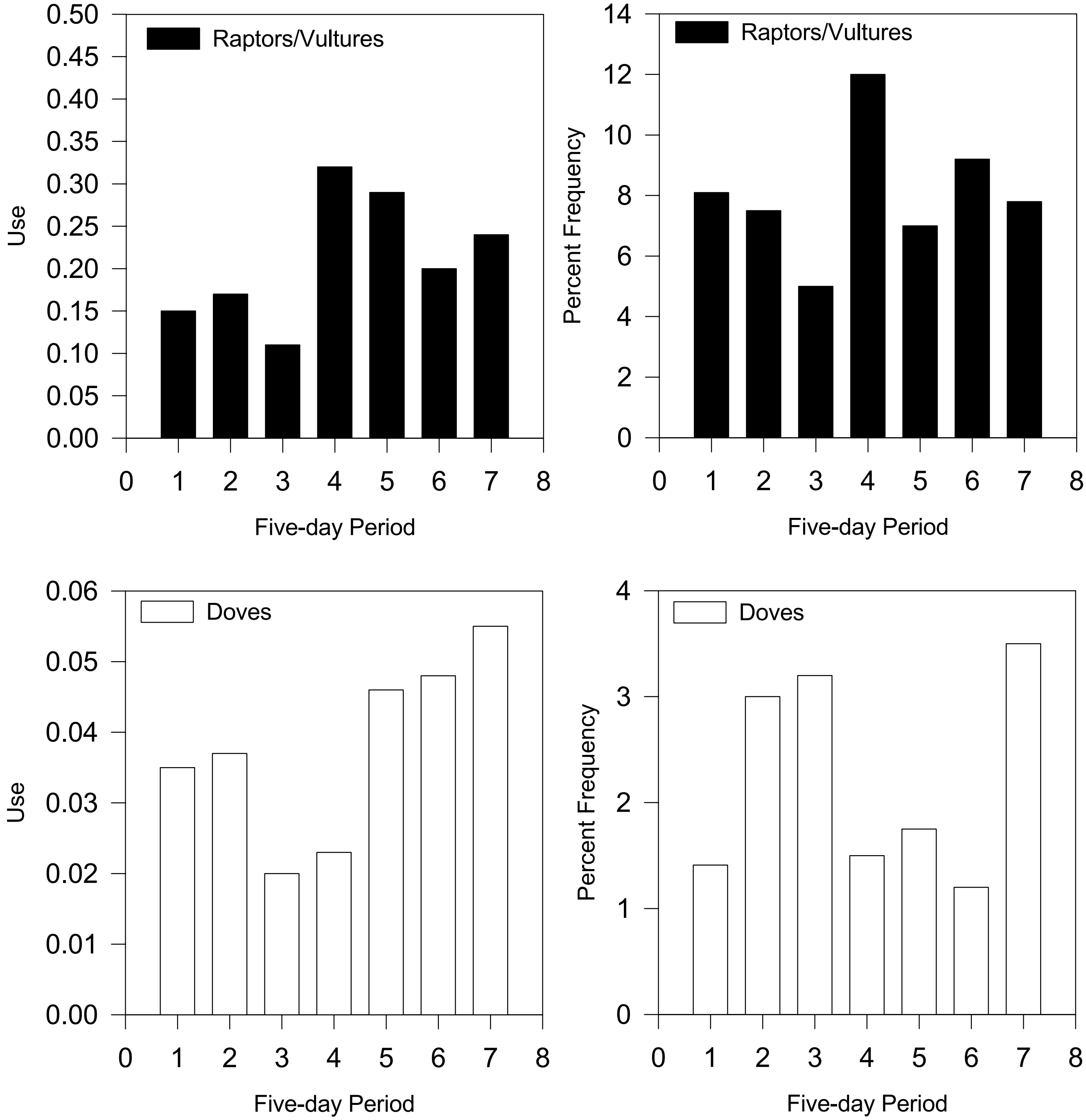


Figure 3 (continued). Mean use and frequency of occurrence for avian groups by 5-day periods from May 12 to June 15.

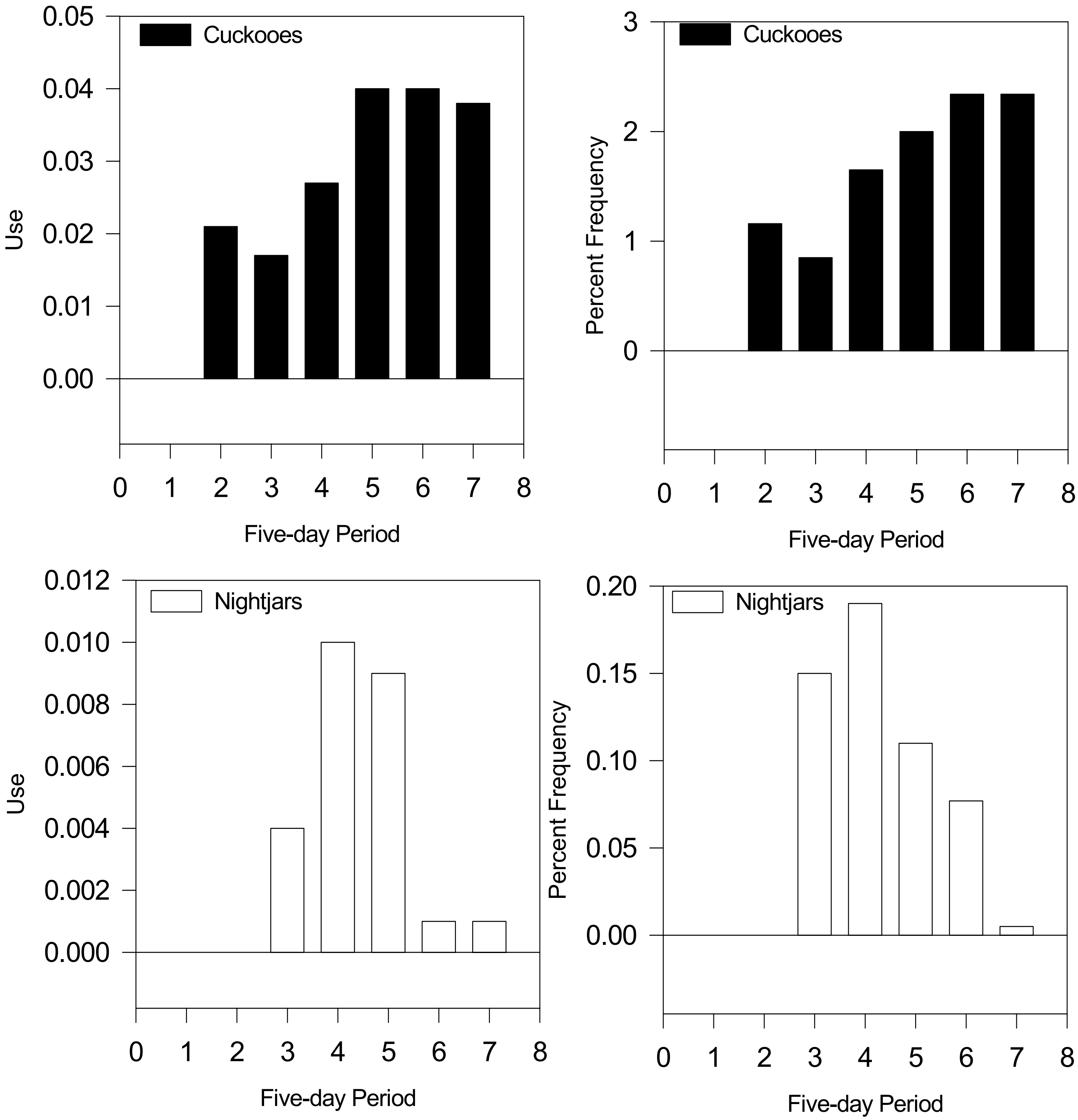


Figure 3 (continued). Mean use and frequency of occurrence for avian groups by 5-day periods from May 12 to June 15.

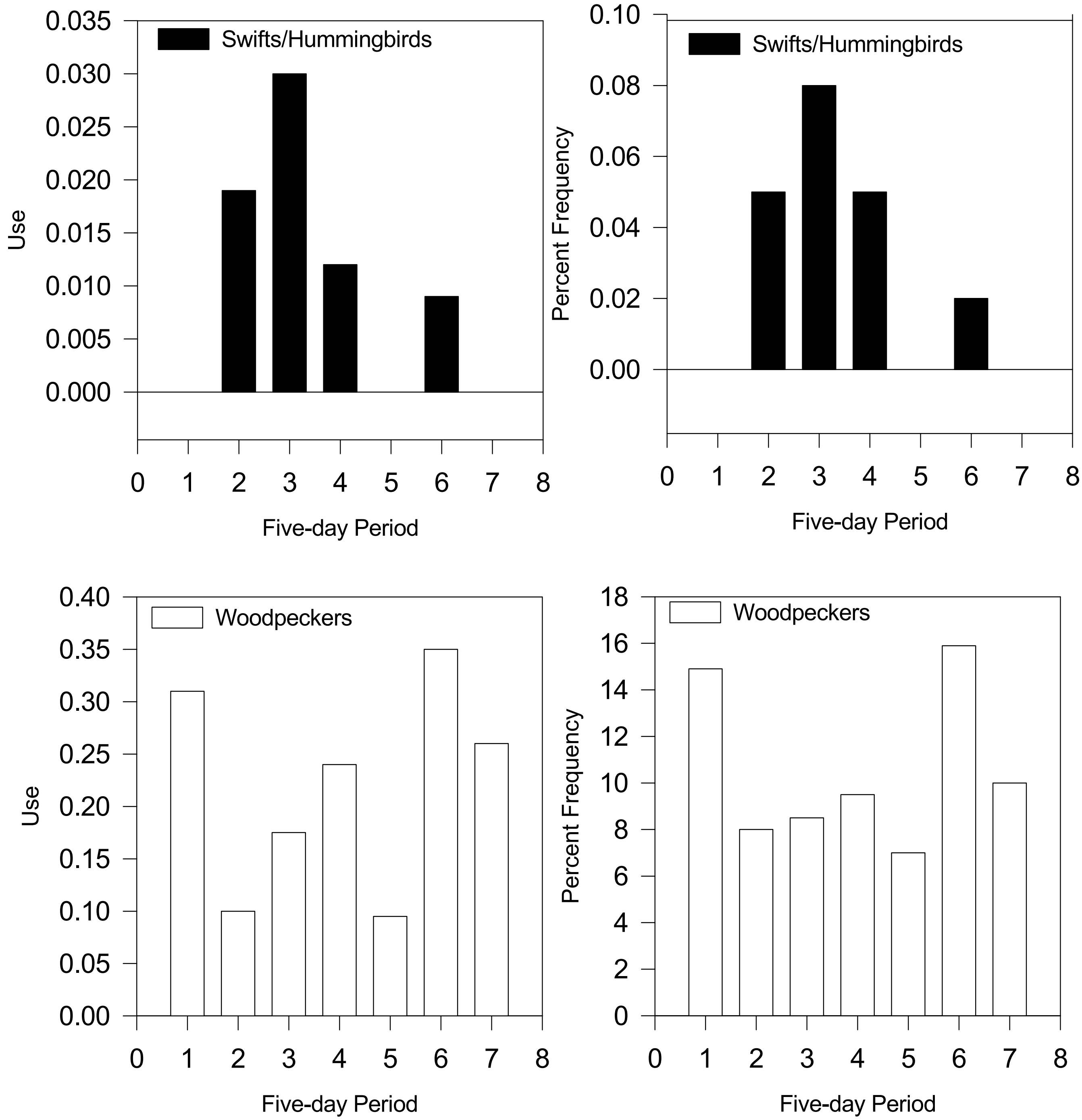


Figure 3 (continued). Mean use and frequency of occurrence for avian groups by 5-day periods from May 12 to June 15.

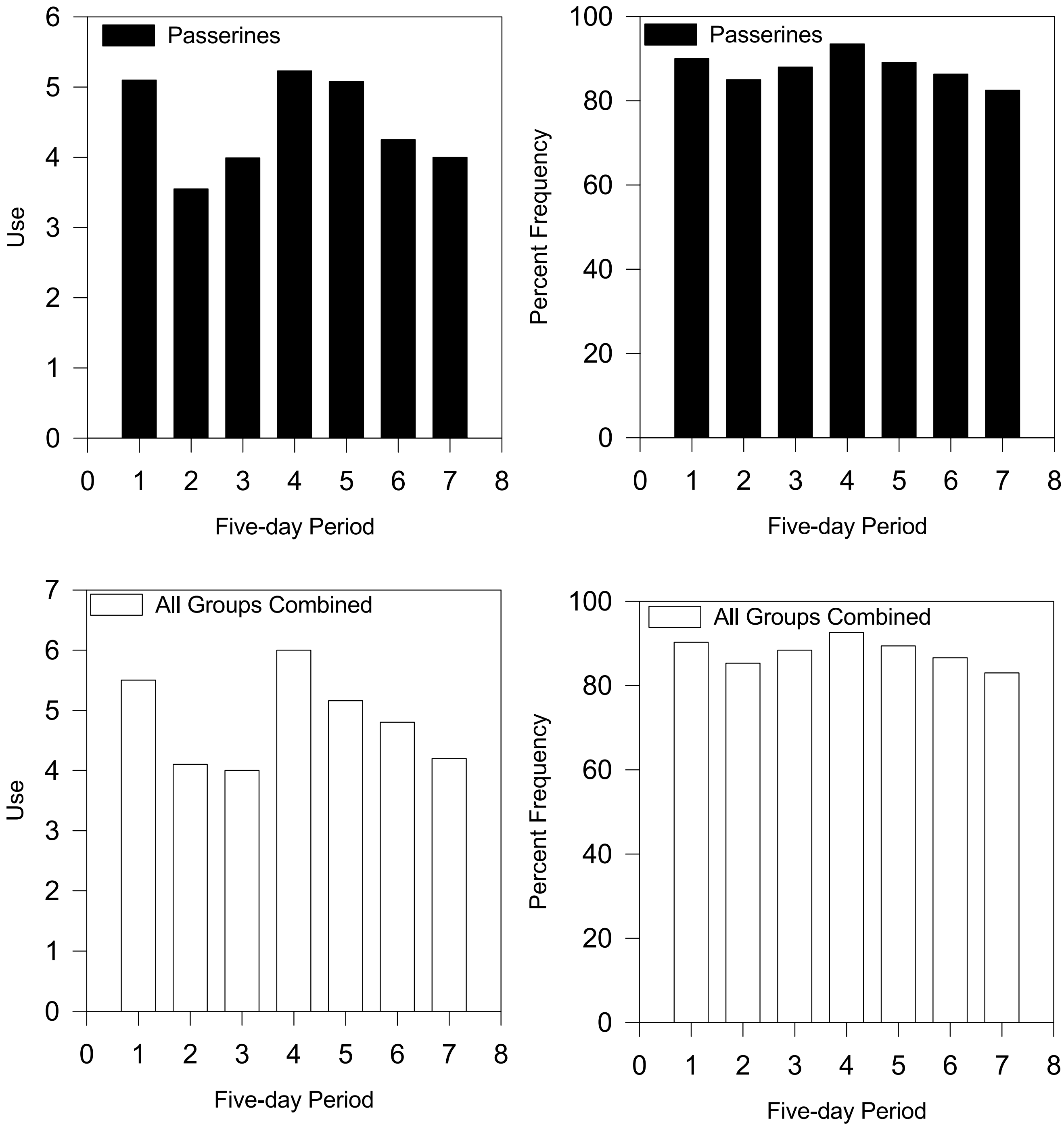


Figure 3 (continued). Mean use and frequency of occurrence for avian groups by 5-day periods from May 12 to June 15.

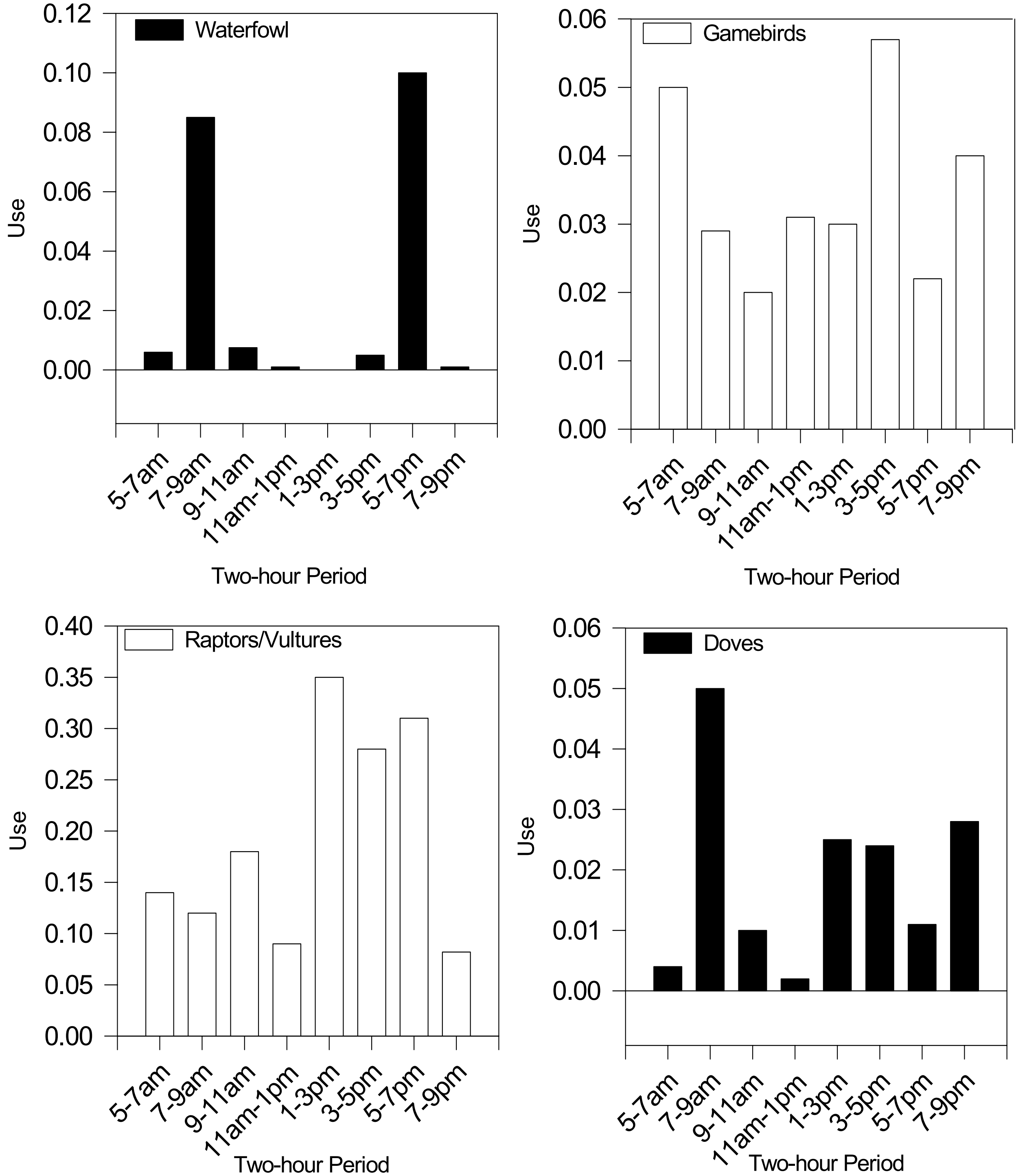


Figure 4. Mean difference in use over two-hour time periods during the spring.

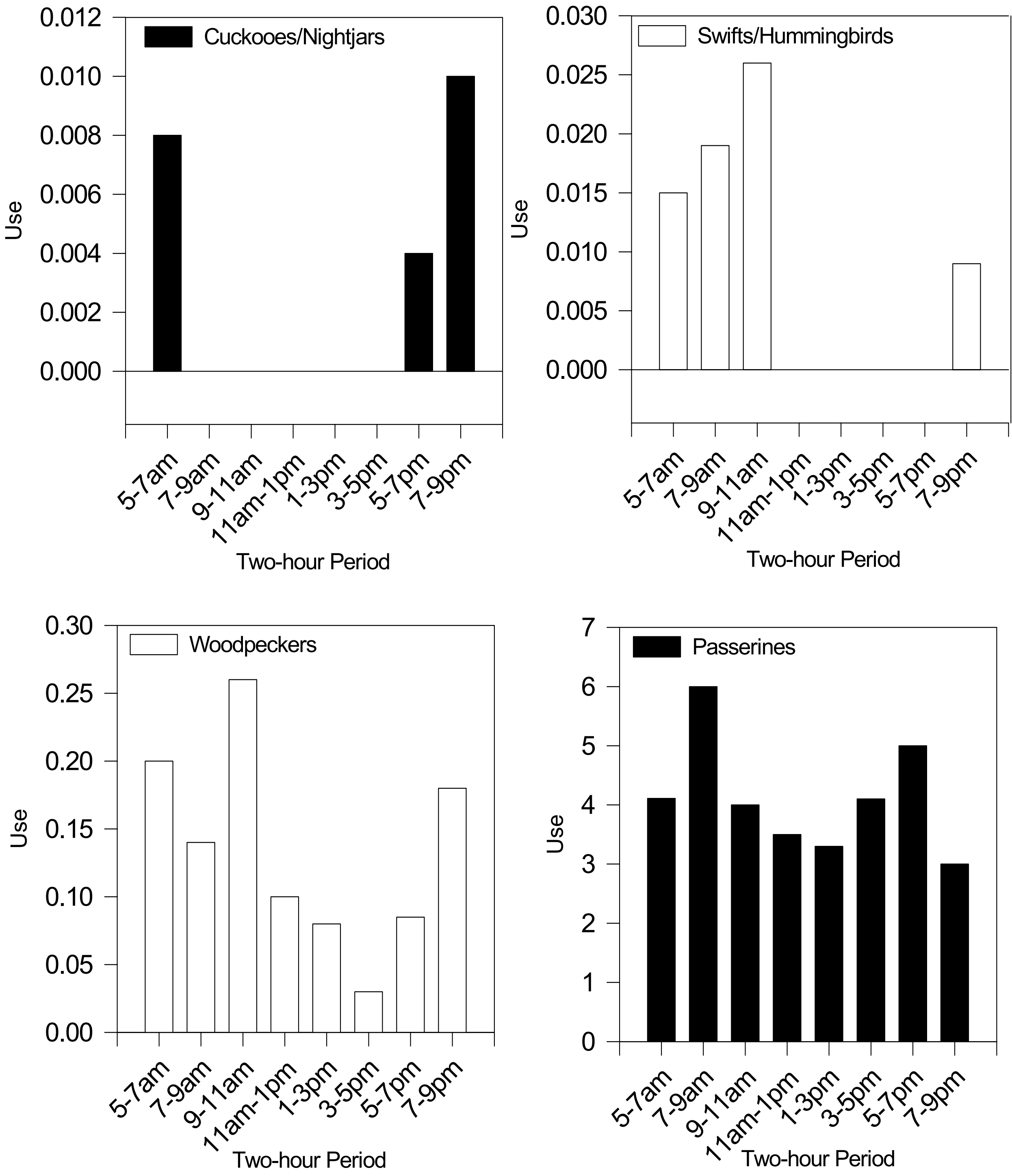


Figure 4. Mean difference in use over two-hour time periods during the spring.

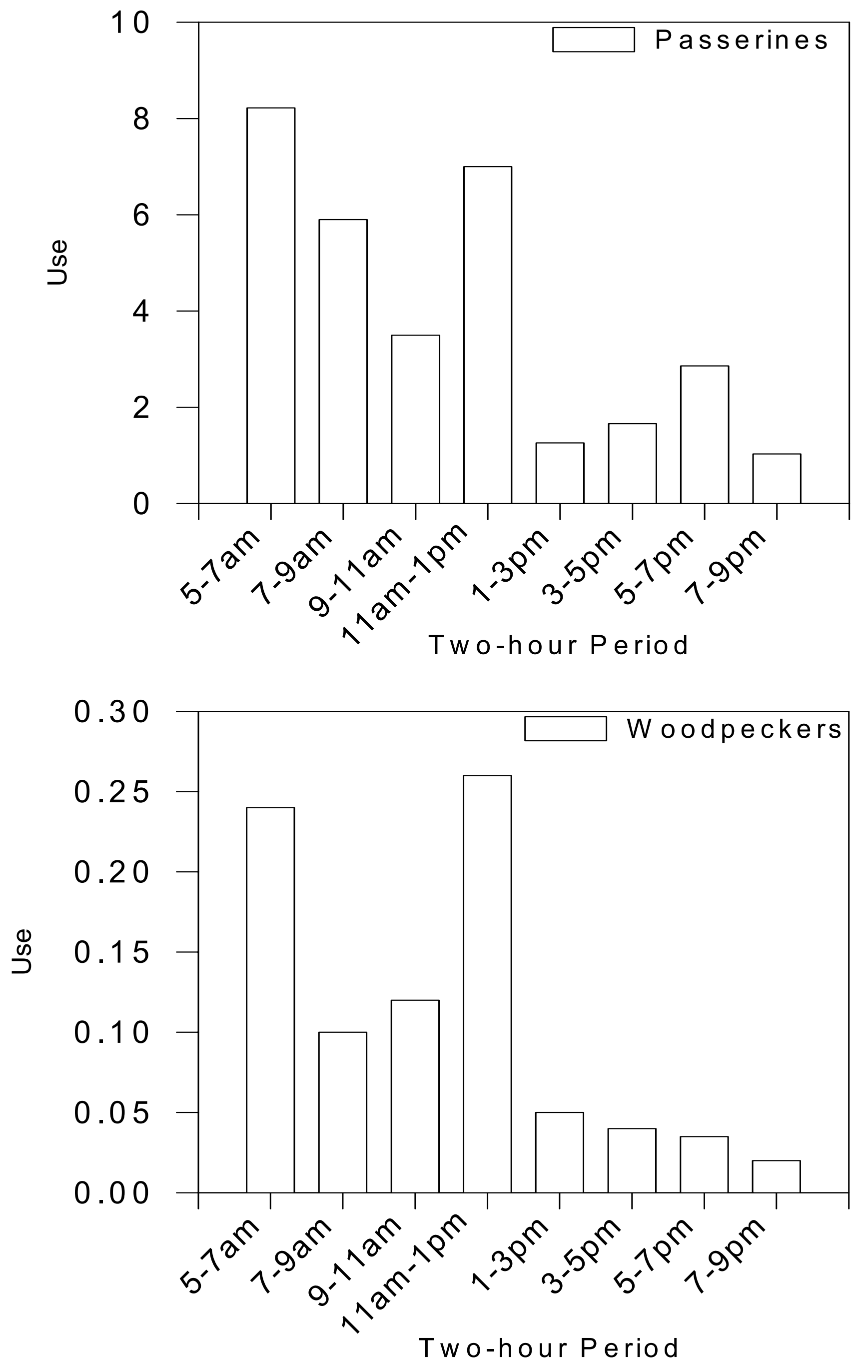
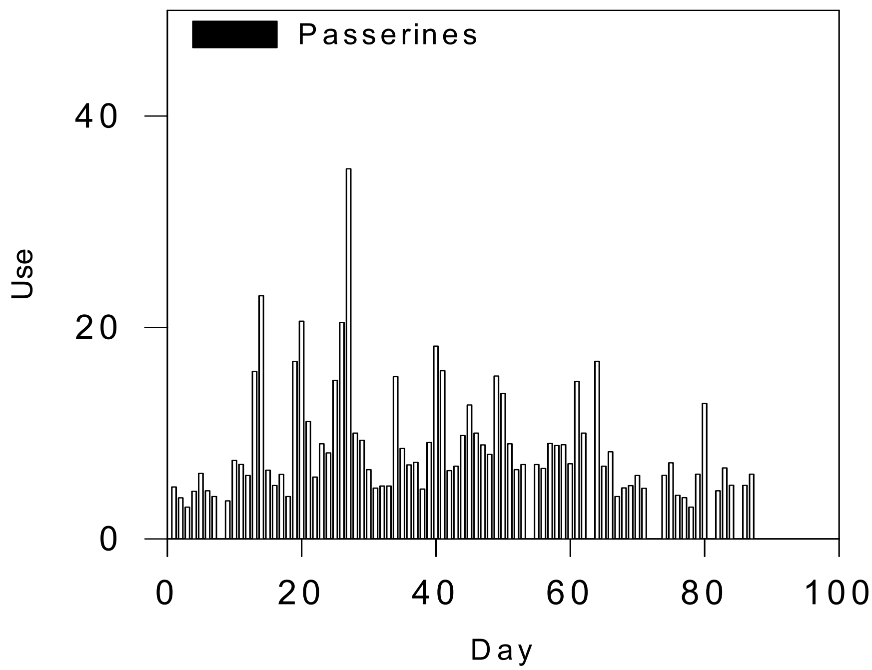


Figure 5. Mean difference in use over two-hour time periods for passerines and woodpeckers in the fall 2005.



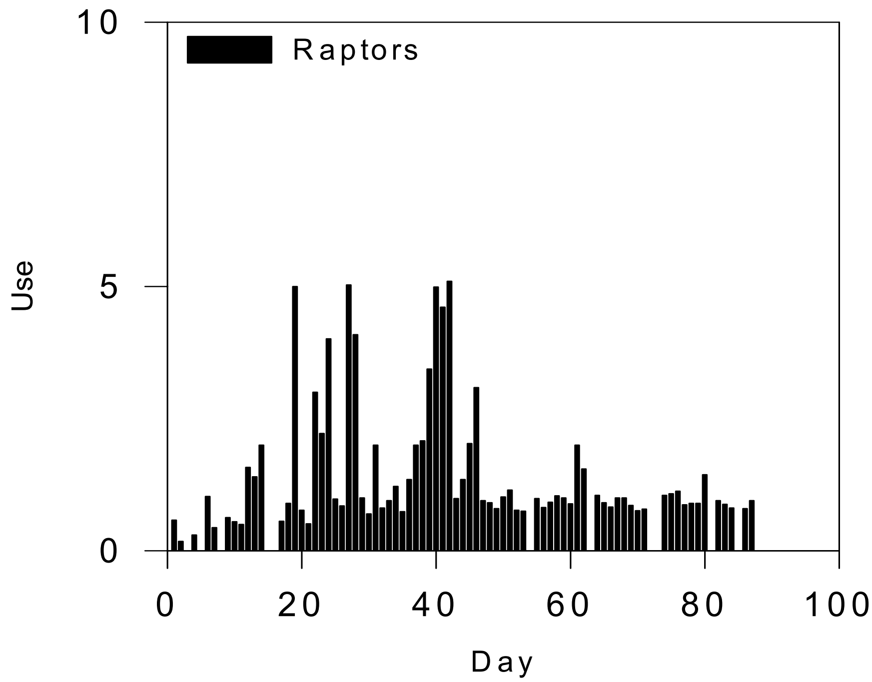


Figure 6. Number of observations per 10-min. survey plotted by day from August 23 - November 15, 2005.

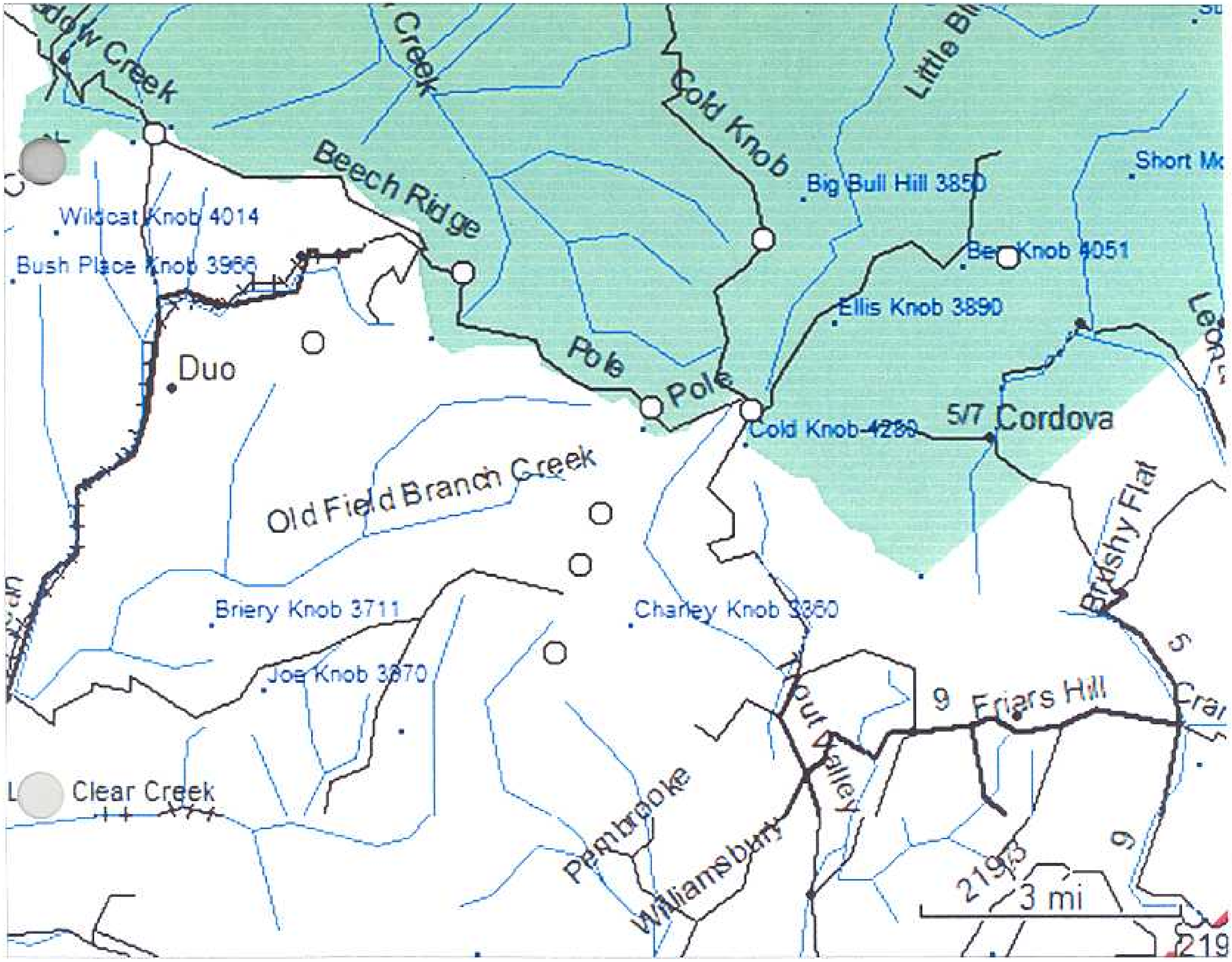


Figure 7. Localities of where Red-shouldered Hawks responded to broadcast calls.

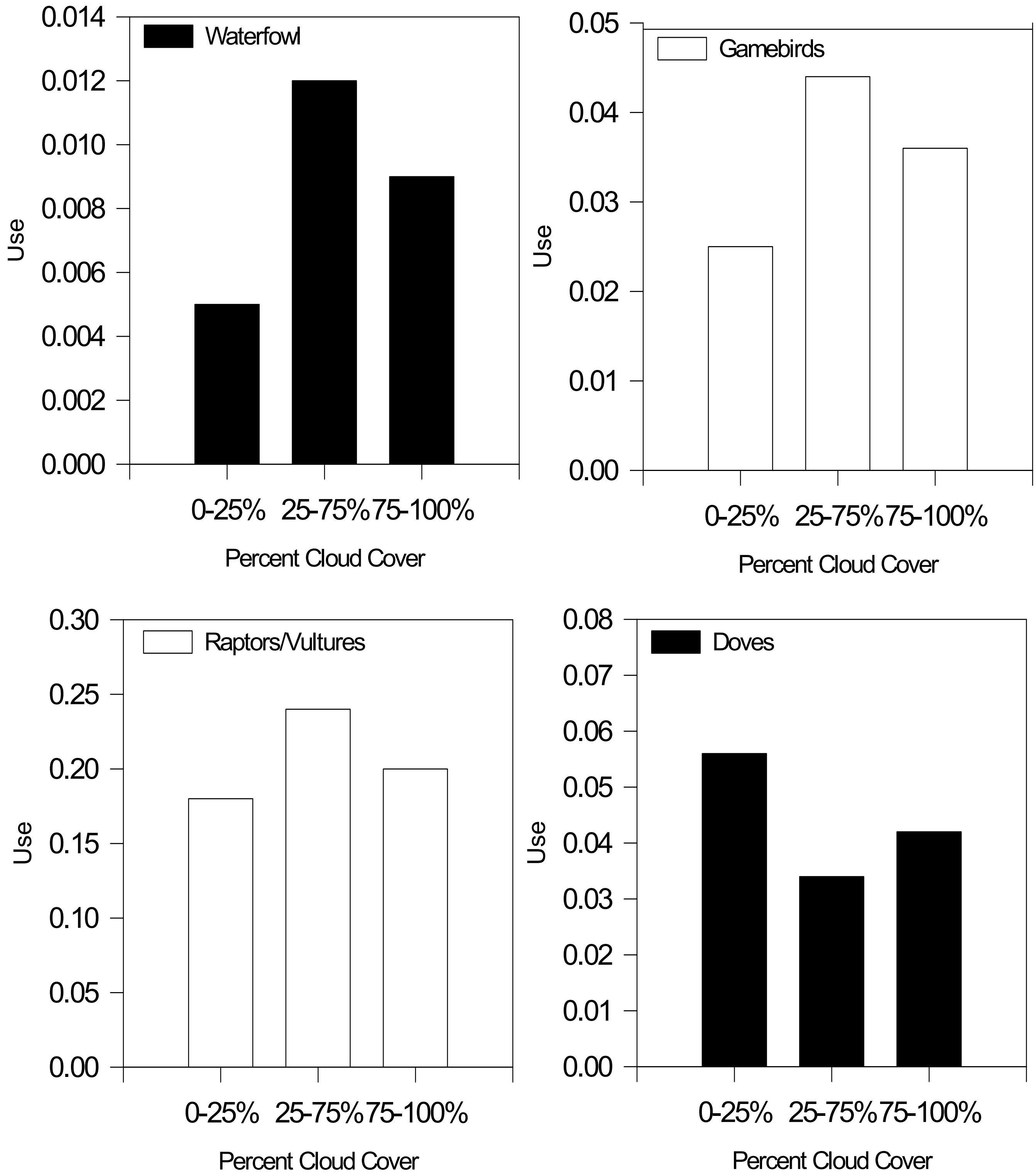


Figure 8. Mean difference in use during surveys with low, medium, and high cloud cover during the spring.

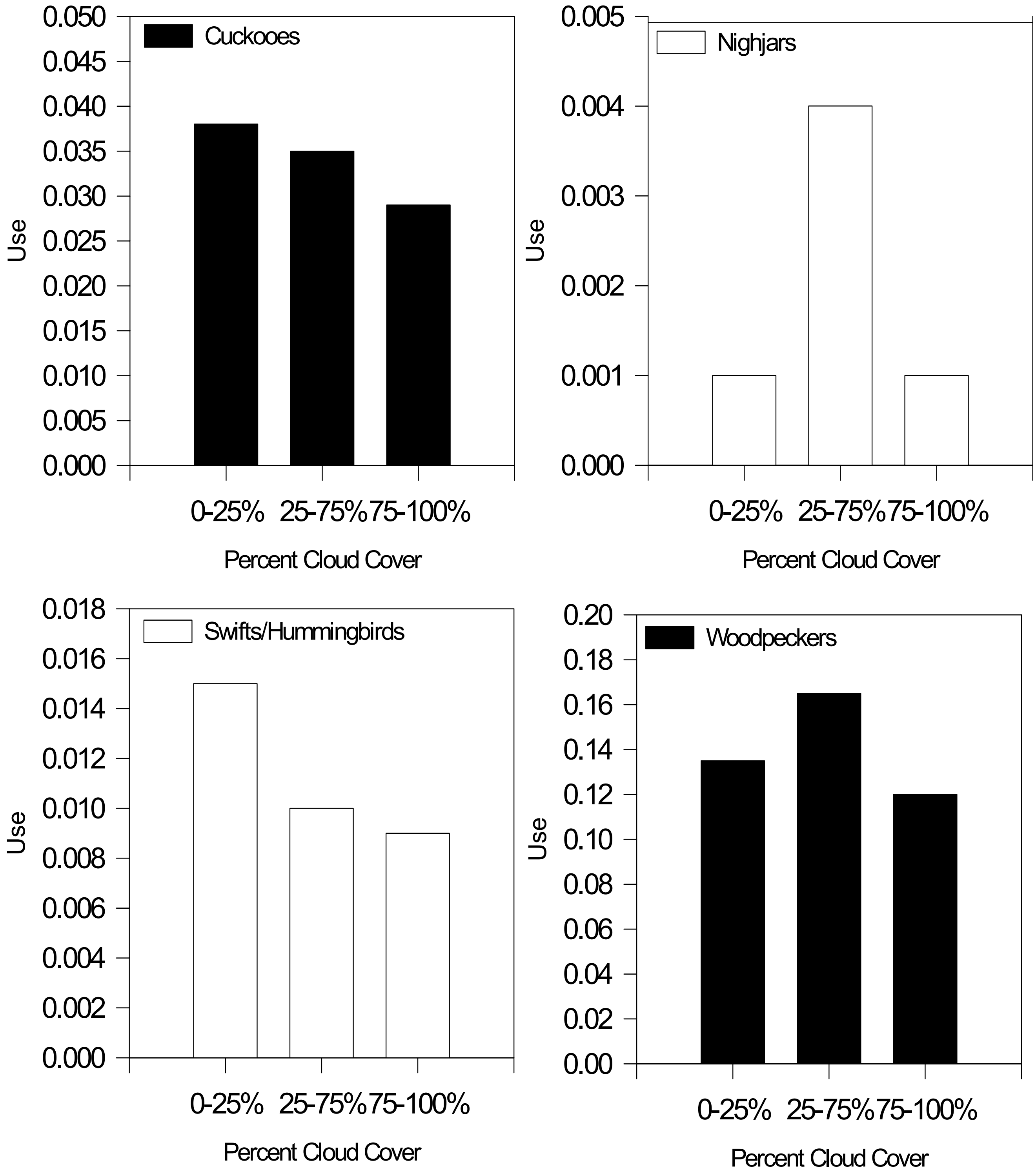
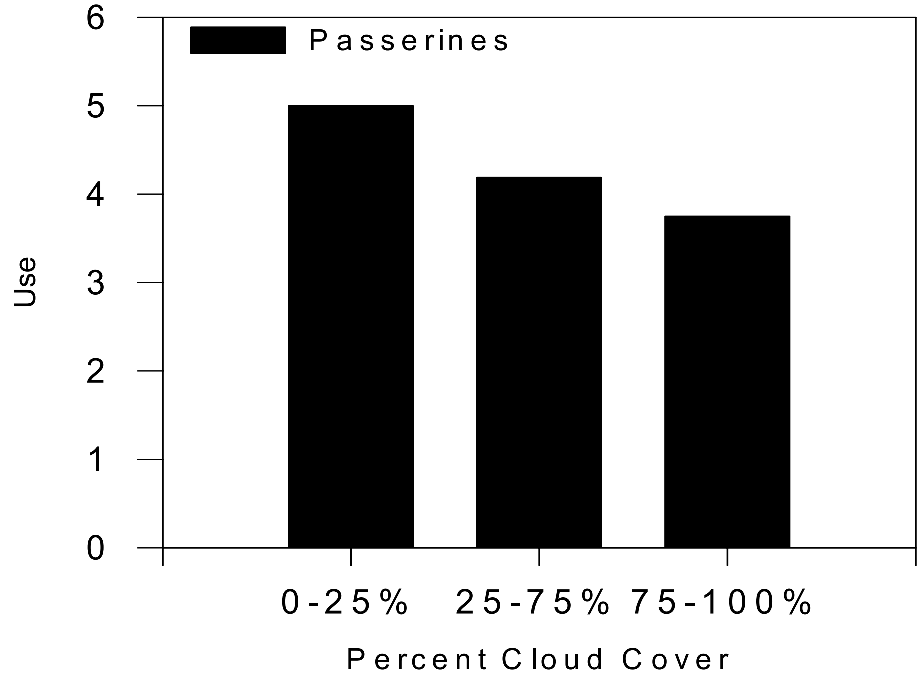


Figure 8 (continued). Mean difference in use during surveys with low, medium, and high cloud cover during the spring.



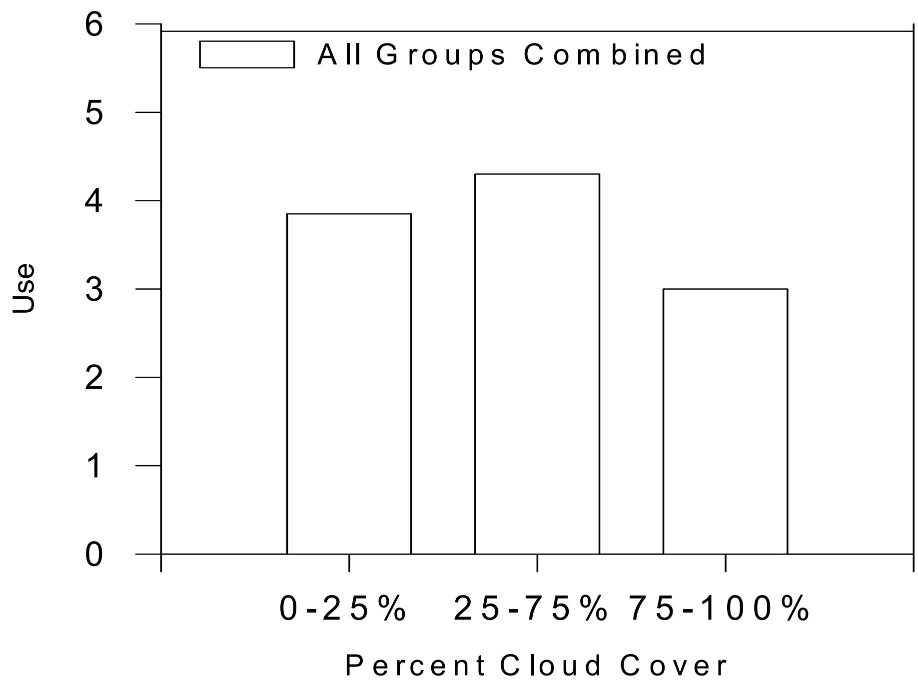


Figure 8 (continued). Mean difference in use during surveys with low, medium, and high cloud cover during the spring.

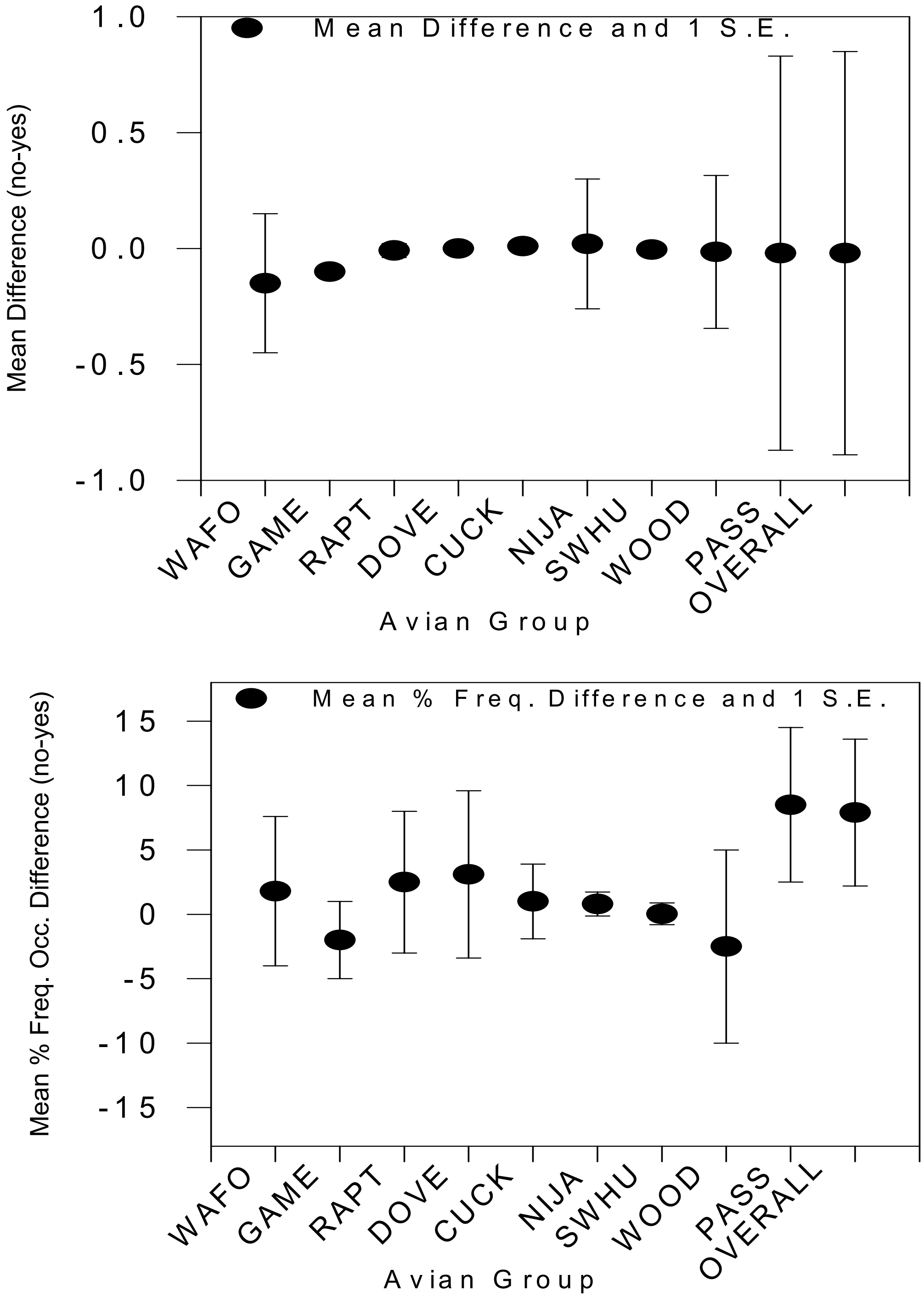


Figure 9. Mean difference in spring use and freguency of occurrence between surveys with and without precipitation (bars are 1 standard error)

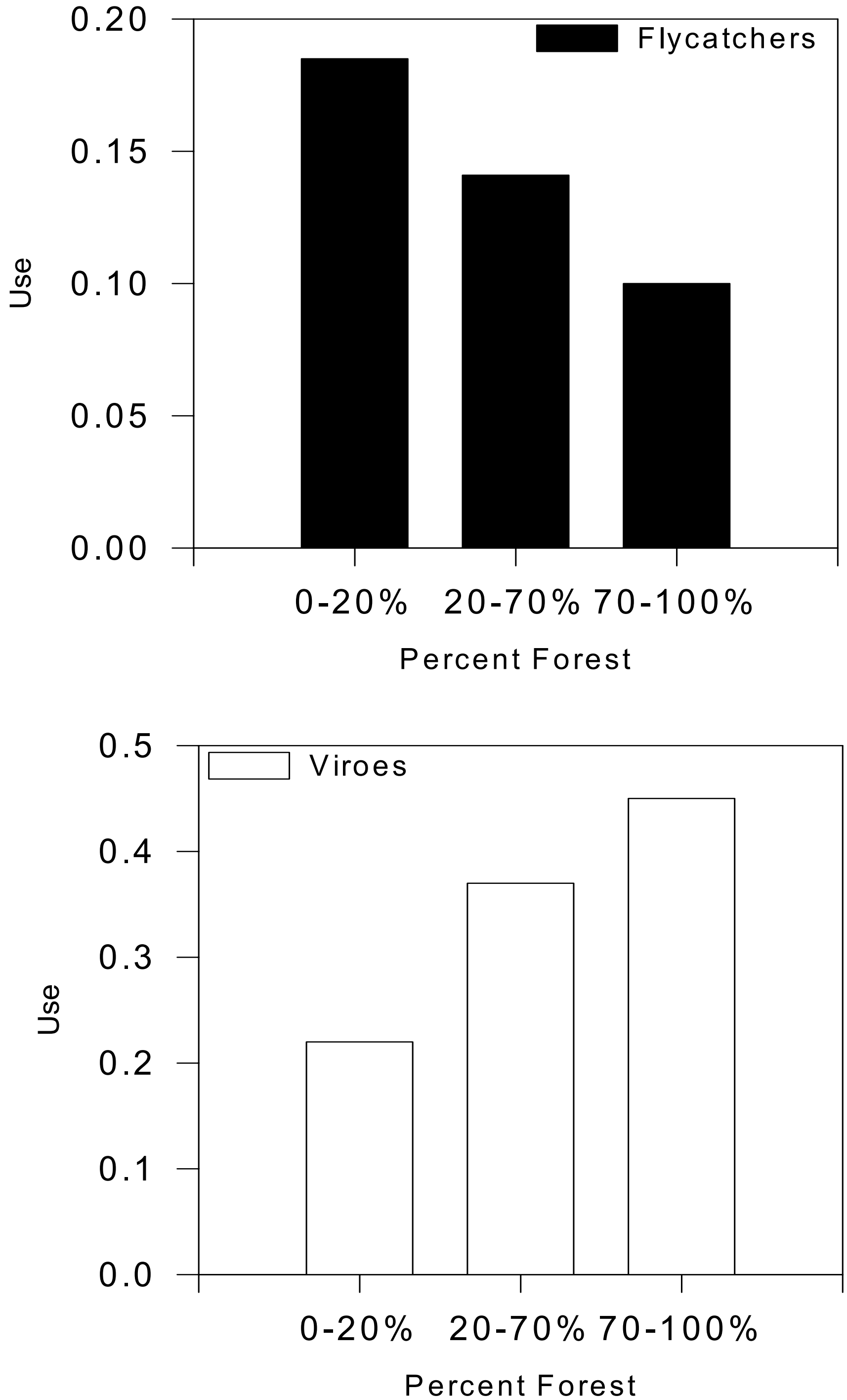


Figure 10. Passerine use by forest cover during the spring.

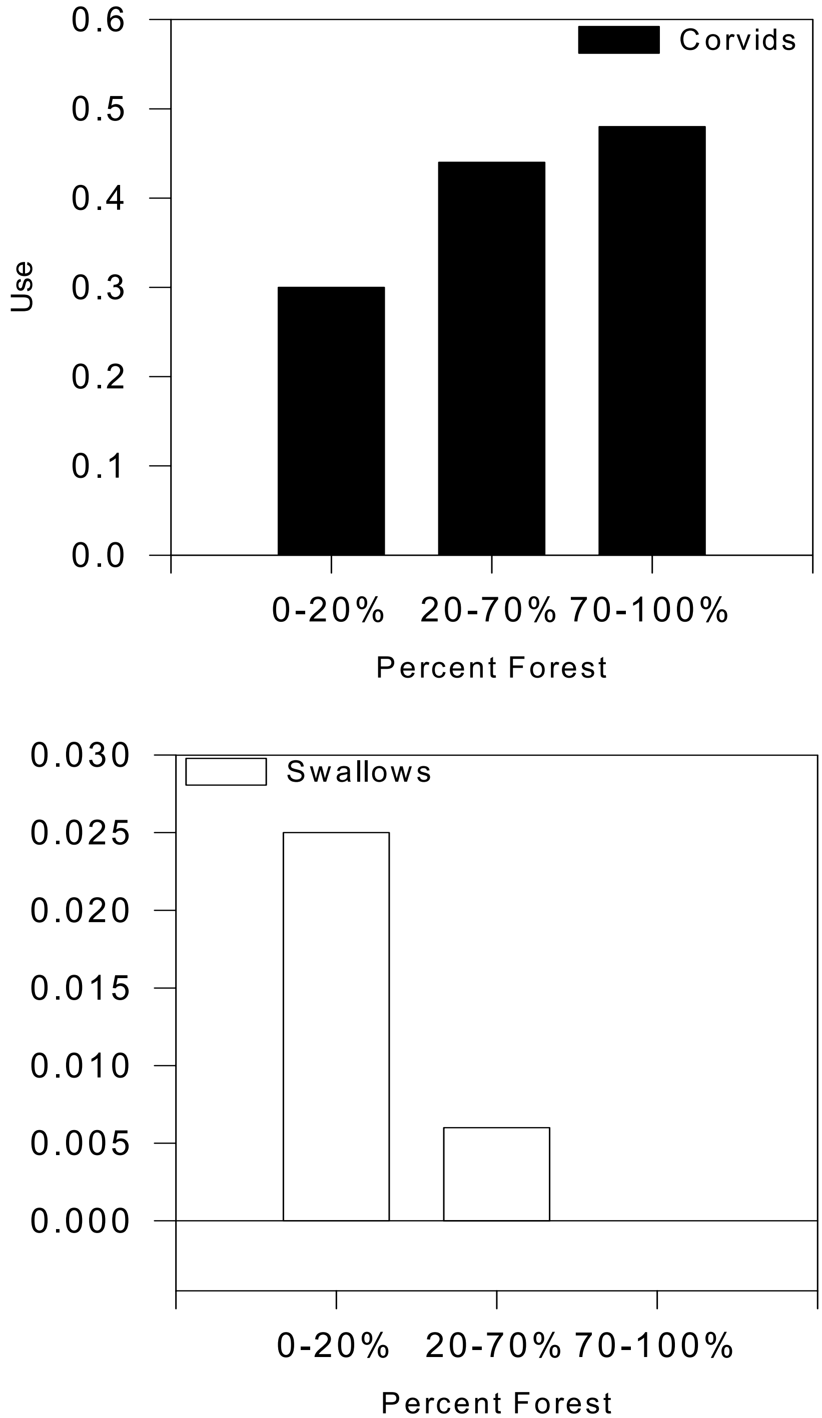


Figure 10 (continued). Passerine use by forest cover during the spring.

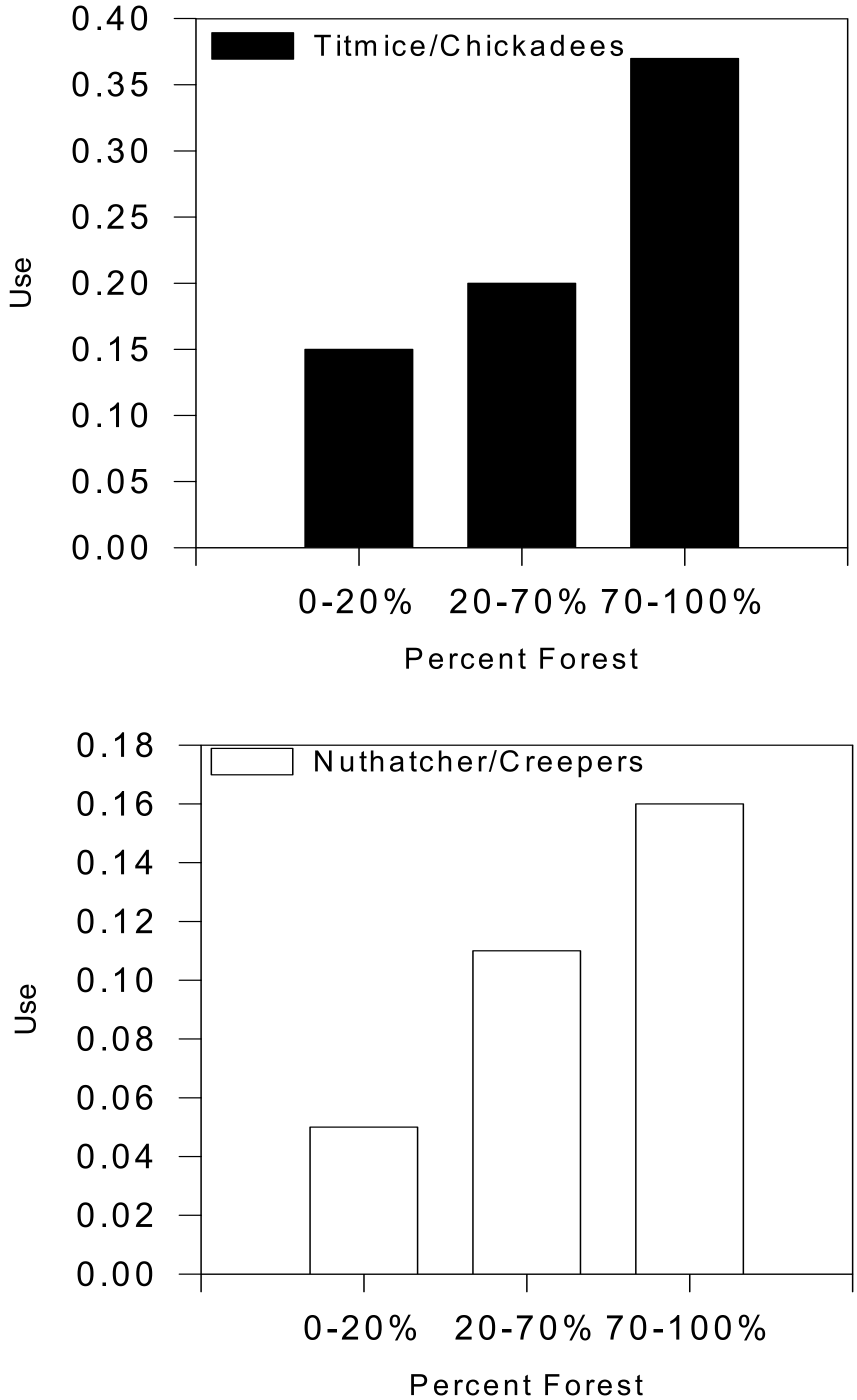
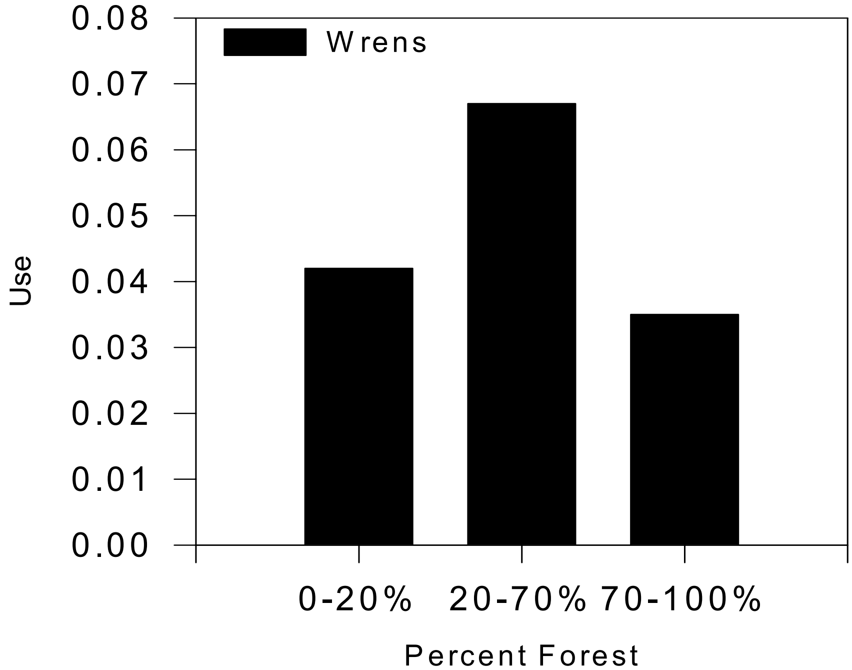


Figure 10 (continued). Passerine use by forest cover during the spring.



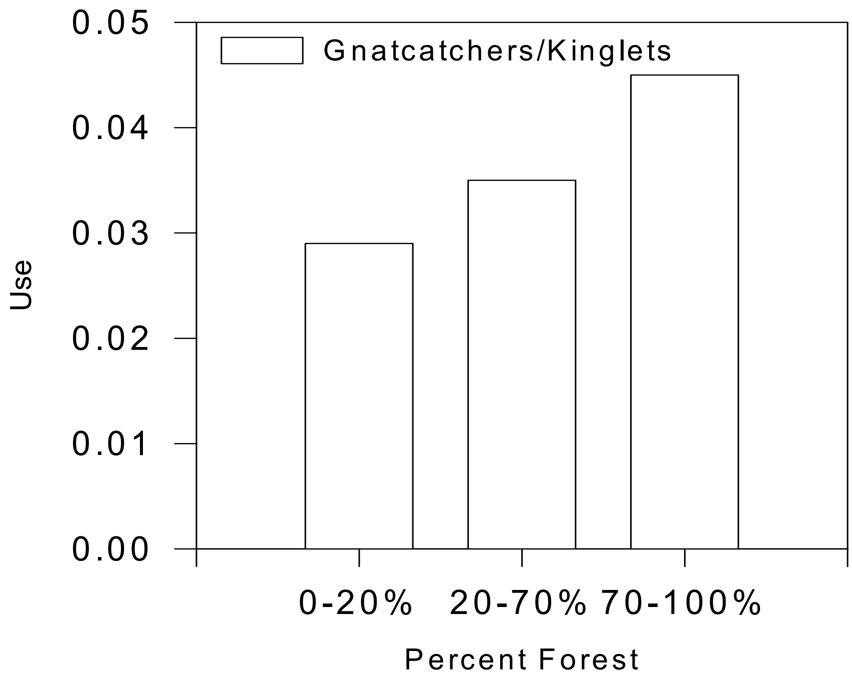


Figure 10 (continued). Passerine use by forest cover during the spring.

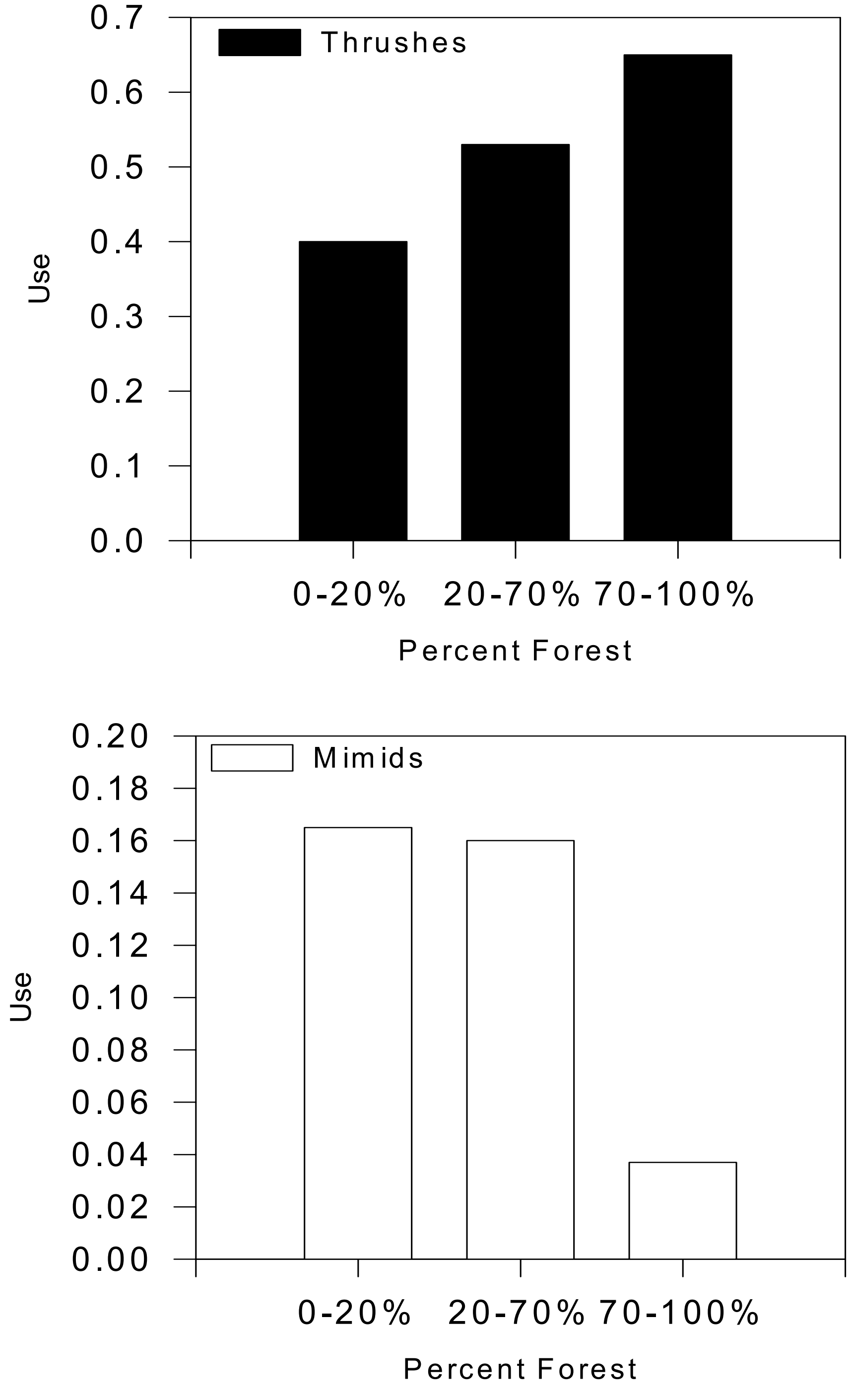


Figure 10 (continued). Passerine use by forest cover during the spring.

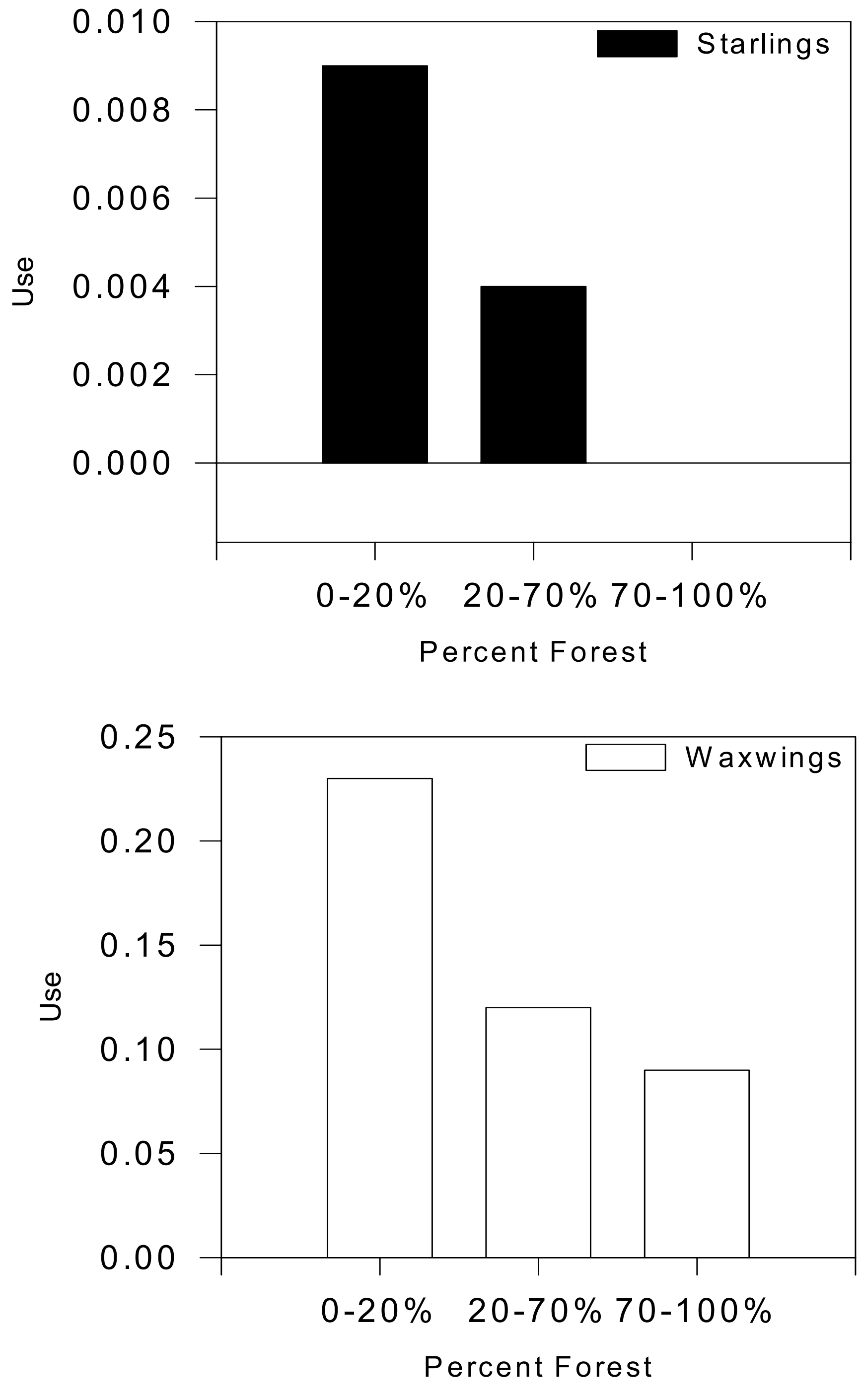
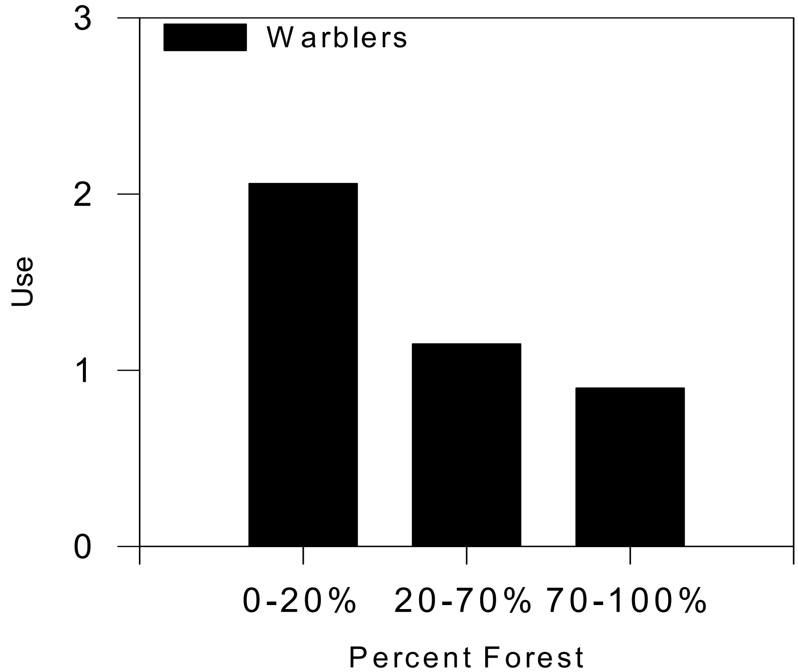


Figure 10 (continued). Passerine use by forest cover during the spring.



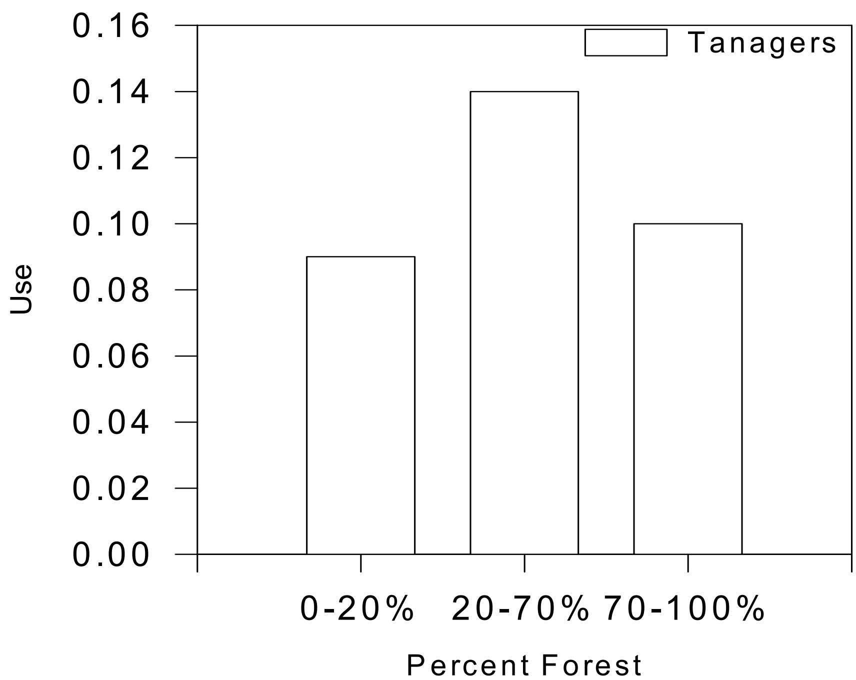


Figure 10 (continued). Passerine use by forest cover during the spring.

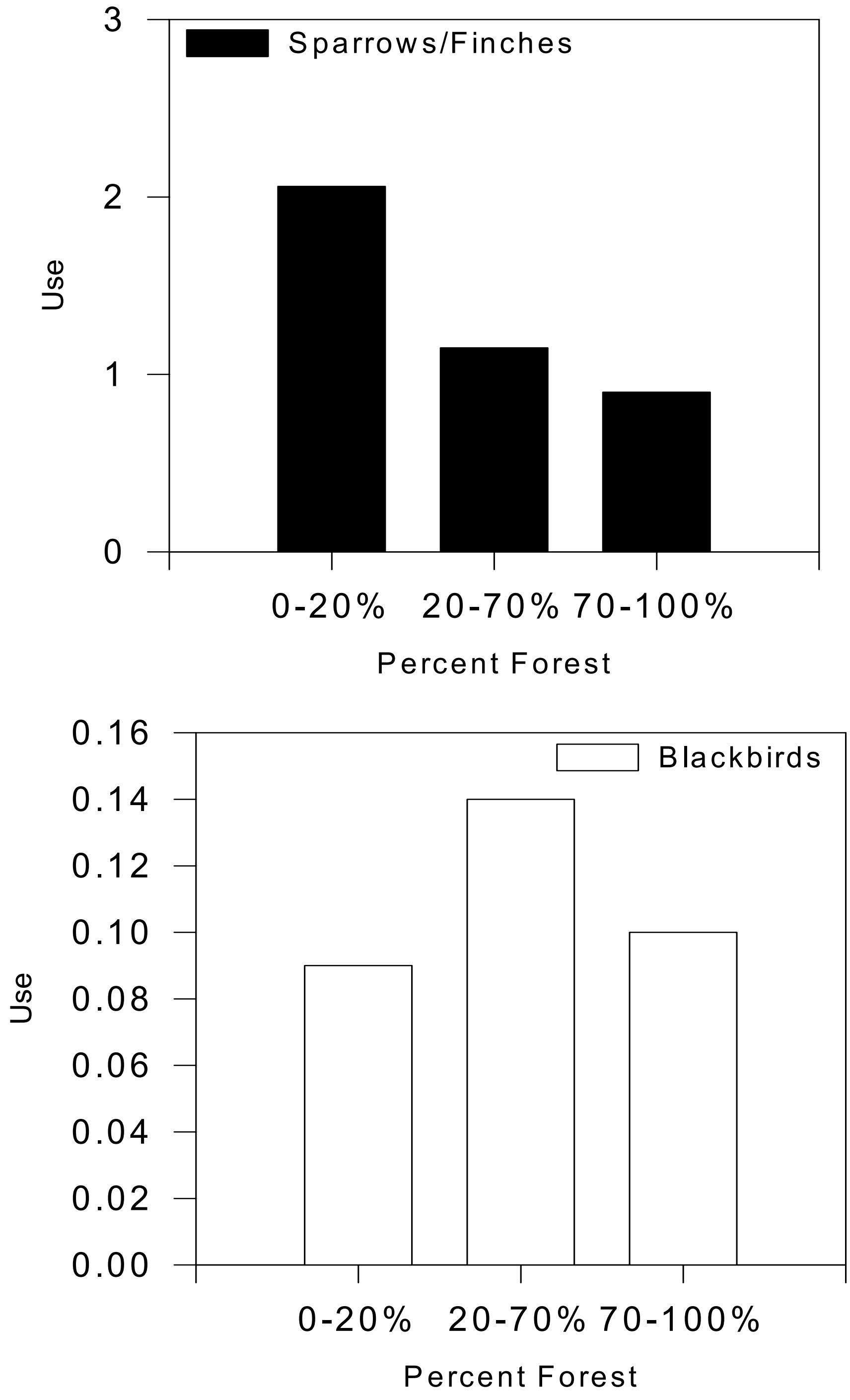
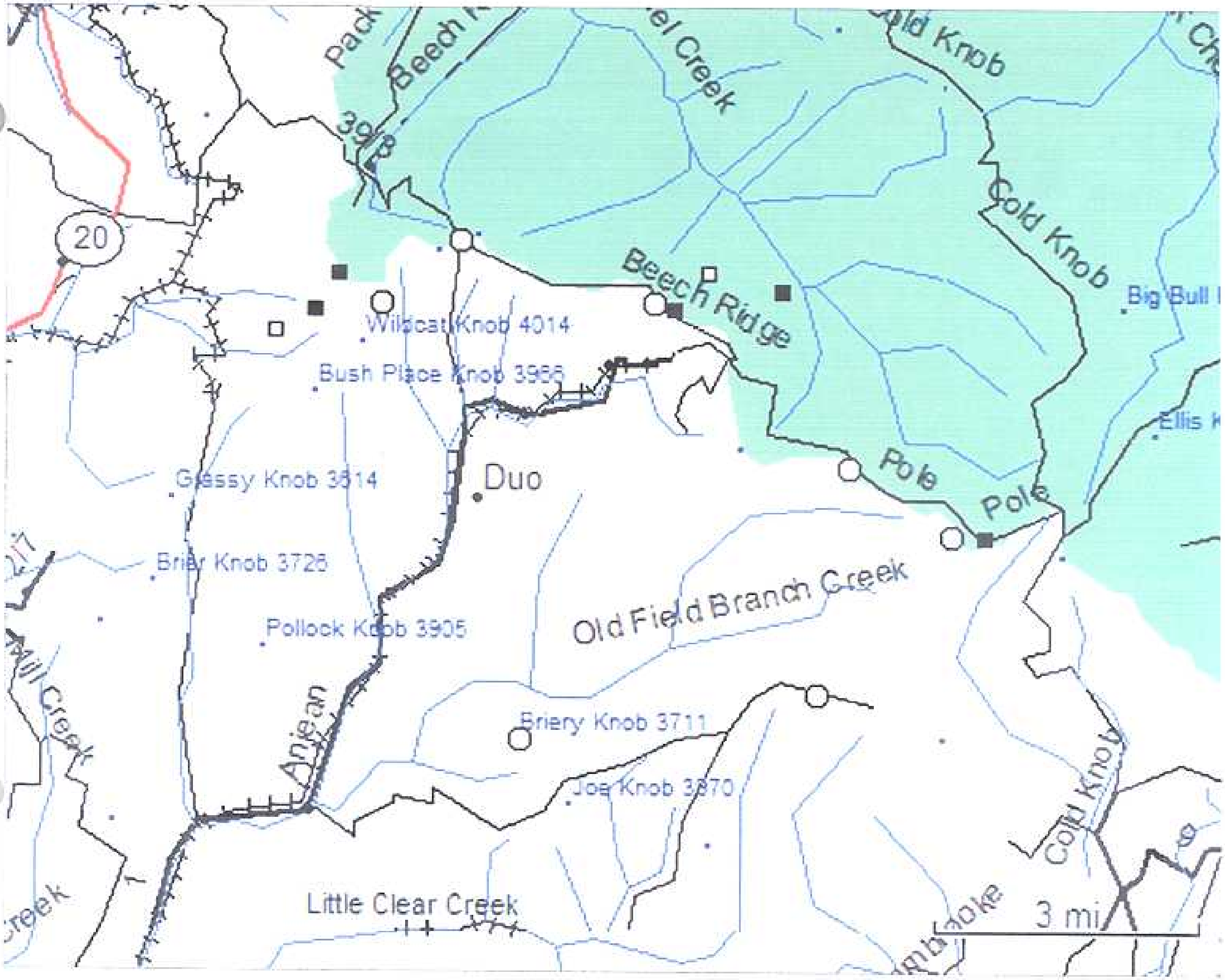


Figure 10 (continued). Passerine use by forest cover during the spring.



Pack
Beech
Creek
Knob
39/8
20
Cold Knob
Beech Ridge
Big Bull
Wildcat Knob 4014
Bush Place Knob 3966
Ellis
Grassy Knob 3614
Duo
Pole
Pole
Briar Knob 3726
Old Field Branch Creek
Pollock Knob 3905
Mill Creek
Anjean
Briery Knob 3711
Joe Knob 3870
Cold Knob
Little Clear Creek
Creek
3 mi

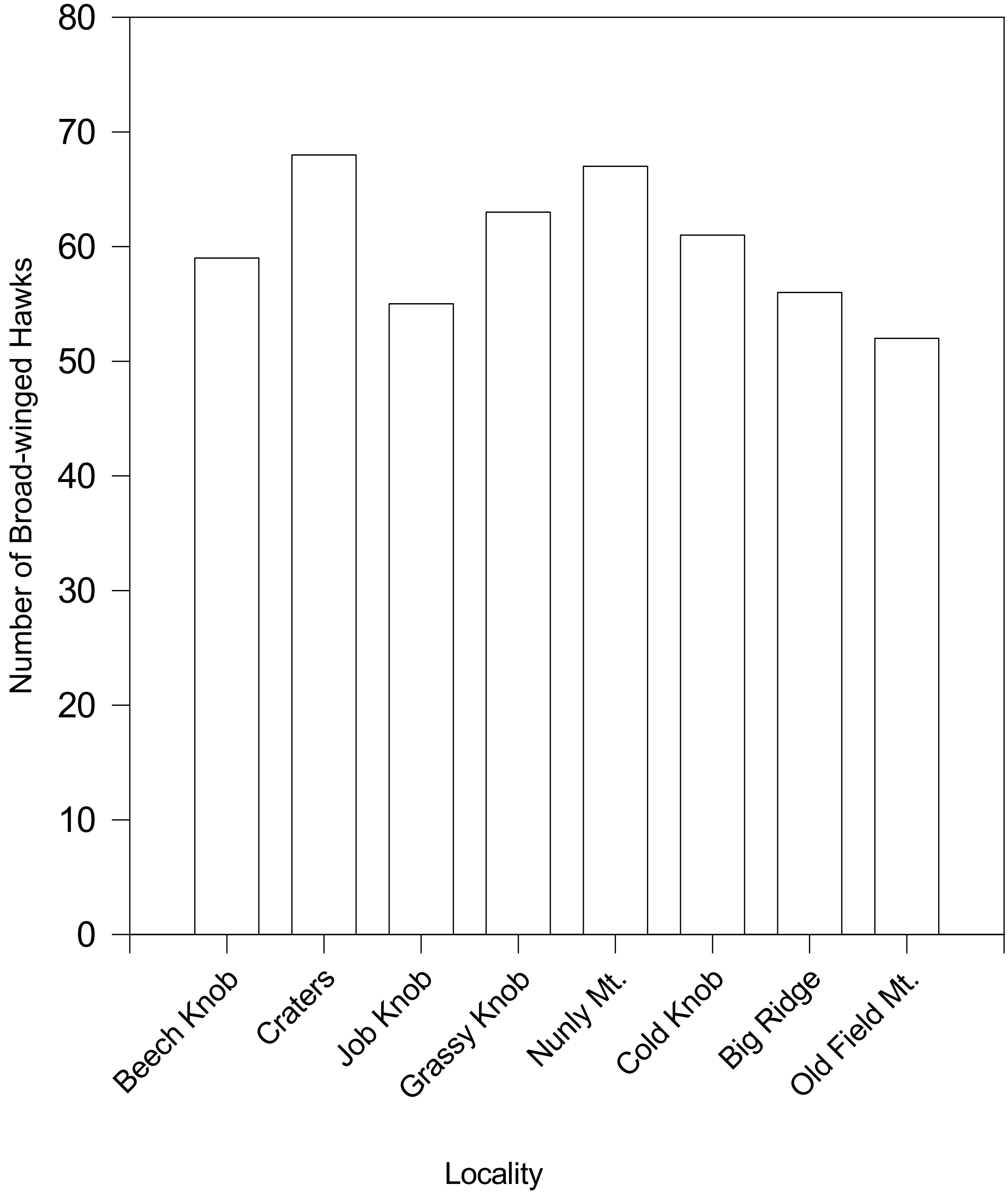


Figure 12. Number of Broad-winged Hawks recorded during 12.5 hours of observation at each locality during a fall raptor study.

AVIAN FATAL FLAW ANALYSIS

FOR

MEAD WESTVACO WIND FARM AREA,

GREENBRIER COUNTY, WEST VIRGINIA

September 2004

Report Prepared for:

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Report Prepared by:

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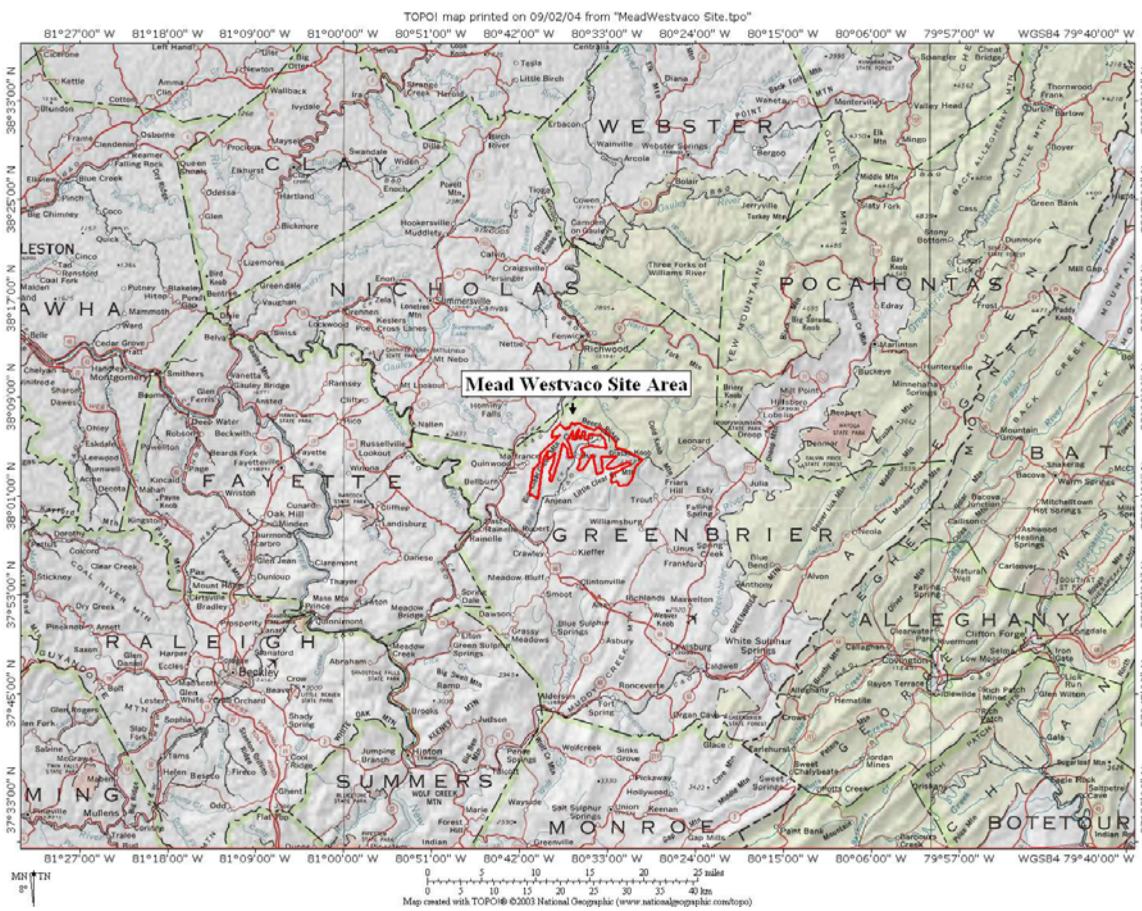
Introduction

A desktop analysis was conducted to determine if there were potential fatal flaws associated with avian risk at a proposed wind power project located in northwestern Greenbrier County, West Virginia. The following analyses are based on examination of topographic maps, a brief review of the literature, prior knowledge of the avifauna of the region, and extensive experience with wind power development in West Virginia and elsewhere. A brief literature and database search was conducted to determine if there are potential fatal flaws to the project. Most importantly, the search focused on identifying federal and state endangered, threatened and species of special concern that may be found on and around the project site.

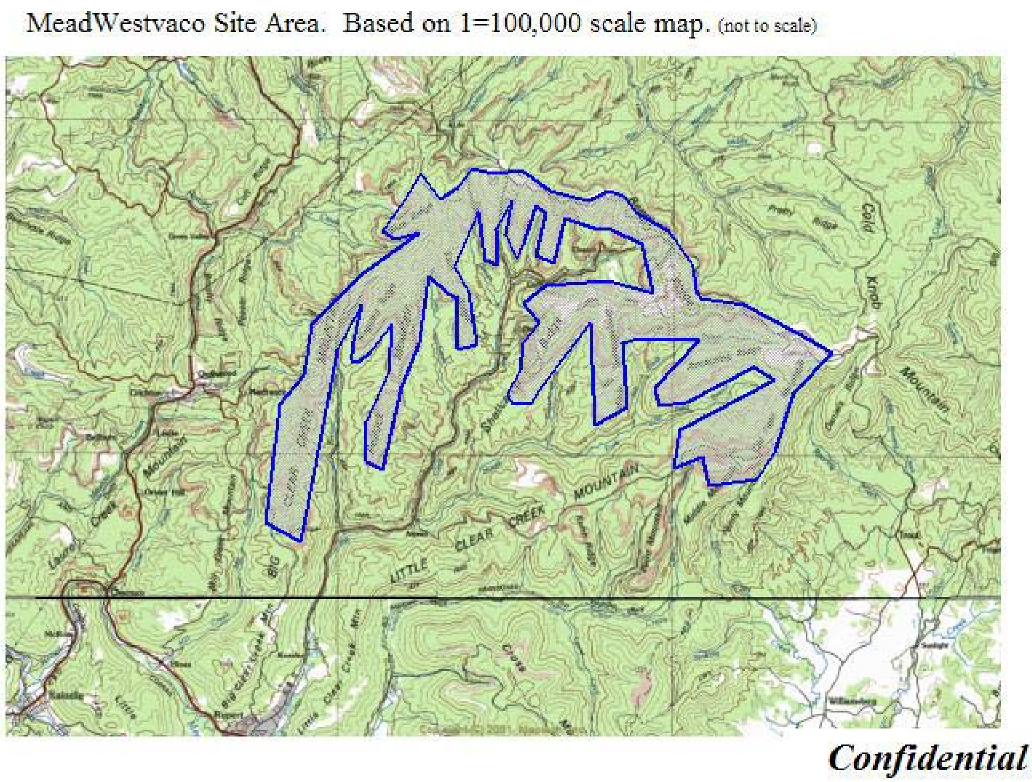
The Mead Westvaco wind power site is located about 4 miles north of Rupert in Greenbrier County, West Virginia (Figure 1). The project site includes the area from about 2 miles east of Quinwood eastward to Old Field Mountain and southward to within 2 miles of Anjean. The site encompasses over 30 linear miles of mountaintop area. Elevations range between approximately 3,200 feet and 4,200 feet ASL.

Figure 1 – Map of Mead Westvaco Wind Power Site in Greenbrier County, West Virginia, showing the site and surrounding area.



Land ownership is mainly private and the land on and near the site is largely undeveloped, with many mining activities and some timbering. There are small villages and residential areas near the site. The general area surrounding the site is comprised of mountains, valleys, and large elevation changes. There are some deep valleys, streams, lakes and high mountains on and adjacent to the site (Table 2).

Figure 2 – Detailed map of Mead Westvaco Wind Power Site showing actual boundaries and topography within and surrounding the site.



Nearby Parks, Forests, Nature Preserves and Wildlife Refuges

The southern boundary of Monongahela National Forest is located adjacent to the to the project site. There appear to a number of State Parks around the project area; however, none are within 10 miles of the site. No National Parks, Nature Preserves or National Wildlife Refuges are located near the project area. National forests are multiple use areas, although some do have habitat for sensitive wildlife. It did not appear that the Monongahela National Forest adjacent to the project site was such habitat. For permitting in West Virginia, the proximity of a National Forest is not relevant, unless that Forest is critical habitat for endangered or threatened species and those species are likely to be present.

Habitat

The habitat on site consists primarily of uplands forests and cleared areas. The forests are primarily deciduous hardwoods (maple-beech) and there may be some conifers nearby. There may be isolated wetlands in the lower lying areas and near the tops of ridges, mostly well away from turbine locations. Some small streams run through the valleys near the site. If roads must be built across streams or small wetlands, federal permits may be required. Such permits would entail securing U. S. Army Corps of Engineer permits, thereby triggering scrutiny by the U. S. Fish and Wildlife Service and, potentially, the NEPA process. Habitats are combinations of uninterrupted forest, forest patches, and clearings. Habitats have been impacted by timbering, mining, and other land-use practices on and near the site during the past two centuries. There is little or no habitat for endangered or threatened species on or adjacent to the project site.

Rivers, Lakes, Ponds and Wetlands

No major rivers or lakes are located near the project area. There are numerous smaller rivers, many creeks on and nearby the project area. Summersville Lake is about 17 miles to the northwest of the project area. The Greenbrier River lies about 20 miles to the south of the site. The Gauley, Laurel and the Cherry Rivers are located within about 12 miles to the north of the site. Numerous burrow pits and settling pods are located nearby the many coal mines on and around the site. It is unlikely that these smaller bodies of water would provide habitat for endangered or threatened species.

U.S. Fish & Wildlife Service – Listed Species

According to the U.S. FWS only a single listed bird species is known to occur in the State of West Virginia. Table 1 provides the status and distribution of the species in West Virginia.

Table 1 – U.S. Fish and Wildlife Federally listed avian species for West Virginia.

Species	Federal Status	Distribution
Bald Eagle	Threatened	Entire state

Of the West Virginia federally listed species only Bald Eagles may potentially occur on or near the Mead Westvaco project area. These birds are known to travel over wide areas and visit lakes, rivers, and large waterways throughout the eastern United States. During migration, Bald Eagles visit almost all lakes the size of Summerville Lake and other water bodies. Eagles basically look for any lake that could potentially provide sustenance in the form of fish or waterfowl, so it is likely that small numbers of eagles will visit water bodies near the project site. The U.S. Fish and Wildlife Service has made this point in writing or verbally with respect to at least 6 other proposed wind power projects in the eastern United States, including sites in West Virginia and nearby Pennsylvania and Maryland. Further investigation is advised to determine whether this species inhabits the general area. It is unlikely to nest on the site, but it could migrate or fly over the site during the year.

West Virginia Department of Natural Resources and Natural Heritage Program

The West Virginia Department of Natural Resources (DNR) maintains a list of species that are considered to be threatened, endangered, and of special concern by the State of West Virginia. Because West Virginia does not have state threatened and endangered species legislation, the species listed as either threatened or endangered in the State are the same as those found on the U.S. Fish and Wildlife Service's list of federally threatened and endangered species.

In addition to federal status under the Endangered Species Act, rare species are assigned State Ranks by the West Virginia Natural Heritage Program through the West Virginia Wildlife Diversity Program (WDP). These ranks are based on the species' documented occurrences and distributions. Other factors, such as habitat and threats to existing populations, may affect these rankings. Species with State Ranks of S1, S2, or S3 are tracked by the WDP. State ranks are defined in the following.

> **S1 -** Five or fewer documented occurrences, or very few remaining individuals within the state. Extremely rare and critically imperiled; or because of some factor(s) making it especially vulnerable to extirpation.
>
> **S2 -** Six to 20 documented occurrences, or few remaining individuals within the state. Very rare and imperiled; or because of some factor(s) making it vulnerable to extirpation.
>
> **S3 -** Twenty-one to 100 documented occurrences. May be somewhat vulnerable to extirpation.

Table 2 provides a listing of bird species that are tracked by the West Virginia Wildlife Diversity Program (WDP). Please note that this list is a comprehensive list for the state of West Virginia, not a list of species thought to inhabit the Mead Westvaco project area. Further investigation of the site will help to determine which species may be present on the project sites.

Table 2 – West Virginia Department of Natural Resources Listed Species.

Common Name	Scientific Name	State Rank
	State Rank S1	
Northern goshawk	Accipiter gentilis	S1
Henslow's sparrow	Ammodramus henslowii	S1
Short-eared owl	Asio flammeus	S1
Long-eared owl	Asio otus	S1

Common Name	Scientific Name	State Rank
American bittern	Botaurus lentiginosus	S1
Chuck-will's-widow	Caprimulgus carolinensis	S1
Pine siskin	Carduelis pinus	S1
Swainson's thrush	Catharus ustulatus	S1
Lark sparrow	Chondestes grammacus	S1
Northern harrier	Circus cyaneus	S1
Marsh wren	Cistothorus palustris	S1
Sedge wren	Cistothorus platensis	S1
Olive-sided flycatcher	Contopus cooperi	S1
Yellow-bellied flycatcher	Empidonax flaviventris	S1
Peregrine falcon	Falco peregrinus	S1
American coot	Fulica americana	S1
Wilson's snipe	Gallinago delicata	S1
Common moorhen	Gallinula chloropus	S1
Least bittern	Ixobrychus exilis	S1
Migrant loggerhead shrike	Lanius ludovicianus migrans	S1
Hooded merganser	Lophodytes cucullatus	S1
Sora	Porzana carolina	S1
King rail	Rallus elegans	S1
Virginia rail	Rallus limicola	S1
Yellow-bellied sapsucker	Sphyrapicus varius	S1
Appalachian Bewick's wren	Thryomanes bewickii altus	S1
Barn owl	Tyto alba	S1
Nashville warbler	Vermivora ruficapilla	S1
State Rank S2		
Northern saw-whet owl	Aegolius acadicus	S2
American black duck	Anas rubripes	S2
Great blue heron	Ardea herodias	S2
Bobolink	Dolichonyx oryzivorus	S2
Horned lark	Eremophila alpestris	S2
Bald eagle	Haliaeetus leucocephalus	S2
Swainson's warbler	Limnothlypis swainsonii	S2
Red-headed woodpecker	Melanerpes erythrocephalus	S2
Osprey	Pandion haliaetus	S2
Pied-billed grebe	Podilymbus podiceps	S2
Prothonotary warbler	Protonotaria citrea	S2
Bank swallow	Riparia riparia	S2
Northern waterthrush	Seiurus noveboracensis	S2

Common Name	Scientific Name	State Rank
Dickcissel	Spiza americana	S2
Golden-winged warbler	Vermivora chrysoptera	S2
State Rank S3		
Cooper's hawk	Accipiter cooperii	S3
Sharp-shinned hawk	Accipiter striatus	S3
Spotted sandpiper	Actitis macularia	S3
Grasshopper sparrow	Ammodramus savannarum	S3
Whip-poor-will	Caprimulgus vociferus	S3
Brown creeper	Certhia americana	S3
Common nighthawk	Chordeiles minor	S3
Black-billed cuckoo	Coccyzus erythropthalmus	S3
Northern bobwhite	Colinus virginianus	S3
Black vulture	Coragyps atratus	S3
Yellow-rumped warbler	Dendroica coronata	S3
Blackburnian warbler	Dendroica fusca	S3
Alder flycatcher	Empidonax alnorum	S3
Cliff swallow	Petrochelidon pyrrhonota	S3
Vesper sparrow	Pooecetes gramineus	S3

Other Endangered or Threatened Animal Species

Virginia Northern Flying Squirrel – a federally listed endangered species – and Eastern Woodrat – proposed for listing – are known to be in the area but unlikely to be on the site. These prey species if found on or around the site may attract raptors to the site. However, some preliminary studies conducted for a prior developer in the mid 1990s did not identify either of these species or supportive habitats present on this specific site.

Indiana Bat, Virginia big-eared Bat, and Gray Bats are federally listed endangered species that are known to be present in some parts of West Virginia. Significant numbers of Indiana bats hibernate in certain West Virginia caves. This species is known to have hibernacula in Greenbrier and some other counties in West Virginia. Bats may occupy summer habitat throughout the entire state. More Virginia big-eared bats occur in West Virginia than in any other state. Caves are critical to the survival of this bat, and most of the significant caves are protected in some way. As a result, populations in the state are increasing. The known distribution of Virginia big eared bats is primarily northeastern counties, especially Pendleton, Tucker and Grant Counties. Critical habitat: Hellhole Cave, Cave Mountain Cave, Hoffman School Cave, and Sinnit/Thorn Mountain Cave in Pendleton Co.; Cave Hollow/Arbogast Cave in Tucker. None are known from Greenbrier County. Gray bats are extremely rare in the West Virginia, with only one record of two individuals known from Pendleton County, West Virginia. Its occurrence is considered accidental. Of the three listed bats, only Indiana's are likely to be found in Greenbrier County, the same county as the proposed project.

The issue of bat interactions with wind turbines is facing increased scrutiny, although Indiana bats have not been reported to collide with wind turbines or other tall structures. Further investigation is recommended for Indiana bats to determine if the species occurs at or near the project area. If a hibernaculum of this species occurs within 5-10 miles of the site, the project may have difficulties with respect to permitting and development, and further research is certain to be requested by the agencies. Whether or not hibernacula for this species are near the project site is not known at this time. The State of West Virginia will have information about the whereabouts of hibernacula, although a formal request including a map of the site would be required by the state prior to providing such information.

USGS Breeding Birds Surveys - West Virginia

A search of the USGS North American Breeding Bird Survey (BBS) database was conducted to identify federal and state listed species in close proximity to the project area. Two BBS survey routes, closest to the project area, were examined (#90002 – Smoot, Greenbrier County, WV and #90029 – Richwood, Nicholas/Greenbrier Counties, WV). The Smoot survey route passes within 6 miles southwest of the project area, with Richwood within 6 miles to the northeast. For each of these routes, the most recent 10 years of surveys were reviewed. (Note: No data was available for 2002 for Smoot and data was not available for 1998 for Richwood) The results of the BBS data search identified **no** federally listed species and few state listed species, as presented in the following tables (Table 3and Table 4). There were some West Virginia rare species found on the Breeding Bird Surveys in the general area of the project site, so site specific habitat information is needed to determine if those species are present on site. Their presence is not likely to be a fatal flaw, but if large numbers are present, there could be closer scrutiny of the project by the state agencies.

Table 3 – Breeding Bird Survey Route 90002 – Smoot, WV (within 6 miles SW of project area).

Species	Status	Quantity	Year(s)
Cooper's Hawk	S3	1 1	2003 1995
Sharp-shinned Hawk	S3	1	2003
Grasshopper Sparrow	S3	1	1998
Common Nighthawk	S3	1	2000
Northern Bobwhite	S3	1 3 2 1	2000 1999 1997 1995
Black Vulture	S3	2	1999

Table 4 – Breeding Bird Survey Route 90029 – Richwood, WV (within 6 miles NE of project area).

Species	Status	Quantity	Year(s)
Sharp-shinned Hawk	S3	1	1995
Black-billed Cuckoo	S3	2 1 1	2003 2002 1996

National Audubon Society – Christmas Bird Counts, West Virginia

The National Audubon Society's Christmas Bird Count (CBC) database was consulted to determine if there were any listed species wintering near the project area. The Oak Hill (WVOH) and Lewisburg (WVLE) CBC routes were determined to be the closest to the project are and therefore, most relevant for this report. The Oak Hill count circle location is approximately 26 miles west of the project area, while the Lewisburg count is located about 19 miles to the southeast. The CBC reports species observed by volunteer birders during the winter months. The search consisted of the most recent 10 years of count data collected by the CBC. The results of the CBC search indicated that **no** federally listed species were documented by the CBCs reviewed. However, a number of state listed/rare species were identified. Those species are presented in the following tables (Table 5 and Table 6).

Table 5 – Christmas Bird Count circle WVOH – Oak Hill, WV (approx. 26 miles W of the project area).

Species	Status	Quantity	Count Year(s)
Northern Harrier	S1	1	2001
American Coot	S1	7 6	2002 2000
Hooded Merganser	S1	9 1	2002 2000
Yellow-bellied Sapsucker	S1	1 8 7 1 2 5	2003 2000 1999 1997 1995 1994
American Black Duck	S2	6 8 6 3 1	2003 2002 2001 1997 1996
Great Blue Heron	S2	1 1 1 2 1 5 1	2003 1999 1998 1997 1996 1995 1994
Red-headed Woodpecker	S2	1	2003

Species	Status	Quantity	Count Year(s)
		1	1999
Pied-billed Grebe	S2	8	2002
		7	2000
		6	1999
		5	1997
		2	1996
		3	1995
		2	1994
Cooper's Hawk	S3	1	2003
		1	2002
		2	2001
		1	2000
		2	1998
		2	1997
		4	1996
		2	1994
Sharp-shinned Hawk	S3	2	2003
		5	2002
		1	2001
		2	2000
		1	1999
		5	1998
		2	1997
		2	1996
		1	1994
Brown Creeper	S3	4	2003
		2	2001
		5	2000
		5	1999
		10	1998
		3	1997
		4	1996
		1	1995
		2	1994
Black Vulture	S3	11	2001
		2	2000
		3	1996
Yellow-rumped Warbler	S3	3	2002
		13	2001
		3	2000
		10	1999
		3	1998
		34	1997
		31	1996
		34	1995
		6	1994

Table 6 – Christmas Bird Count circle WVLE – Lewisburg, WV (approx. 19 miles SE of the project area).

Species	Status	Quantity	Count Year(s)
Pine Siskin	S1	3	1996

Species	Status	Quantity	Count Year(s)
Northern Harrier	S1	1 1 3	2000 1995 1994
Marsh Wren	S1	1	2003
Peregrine Falcon	S1	1	1995
Loggerhead Shrike	S1	1 1 1 1 1 1 3	2003 2002 2000 1999 1996 1995 1994
Hooded Merganser	S1	9 4 10 2	2003 2002 2000 1999
Yellow-bellied Sapsucker	S1	1 3 2 5 4 2 1 8 1	2003 2002 2001 2000 1999 1998 1997 1996 1994
American Black Duck	S2	26 1 2 1	2003 1999 1996 1995
Great Blue Heron	S2	3 9 8 7 10 5 3 10 3 5	2003 2002 2001 2000 1999 1998 1997 1996 1995 1994
Horned Lark	S2	30 24 66 16 15	2003 1999 1996 1995 1994
Red-headed Woodpecker	S2	1 2 2 6 6 2	2002 2001 2000 1999 1997 1996
Pied-billed Grebe	S2	3	1996
Cooper's Hawk	S3	1 1	2003 2002

Species	Status	Quantity	Count Year(s)
		1	2001
		7	2000
		1	1999
		2	1998
		3	1996
		1	1994
Sharp-shinned Hawk	S3	3	2003
		2	2001
		2	2000
		1	1999
		3	1998
		4	1996
		3	1995
		1	1994
Brown Creeper	S3	5	2003
		5	2002
		4	2000
		5	1999
		6	1998
		1	1997
		10	1996
		3	1995
		6	1994
Northern Bobwhite	S3	1	1994
Black Vulture	S3	64	2003
		166	2002
		41	2001
		146	2000
		166	1999
		56	1998
		15	1997
		306	1996
		82	1995
		182	1994
Yellow-rumped Warbler	S3	16	2001
		4	2000
		43	1999
		5	1998

Flyways – Migration Corridors

There are few scientifically documented migration concentration sites in West Virginia. The project site does not appear to be situated on a major or well-used migration pathway for any of the major types of birds, including hawks, waterfowl, shorebirds, and other birds. These statements are based on the literature, as well as the topography, habitat, and geographic location of the Mead Westvaco project site and what is known about the migration behavior of birds. The habitat within the project boundary is not suggestive of important stopover sites or sites used by large concentrations of shorebirds, waterfowl, songbirds, or other types of avian migrants, although there is certainly some migration of many types of birds over the site, because migrants are known to distribute themselves over wide geographic areas in topographic and habitat situations like those at the Mead Westvaco site.

Recent Developments Regarding Wind Power Development in West Virginia

The Fish and Wildlife Service is using the following statement to request extensive studies of proposed wind project sites in the Eastern United States. Size of the project does not appear to be a factor.

"The potential for collision with resident or migratory species of birds and bats is affected by many factors but location of the wind turbines appears to be one of the most important. In order to determine what the potential collision hazard is for a particular site, the spatial and temporal uses of the airspace by birds, bats and insects need to be defined (insects are included because they are prey for birds and bats). These studies can best be accomplished by using remote sensing technology (radar, acoustic and infrared) to collect data in various spatial scales (ridge tops, side slopes and valley sections) and temporal scales (day and night, season to season, and year to year). Traditional sampling protocols (transect sampling, visual observation, mist netting, anabat detectors, etc.) should be used to supplement the remote sensing work and would likely be necessary to ground truth the data for individual species.

We recommend a multi-season period of data collection for the Mead Westvaco Wind Project using remote sensing and traditional on-the-ground study protocols to define the temporal and spatial uses of the airspace by birds, bats and insects. In particular, the preconstruction studies should consist of, but not necessarily be limited to, the following: a raptor migration study to determine flight characteristics for this avian group; a study of nocturnal migrants using radar and acoustic recorders to determine spatial and temporal use by birds, bats, and insects; and ground truthing studies such as a migration stopover study for birds using mist nests and observation techniques and a study of bats using mist nets, anabat detectors, radio microphones, or other appropriate technology such as thermal imaging cameras.

A multi-season time frame should provide an adequate sampling period to gather data on the year-to-year and seasonal variability of bird, bat insect, and other wildlife activity at the proposed site. This would provide a reasonable opportunity to determine the response of these species groups to the broad array of weather-related phenomena that could be expected and to determine the predator-prey interactions that occur in the airspace above the project area between birds/bats and their insect prey. Special emphasis would be placed on spring and fall migration periods and the breeding brood rearing and juvenile development periods. We would expect the data from this effort to be adequate for macro scale siting analysis to determine site acceptability.

The Service further advises that, "In the absence of adequate preconstruction data on spatial and temporal uses by avian species, you proceed with the project at your own risk.

Any subsequent take of federally-protected species may be evaluated in light of this administrative record."

Taken from 7-7-04 Letter, over the signature of Michael J. Bartlett, Supervisor, New England Field Office.

Conclusions and Recommendations

Fatal Flaw conclusions and recommendations are based on the results of a desktop study of literature and other databases, including maps. We review the information in the context of our experience in assessing a broad range of sites upon which wind farms have been developed, including 5 years of experience in West Virginia and 10 years of experience in the northeastern United States. A fatal flaw is often obvious to the eye of an expert on avian/bat interactions with wind turbines without having to visit the site. However, in this instance we did have a trained biologist conduct a reconnaissance at this site.

We have not found any records documenting the listing of a federally threatened or endangered species located or suspected to be located on the project site. Such a finding would not automatically preclude development of a site at least on a biologically defensible basis. A fatal flaw in this instance would mean the established presence of a T&E species on the proposed site and specifically, risk to that species from wind power development. In addition, it would have to be obvious that there is little or no likelihood of developing a plan for development that would be acceptable by the state or federal agency with jurisdiction over the issue.

It is our considered opinion that the Mead Westvaco site is not encumbered with one or more fatal flaws. For example, the likelihood that there would be endangered or threatened species at or immediately adjacent to the project site is relatively low and risk to such species is, similarly, unlikely. The available literature regarding the habitat and geographic location of the proposed project do not suggest the evidence of major bird migration and/or potential stopover sites within the project boundary. The Virginia Northern Flying Squirrel – a federally listed endangered species – and Eastern Woodrat – proposed for listing – are known to be in the area but unlikely to be on the site. However, some preliminary studies conducted for a prior developer in the mid 1990s did not identify either of these species or supportive habitats present on this specific site.

As stated earlier, in this part of the country there is a concerted effort being made by the U.S. Fish and Wildlife Service to secure multiple year studies of avian and bat spatial and temporal use of proposed sites as well as night migration over every project site, regardless of the size of the installation. On non-federal lands (or when no federal permits, such as for wetland impacts), the Service must defer to the state permitting authorities to make this a requirement. With small projects such as one in Vermont consisting of four turbines (for which the Service and the state agency requested

$800,000 of studies), this would constitute a fatal flaw in the absence of relief due to the cost to conduct these studies.

A Phase I Risk Assessment, or a variation thereof, may be necessary to establish a site specific scientific basis for reducing the request for additional studies. In any event, additional on site data collection and agency consultation will likely be required by the West Virginia Department of Natural Resources to proceed with the permitting of this project. The U. S. Fish and Wildlife Service will also likely request further study, although they are unlikely to have a legal nexus for their request.

Spring and Fall Eagle and Osprey Surveys for the Beech Ridge Wind Energy Project, Greenbrier and Nicholas Counties, West Virginia

March-May and September-October, 2011

Prepared for:

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January 23, 2011

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

EXECUTIVE SUMMARY

Beech Ridge Energy LLC, a wholly-owned subsidiary of Invenergy LLC, has developed the Beech Ridge Wind Energy Project (BRWEP) in Greenbrier and Nicholas Counties, West Virginia. The West Virginia Public Service Commission (WV PSC) permit issued for the project included a requirement for a one-year post-construction study of eagle and osprey use at the BRWEP. The Technical Advisory Committee for the BRWEP determined that raptor migration surveys conducted during the migration seasons would fulfill this requirement in part. The principal objectives of the study were to: (1) provide site-specific osprey, eagle, and other raptor use data that would be useful in evaluating potential impacts from the Project; and (2) fulfill WV PSC permit requirements.

Raptor migration surveys were conducted at five survey stations in spring between March 16 and May 13, and in fall between September 7 and October 28, 2011. All surveys were conducted between the hours of 0900 and 1600 on days conducive to raptor migration. Over 253 surveys, mean use for all raptors, including vultures, was 2.93 birds per observer-hour, and overall species richness was 1.25 raptor species per survey. Spring mean raptor use, excluding vultures, was 0.71 birds per observer-hour, while fall raptor use was 0.95 birds per observer-hour. In spring, vulture use was 2.98 vultures per observer-hour; in fall vulture use was 1.14 vultures per observer-hour. One osprey was observed during spring surveys, and three were observed during fall surveys. More eagles were observed in spring, with one bald eagle in spring and none in fall, and six golden eagles in spring and four in fall.

The highest mean raptor and vulture use in spring was at Station 5, with 7.92 birds per observer-hour, while Station 4 had the highest use in fall, with 2.63 birds per observer-hour. Daily raptor and vulture use peaked in the middle of the day, during the 1200 hour. Bird use fluctuated throughout the spring and fall survey periods. In spring, raptor use peaked on April 26 with 15 individuals observed, while vulture use peaked on April 3 with 47 individuals observed. In fall, raptor use peaked on September 28 with 31 individuals while vultures had two peaks, on September 9 with 26 individuals and on October 24 with 24 individuals observed.

For raptors observed flying within 800 meters (m) of the survey station, 50.9% were observed flying in the rotor-swept height (RSH; 41.5 to 118.5 m [136.2 to 388.8 feet] above ground level), while 42.8% of vultures were observed flying in the RSH. Two of the three ospreys observed within 800 m were observed within the RSH. One bald eagle and one golden eagle were observed flying within 800 m of the survey stations, and both were flying in the RSH.

Data collected during spring and fall surveys suggest that the BRWEP receives relatively low use by ospreys and eagles, which each accounted for approximately or less than one percent of all raptor use. When averaged over all survey days to provide a comparable metric to other hawk watch sites, raptor use during the spring and fall study periods was 1.11, and was substantially lower than average use at four other Hawk Watch sites in the same geographic region for data from the same survey days (range of 9.15 to 56.85 raptors per observer-hour).

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INTRODUCTION

Beech Ridge Energy LLC (BRE), a wholly-owned subsidiary of Invenergy LLC, has developed a wind-energy facility, the Beech Ridge Wind Energy Project (BRWEP), in Greenbrier and Nicholas Counties, West Virginia (Figure 1). BRE contracted Western EcoSystems Technology, Inc. (WEST) to monitor wildlife resources as part of fulfilling West Virginia Public Service Commission (WV PSC) permit requirements for the BRWEP.

The WV PSC permit issued for the project included a requirement for a one-year post-construction eagle and osprey study at the BRWEP. The Technical Advisory Committee for BRWEP determined that raptor migration surveys conducted during the migration seasons would fulfill this requirement in part. An additional raptor migration study was completed in the BRWEP's proposed expansion area and is described in a separate report. The principal objectives of the study were to: (1) provide site-specific osprey, eagle, and other raptor use data that would be useful in evaluating potential impacts from the BRWEP; and (2) fulfill WV PSC permit requirements. The following report contains results of the 2011 spring and fall surveys, conducted for ospreys (*Pandion haliaetus*), eagles, and other raptors.

METHODS

Surveys at the BRWEP during 2011 consisted of raptor migration surveys during the spring and fall migration seasons, and incidental observations of raptors while field biologists were on site. Raptor migration surveys were designed to provide visual coverage over large areas and generally survey for large birds, specifically eagles and ospreys, as well as other raptor species and vultures.

Raptor Migration Surveys

Survey Stations

Five point-count survey stations were established within the BRWEP to survey for raptors (Figure 1). Point count stations were established on top of ridges in open, non-forest habitats to provide good visual coverage in roughly 360 degrees around the station. This maximized visibility of diurnal migrant raptors over long distances. Each survey plot included an unlimited distance viewshed centered at the station as with typical raptor migration surveys. The location of each station was recorded with GPS coordinates and on a hardcopy map.

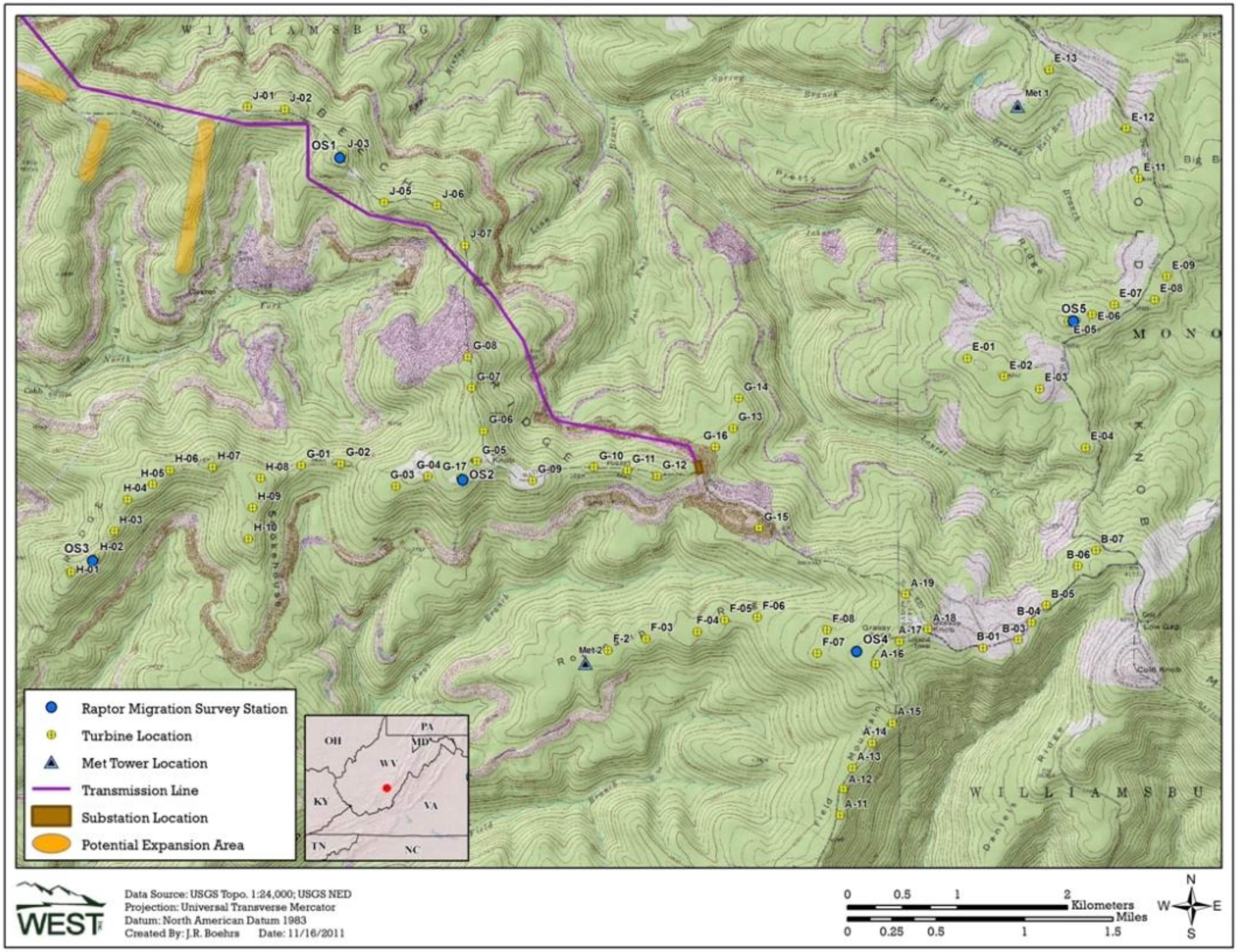

Figure 1. Overview of the Beech Ridge Wind Energy Project and raptor migration survey stations.

Survey Methods

Surveys were conducted according to methods used by the Hawk Migration Association of North America (HMANA) and Hawk Watch International (HWI) with observers continuously scanning overhead for migrating raptors. Binoculars were frequently used throughout each survey period to aid in locating migrating raptors. The date, start and end time of the survey period, and weather information such as temperature, wind speed, wind direction, barometric pressure, percent cloud cover, precipitation, and maximum visibility estimates were recorded for each survey. Weather information was recorded using a Kestrel® 2500 pocket wind meter. Time of observation, species or best possible identification, number of individuals, age and sex (if possible), estimation of distance from observer, flight height, and flight direction were recorded for each raptor observation.

Observation Schedule

During spring migration, each survey station was surveyed approximately three times per week from March 16 to May 13, 2011. During fall migration, each station was surveyed twice weekly from September 7 to October 28, 2011. These periods were selected based on information obtained from regional hawk migration surveys and covered the periods when most migrant raptors, including eagles and ospreys, were observed at these other hawk watch sites during spring and fall migrations (HMANA 2011). Survey duration at each station was one hour and surveys were conducted between approximately 0900 and 1600 hours (hrs), which is the peak daily period for migrating raptor activity. Surveys were only conducted on days when weather conditions were conducive to raptor migration (e.g., warm, clear, high pressure conditions).

Incidental Wildlife Observations

The objective of incidental wildlife observations was to record raptors seen outside of standardized surveys. All raptors observed while the field biologist was on site but not conducting a standardized survey were recorded in a similar fashion as those observed during a survey. The observation number, date, time, species, number of individuals, sex/age class, activity, estimated distance from observer, and height above ground (for flying birds), and habitat were recorded.

Statistical Analysis

Following field surveys, observers inspected data forms for completeness, accuracy, and legibility. A Microsoft® ACCESS database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. A sample of records from the electronic database was compared to the raw data forms and any errors detected were corrected. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. All data forms, field notebooks, and electronic data files were retained for reference.

Raptor Diversity and Species Richness

Raptor diversity was represented by the total number of species observed. Species richness was represented by the mean number of species observed per survey. Species richness for a visit[1] was calculated by averaging the number of species observed across all surveys in that visit. Species richness for a survey station was calculated by averaging across all visits. Overall species richness for the season was calculated by averaging across all visits within the season.

Raptor Use, Percent of Use, and Frequency of Occurrence

For raptor migration surveys, observations of birds detected within an unlimited viewshed were used in the analysis. The common standardized metric for raptor migration surveys is the mean number of birds per observer-hour. This metric allows comparison between sample locations, over time (e.g., hours, days, weeks, seasons), or with other studies where similar data exist. Mean use was calculated by dividing the total number of birds observed during a survey by the number of hours in the survey. To calculate mean use for any given visit, use was averaged across all the stations that were surveyed on that date or for that visit. To calculate overall mean use, the mean use for each visit was averaged for all visits in the season.

To investigate changes in use over time of day, mean use was averaged across all stations for each time block (e.g., 1000 – 1100 hrs, 1100 – 1200 hrs, etc.). This accounts for variation in survey effort among stations and visits.

Frequency of occurrence was calculated as the percent of surveys in which a particular species or raptor type was observed. Percent of use was calculated as the proportion of the overall mean use that is attributable to a particular species or raptor type. Frequency of occurrence and percent of use provide relative estimates of species exposure to the wind energy facility. For example, a species may have high use estimates for the site based on just a few observations of large groups; however, the frequency of occurrence will indicate that the species occurs during very few of the surveys and, therefore, may be less likely affected by the facility.

Bird Flight Height

For observations of raptors within 800 meters (m) of the survey station[2], the approximate flight height was recorded at the point where the bird was first observed. This flight height was used to calculate the percentage of raptors flying within the rotor-swept height (RSH; 41.5 to 118.5 m [136.2 to 388.8 feet] above ground level) for the BRWEP turbines.

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[1] A visit is defined as the period or effort required to conduct a complete round of surveys at all five stations.

[2] Due to the difficulty with estimating flight height when there are few reference points, flight height was not estimated for observations of birds greater than 800 m from the survey station.

Comparison with Other Hawk Watch Sites

Established hawk watch sites are typically surveyed from one location for a period of time (hours) each survey day. To calculate daily raptor use for hawk watch sites, the total number of raptors observed is divided by the total number of observer-hours. To calculate an overall mean use for the study period at hawk watch sites, the daily mean number of raptors per observer hour is averaged across all days surveyed.

To generate a metric that would be comparable for the BRWEP study area, daily mean raptor use was calculated as the average number of raptors per observer hour for all survey stations visited on that day. To calculate a comparable overall mean use for the study period, this daily use value was averaged across all days surveyed. Data for the established hawk watch sites for the same survey days as those at BRWEP were tallied and averaged across all days surveyed for comparison.

RESULTS

Raptor migration surveys were conducted at each of the five stations between 26 and 28 times from March 16 to May 13, and between 23 to 24 times from September 7 to October 28, 2011 (Table 1).

Table 1. Summary of raptor use and species richness during spring and fall raptor migration surveys at the Beech Ridge Wind Energy Project.

Station	Total Number of Surveys	Total Number of Species	Mean Use (number of birds/hour)	Mean Number of Species/Survey
		Spring		
1	26	8	3.78	1.5
2	27	5	1.77	1.04
3	26	6	2.69	1.46
4	28	8	2.78	1.43
5	28	8	7.92	1.54
Total	**135**	**11**	**3.68**	**1.34**
		Fall		
1	24	10	2.42	1.33
2	24	6	1.51	1.04
3	23	7	1.72	1.13
4	23	8	2.63	1.35
5	24	8	2.61	0.96
Total	**118**	**12**	**2.09**	**1.14**
		Overall (Spring and Fall)		
1	50	11	3.13	1.42
2	51	7	1.64	1.04
3	49	8	2.23	1.31
4	51	9	2.71	1.39
5	52	10	5.47	1.27
Total	**253**	**13**	**2.93**	**1.25**

Raptor Diversity and Species Richness

A total of 968 raptors and vultures was observed in the BRWEP during the surveys, representing 13 species and one unidentified accipiter (Table 2), with an overall mean species richness of 1.25 species per survey for both seasons (Table 1). Turkey vulture (*Cathartes aura*) was the most commonly recorded species during the surveys, composing 69.4% of all observations (Table 2). Excluding vultures, 284 raptors were recorded (Table 2). Four ospreys were observed, with one in spring and three in fall, accounting for 1.4% of total observed raptors and 0.4% of all individuals. Ten golden eagles (*Aquila chrysaetos*) were observed, with six in spring and four in fall, representing 3.5% of total observed raptors and 1.0% of all individuals. Only one bald eagle (*Haliaeetus leucocephalus*) was observed in spring and none in fall.

Table 2. Total number of groups and individuals for each raptor subtype and species observed during spring and fall raptor migration surveys at the Beech Ridge Wind Energy Project.

		Spring		Fall		Overall	
Species/Type	**Scientific Name**	**Number of Groups**	**Number of Individuals**	**Number of Groups**	**Number of Individuals**	**Number of Groups**	**Number Of Individuals**
Diurnal Raptors		**105**	**127**	**111**	**157**	**216**	**284**
Accipiters		*16*	*18*	*17*	*18*	*33*	*36*
Cooper's hawk	*Accipiter cooperii*	4	5	4	4	8	9
sharp-shinned hawk	*Accipiter striatus*	12	13	12	13	24	26
unidentified accipiter		0	0	1	1	1	1
Buteos		*81*	*99*	*80*	*125*	*161*	*224*
broad-winged hawk	*Buteo platypterus*	30	37	17	37	47	74
red-shouldered hawk	*Buteo lineatus*	25	30	17	25	42	55
red-tailed hawk	*Buteo jamaicensis*	26	32	46	63	72	95
Northern Harrier		*0*	*0*	*1*	*1*	*1*	*1*
northern harrier	*Circus cyaneus*	0	0	1	1	1	1
Eagles		*5*	*7*	*4*	*4*	*9*	*11*
bald eagle	*Haliaeetus leucocephalus*	1	1	0	0	1	1
golden eagle	*Aquila chrysaetos*	4	6	4	4	8	10
Falcons		*2*	*2*	*6*	*6*	*8*	*8*
American kestrel	*Falco sparverius*	2	2	5	5	7	7
merlin	*Falco columbarius*	0	0	1	1	1	1
Osprey		*1*	*1*	*3*	*3*	*4*	*4*
osprey	*Pandion haliaetus*	1	1	3	3	4	4
Vultures		**279**	**506**	**119**	**178**	**398**	**684**
black vulture	*Coragyps atratus*	4	7	2	5	6	12
turkey vulture	*Cathartes aura*	275	499	117	173	392	672
Overall		**384**	**633**	**230**	**335**	**614**	**968**

Raptor Use, Percent of Use, and Frequency of Occurrence

Combined raptor and vulture use was higher in spring (3.68 birds/hour) than fall (2.09; Table 3). In spring, mean raptor and vulture use varied from 1.77 birds per observer-hour at station 2 to 7.92 birds per observer-hour at station 5 (Table 3). In fall, mean raptor and vulture use ranged from 1.51 birds per observer-hour at station 2 to 2.63 birds per observer-hour at station 4 (Table 3).

Raptors

Mean raptor use, excluding vultures, was 0.71 birds per observer-hour in spring and 0.95 birds per observer-hour in fall (Table 3). Buteos had the highest use of all raptor subtypes (0.56 birds per observer-hour in spring and 0.77 in fall), composing 15.2% of all use in spring and 36.9% of all use in fall. Buteos were observed during 35.7% of spring surveys and 35.0% of fall surveys. Broad-winged hawk (*Buteo platypterus*) was the buteo most commonly observed in spring with

37 individuals, while red-tailed hawk (*B. jamaicensis*) was the most commonly observed buteo in fall with 63 individuals observed (Table 2). Eagles were observed during 3.6% of spring surveys and 3.2% of fall surveys. Eagle use in spring was 0.04 birds per observer-hour and eagles represented 1.1% of overall spring raptor and vulture use (Table 3). In fall, eagle use was 0.02 birds per observer-hour and eagles accounted for 1.2% of overall fall use (Table 3). Osprey were observed in only 0.7% of spring surveys and osprey use in spring was less than 0.01 ospreys per observer-hour, representing less than 0.1% of overall use (Table 3). Fall osprey use was 0.01 ospreys per observer-hour, ospreys represented 0.6% of overall use, and they were observed in 2.4% of all surveys (Table 3).

Vultures

Two vulture species were recorded within the BRWEP, turkey vulture and black vulture (*Coragyps atratus*). In spring, vulture use was 2.98 vultures per observer-hour; in fall vulture use was 1.14 vultures per observer-hour (Table 3). Vultures composed 80.9% of overall use in spring and were observed in 71.4% of spring surveys (Table 3). In fall, vultures composed 54.4% of overall use, and they were observed in 41.4% of fall surveys (Table 3).

Table 3. Mean use (number of birds per observer-hour), percent of overall use, and frequency of occurrence for each raptor subtype observed during the spring and fall raptor migration surveys at the Beech Ridge Wind Energy Project.

	Mean Use		Percent of Use		Percent Frequency	
Species	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**
			Overall - All Stations			
Diurnal Raptors	0.71	0.95	19.1	45.6	40.7	50.4
Accipiters	*0.09*	*0.10*	*2.5*	*4.8*	*9.3*	*13.8*
Buteos	*0.56*	*0.77*	*15.2*	*36.9*	*35.7*	*35.0*
Northern Harrier	*0*	*0.02*	*0*	*1.0*	*0*	*4.0*
Eagles	*0.04*	*0.02*	*1.1*	*1.2*	*3.6*	*3.2*
Falcons	*<0.01*	*0.02*	*0.2*	*1.1*	*1.4*	*4.0*
Osprey	*<0.01*	*0.01*	*<0.1*	*0.6*	*0.7*	*2.4*
Vultures	2.98	1.14	80.9	54.4	71.4	41.4
Overall	**3.68**	**2.09**	**100**	**100**		
			Station 1			
Diurnal Raptors	0.97	1.08	25.6	44.4	53.8	58.3
Accipiters	*0.10*	*0.09*	*2.7*	*3.8*	*15.4*	*12.5*
Buteos	*0.79*	*0.87*	*20.9*	*36.0*	*42.3*	*45.8*
Northern Harrier	*0*	*0.02*	*0*	*0.9*	*0*	*4.2*
Eagles	*0.08*	*0.03*	*2.0*	*1.2*	*7.7*	*4.2*
Falcons	*0*	*0.02*	*0*	*0.9*	*0*	*4.2*
Osprey	*0*	*0.04*	*0*	*1.7*	*0*	*8.3*
Vultures	2.81	1.35	74.4	55.6	73.1	50.0
Overall	**3.78**	**2.42**	**100**	**100**		

Table 3. Mean use (number of birds per observer-hour), percent of overall use, and frequency of occurrence for each raptor subtype observed during the spring and fall raptor migration surveys at the Beech Ridge Wind Energy Project.

	Mean Use		Percent of Use		Percent Frequency	
Species	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**
			Station 2			
Diurnal Raptors	0.31	1.03	17.3	68.7	25.9	41.7
Accipiters	*0*	*0.04*	*0*	*2.9*	*0*	*8.3*
Buteos	*0.29*	*0.99*	*16.3*	*65.7*	*22.2*	*41.7*
Osprey	*0.02*	*0*	*1*	*0*	*3.7*	*0*
Vultures	1.46	0.47	82.7	31.3	70.4	33.3
Overall	**1.77**	**1.51**	**100**	**100**		
			Station 3			
Diurnal Raptors	0.86	0.74	31.8	43.0	53.8	52.2
Accipiters	*0.14*	*0.14*	*5.1*	*8.1*	*11.5*	*17.4*
Buteos	*0.66*	*0.53*	*24.6*	*30.9*	*50.0*	*34.8*
Eagles	*0.06*	*0.07*	*2.1*	*4.0*	*3.8*	*8.7*
Vultures	1.83	0.98	68.2	57.0	73.1	43.5
Overall	**2.69**	**1.72**	**100**	**100**		
			Station 4			
Diurnal Raptors	0.72	1.06	26.0	40.2	42.9	47.8
Accipiters	*0.09*	*0.09*	*3.4*	*3.4*	*10.7*	*13.0*
Buteos	*0.54*	*0.86*	*19.2*	*32.7*	*35.7*	*39.1*
Eagles	*0.08*	*0*	*2.7*	*0*	*7.1*	*0*
Falcons	*0.02*	*0.11*	*0.6*	*4.1*	*3.6*	*17.4*
Vultures	2.06	1.57	74.0	59.8	67.9	47.8
Overall	**2.78**	**2.63**	**100**	**100**		
			Station 5			
Diurnal Raptors	0.82	0.98	10.3	37.4	35.7	45.8
Accipiters	*0.15*	*0.17*	*1.9*	*6.5*	*10.7*	*20.8*
Buteos	*0.64*	*0.75*	*8.1*	*28.9*	*35.7*	*20.8*
Eagles	*0*	*0.03*	*0*	*1.3*	*0*	*4.2*
Falcons	*0.02*	*0*	*0.2*	*0*	*3.6*	*0*
Osprey	*0*	*0.02*	*0*	*0.8*	*0*	*4.2*
Vultures	7.11	1.63	89.7	62.6	85.7	41.7
Overall	**7.92**	**2.61**	**100**	**100**		

Temporal Use

For mean use throughout the day, raptor use peaked in the 1200-1300 hour block (1.47 birds/observer-hr/survey; Figure 2). Eagles were observed between 1100 and 1600 hrs, with peak use occurring in the 1400-1500 hour (0.09 birds per observer-hour; Figure 2). Osprey observations were recorded between hrs 1000 and 1200 with no discernable peak due to so few observations. Vulture use peaked during the 1200-1300 hr (Figure 2).

Seasonal Use

Daily raptor activity fluctuated between zero and 15 individuals through the spring study period, with the peak in activity on April 26 (Figure 3a). Raptors were not observed on four survey days during the study period (March 16, March 28, April 1, and May 4; Figure 3a). Vulture activity ranged from zero to 47 individuals per day (Figure 3a). Vulture activity peaked earlier than raptors, on April 3 (Figure 3a). The days with the fewest vultures observed occurred on March 16 and April 1 with zero individuals, and March 25 with two individuals observed (Figure 3a).

In fall, raptor activity was variable, with peak activity on September 28 with 31 individuals observed, and zero observed on September 23, October 20-21, and October 27-28 (Figure 3b). Vulture activity patterns in fall were different than raptors, with observation peaks on September 9 with 26 individuals, and on October 24 with 24 individuals observed. Zero vultures were observed on 11 different days throughout the fall study period (Figure 3b).

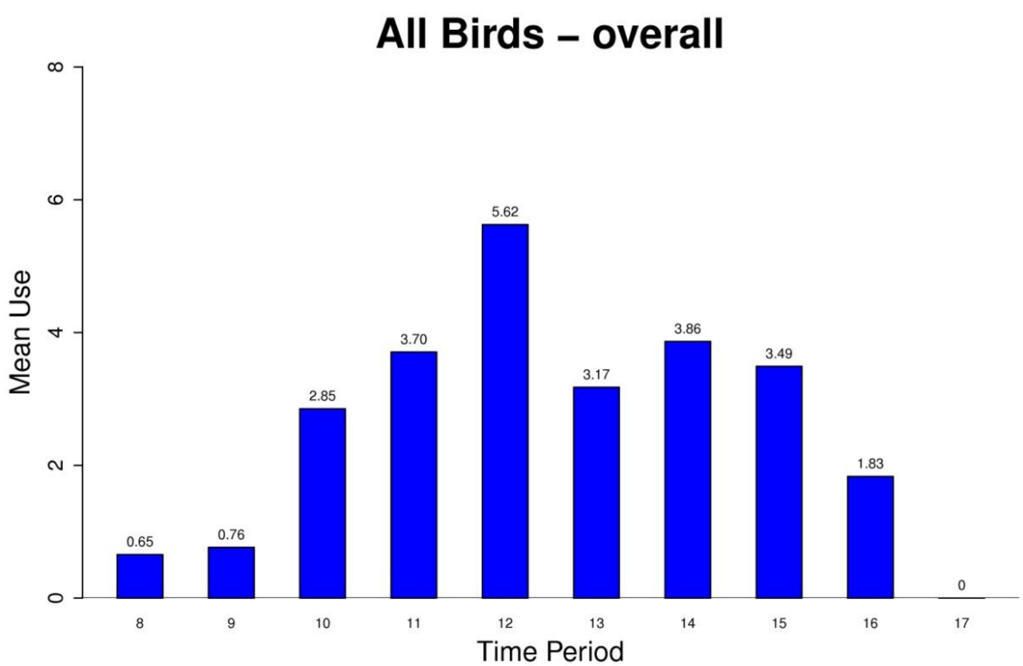


Figure 2. Mean use (number of birds per observer-hour) by time period (hour) for the spring and fall raptor migration surveys for all birds, diurnal raptors, and vultures at the Beech Ridge Wind Energy Project.

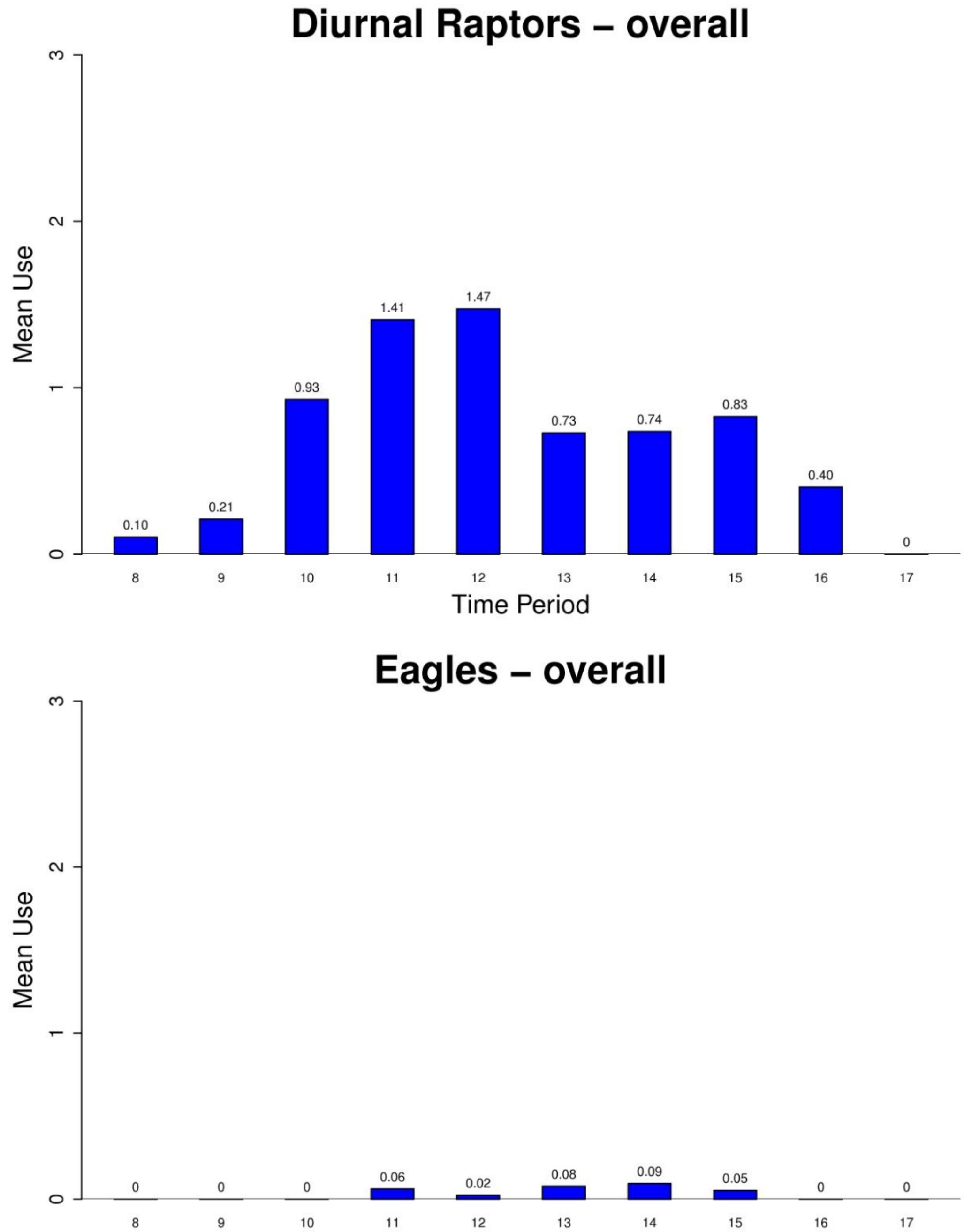
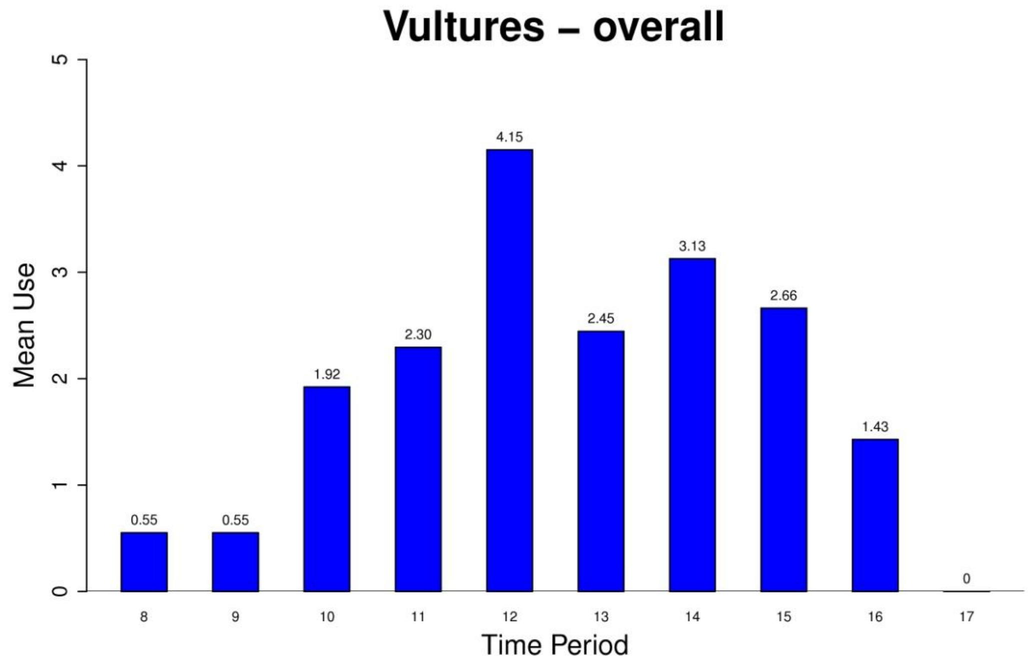


Figure 2 (*continued*). Mean use (number of birds per observer-hour) by time period (hour) for the spring and fall raptor migration surveys for all birds, diurnal raptors, and vultures at the Beech Ridge Wind Energy Project.



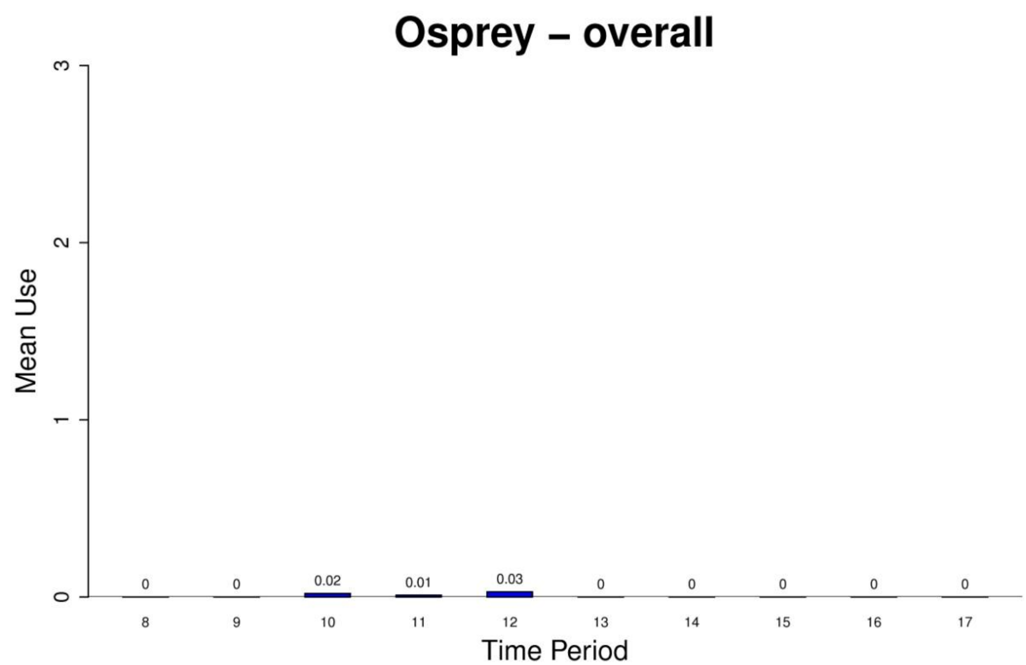


Figure 2 (*continued*). Mean use (number of birds per observer-hour) by time period (hour) for the spring and fall raptor migration surveys for all birds, diurnal raptors, and vultures at the Beech Ridge Wind Energy Project.

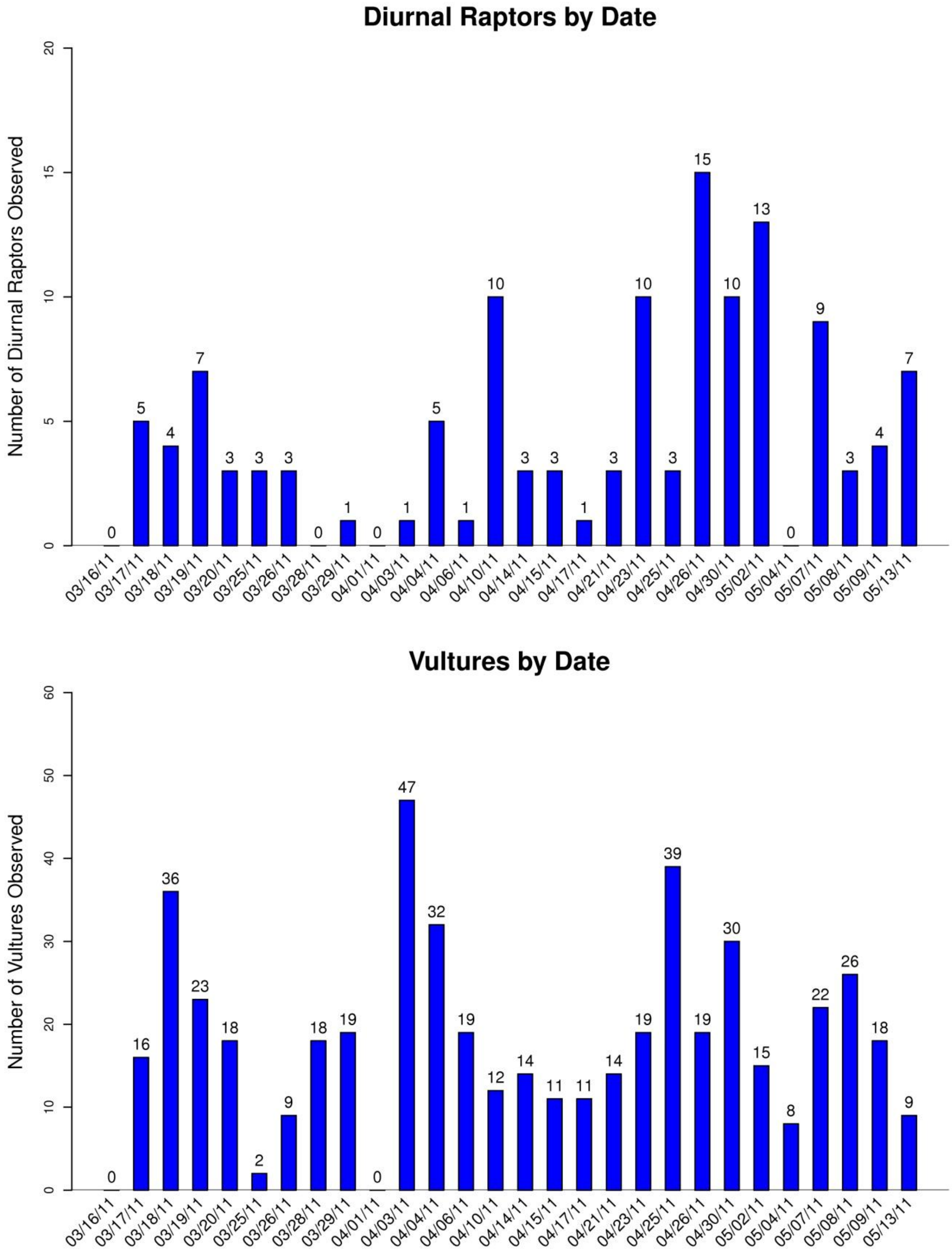
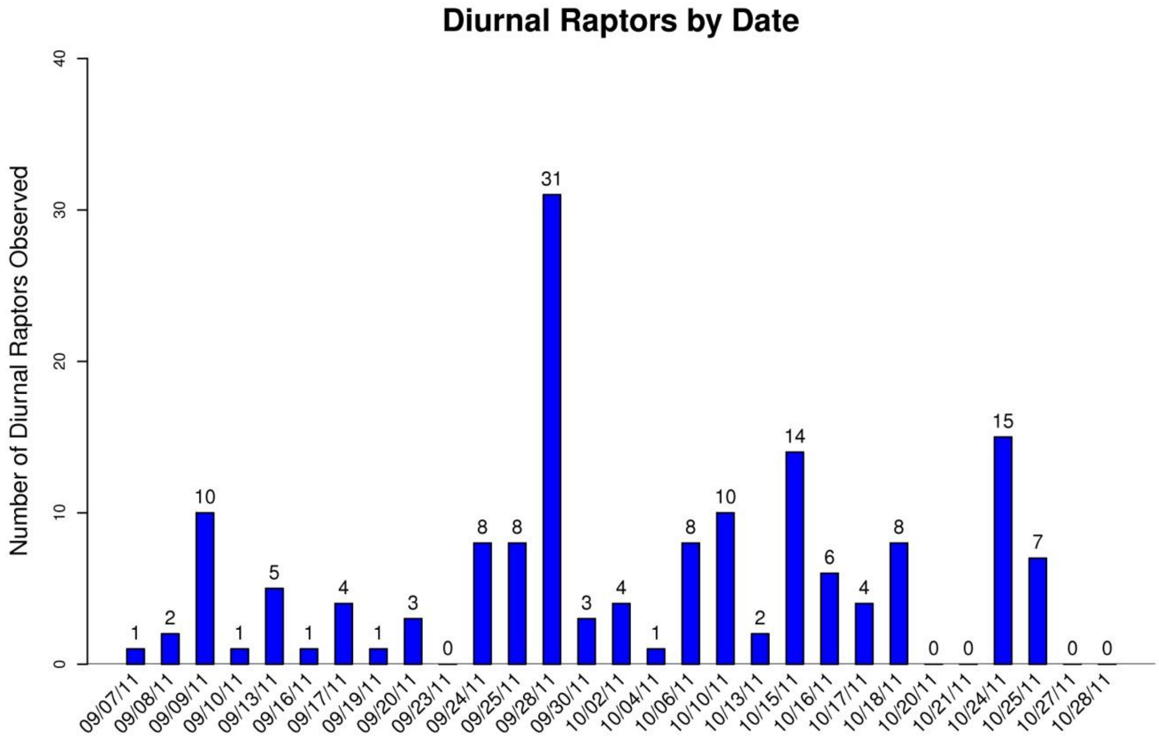


Figure 3a. Total number of individuals observed by survey day for diurnal raptors and vultures during spring raptor migration surveys at the Beech Ridge Wind Energy Project.



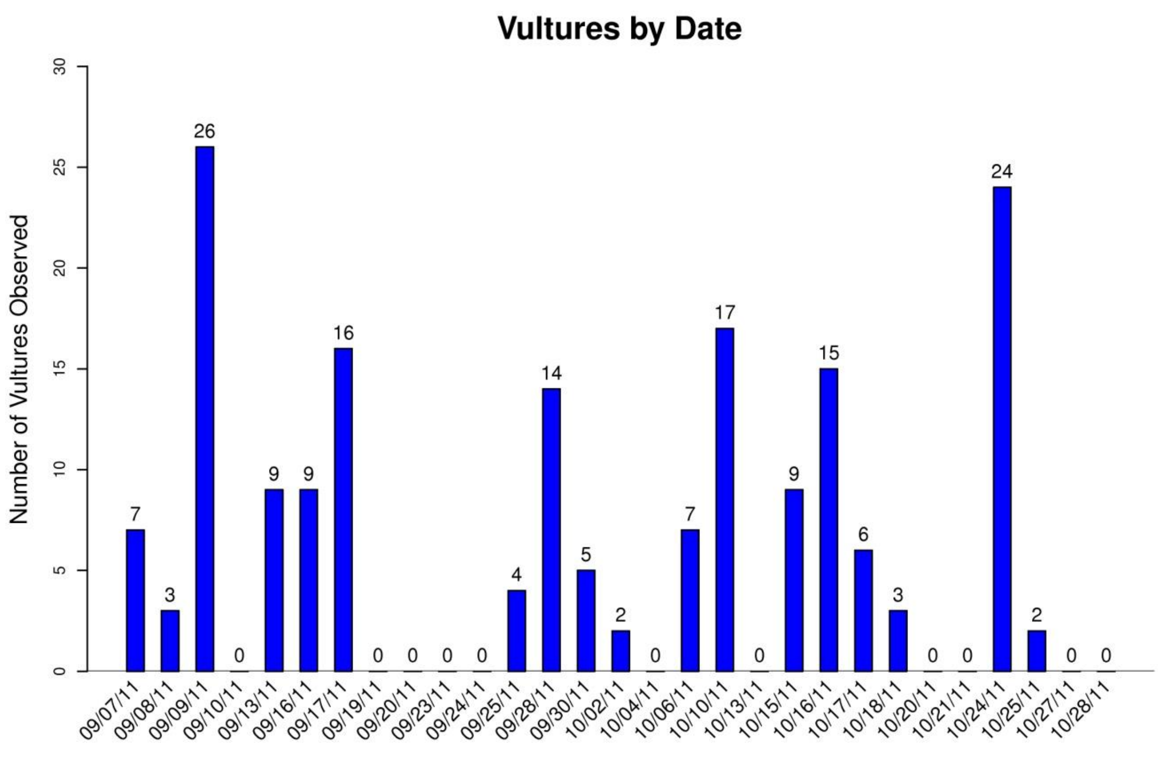


Figure 3b. Total number of individuals observed by survey day for diurnal raptors and vultures during the fall raptor migration surveys at the Beech Ridge Wind Energy Project.

Flight Height Characteristics

Approximately 51% of raptors observed flying within 800 m of the survey stations were observed flying in the RSH (Table 4). Two of the three ospreys observed within 800 m were observed within the RSH. One bald eagle and one golden eagle were observed flying within 800 m of the survey stations, and both were flying in the RSH. For turkey vultures observed within 800 m of the survey station, 42.8% were observed within the RSH (Table 4).

Table 4. Flight height characteristics of raptor subtypes, species, and vultures observed during the spring and fall raptor migration surveys[a] at the Beech Ridge Wind Energy Project.

Species/Type	Number of groups	Number of individuals	Mean Flight Height (m)	Median Flight Height (m)	Percent in Flight	Percent Within RSH[b]
Diurnal Raptors	**99**	**114**	**40.66**	**25.0**	**40.1**	**50.9**
Accipiters	*20*	*21*	*42.10*	*35.0*	*58.3*	*61.9*
Cooper's hawk	5	5	74.00	70.0	55.6	100
sharp-shinned hawk	15	16	31.47	25.0	61.5	50.0
Buteos	*66*	*80*	*42.20*	*23.5*	*35.7*	*50.0*
broad-winged hawk	21	24	38.19	16.0	32.4	37.5
red-shouldered hawk	12	13	44.42	37.5	23.6	69.2
red-tailed hawk	33	43	43.94	25.0	45.3	51.2
Eagles	*2*	*2*	*52.50*	*52.5*	*18.2*	*100*
bald eagle	1	1	25.00	25.0	100	100
golden eagle	1	1	80.00	80.0	10.0	100
Falcons	*8*	*8*	*15.38*	*12.0*	*100*	*12.5*
American kestrel	7	7	15.57	10.0	100	14.3
merlin	1	1	14.00	14.0	100	0
Osprey	*3*	*3*	*56.67*	*65.0*	*75.0*	*66.7*
osprey	3	3	56.67	65.0	75.0	66.7
Vultures	**187**	**271**	**28.99**	**20.0**	**39.6**	**42.8**
black vulture	2	2	47.50	47.5	16.7	50.0
turkey vulture	185	269	28.79	20.0	40.0	42.8
Overall	**286**	**385**	**33.03**	**20.0**	**39.8**	**45.2**

[a]Limited to observations within 800 m.
[b]RSH = rotor-swept height of 41.5 to 118.5 m (approximately 136.2 to 388.8 feet) above ground level.

Spatial Variation

In spring, raptor use by station ranged from 0.31 birds per observer-hour at station 2 to 0.97 at station 1. In fall, use by station for all raptors ranged from 0.74 birds per observer-hour at station 3 to 1.08 at station 1 (Table 3; Figure 4). In spring, ospreys were observed only at station 2 (0.02 birds per observer-hour), while in fall, ospreys were observed at stations 1 and 5 (Table 3, Figure 5). In spring, eagles were observed at stations 1 and 4, both with 0.08 eagles per observer-hour. Eagles were observed during fall surveys at stations 1, 3, and 5 with use ranging from 0.03 to 0.07 birds per observer-hour (Table 3, Figure 5). Vulture use in spring and fall was greatest at station 5 (7.11 and 1.63 birds per observer-hour, respectively), while vulture use recorded at other stations ranged from 1.46 to 2.81 birds per observer-hour in spring and 0.47 to 1.57 in fall (Table 3; Figure 4).

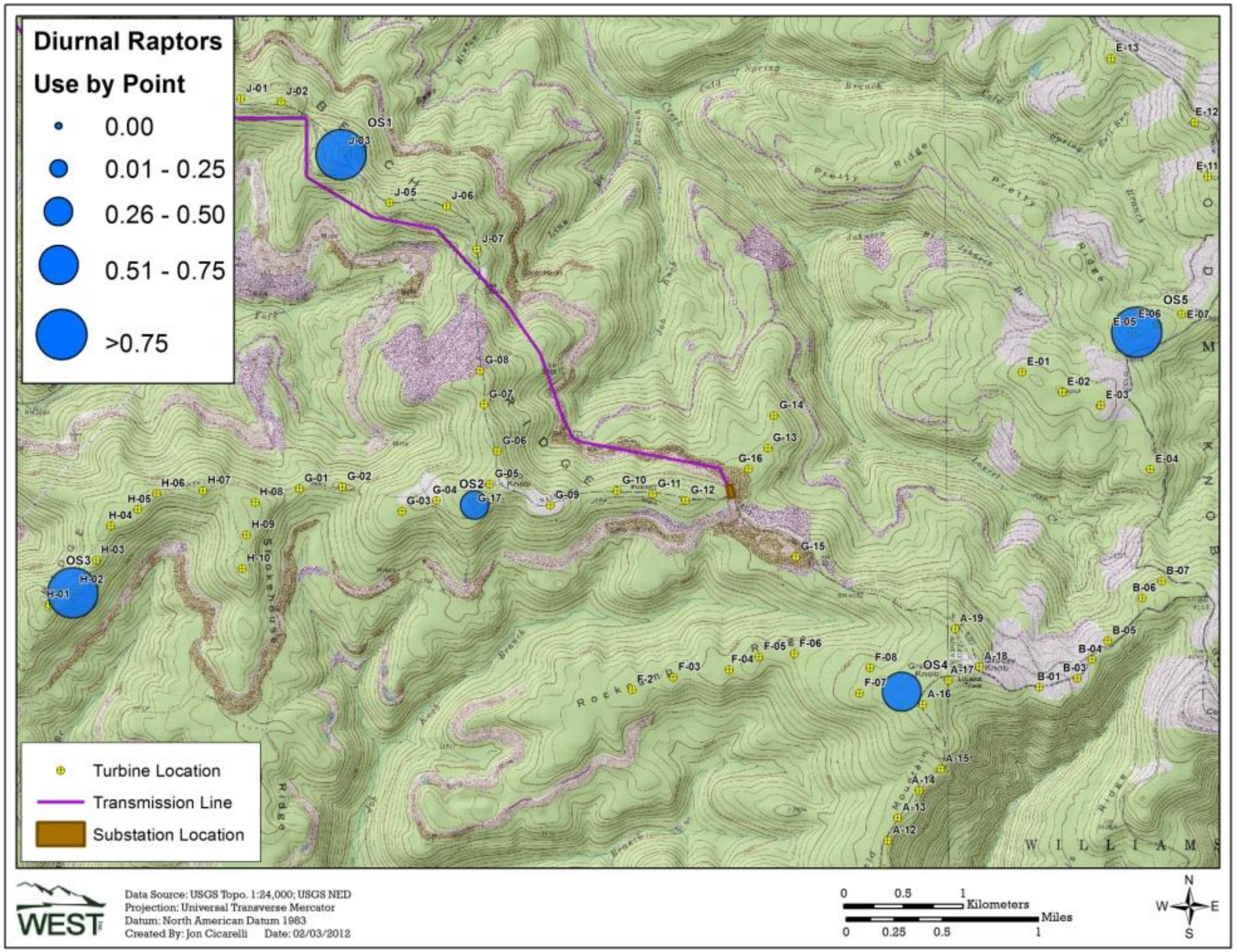


Figure 4a. Bubble plots of diurnal raptor use (number of raptors per observer-hour) by all raptor species during the spring raptor migration surveys.

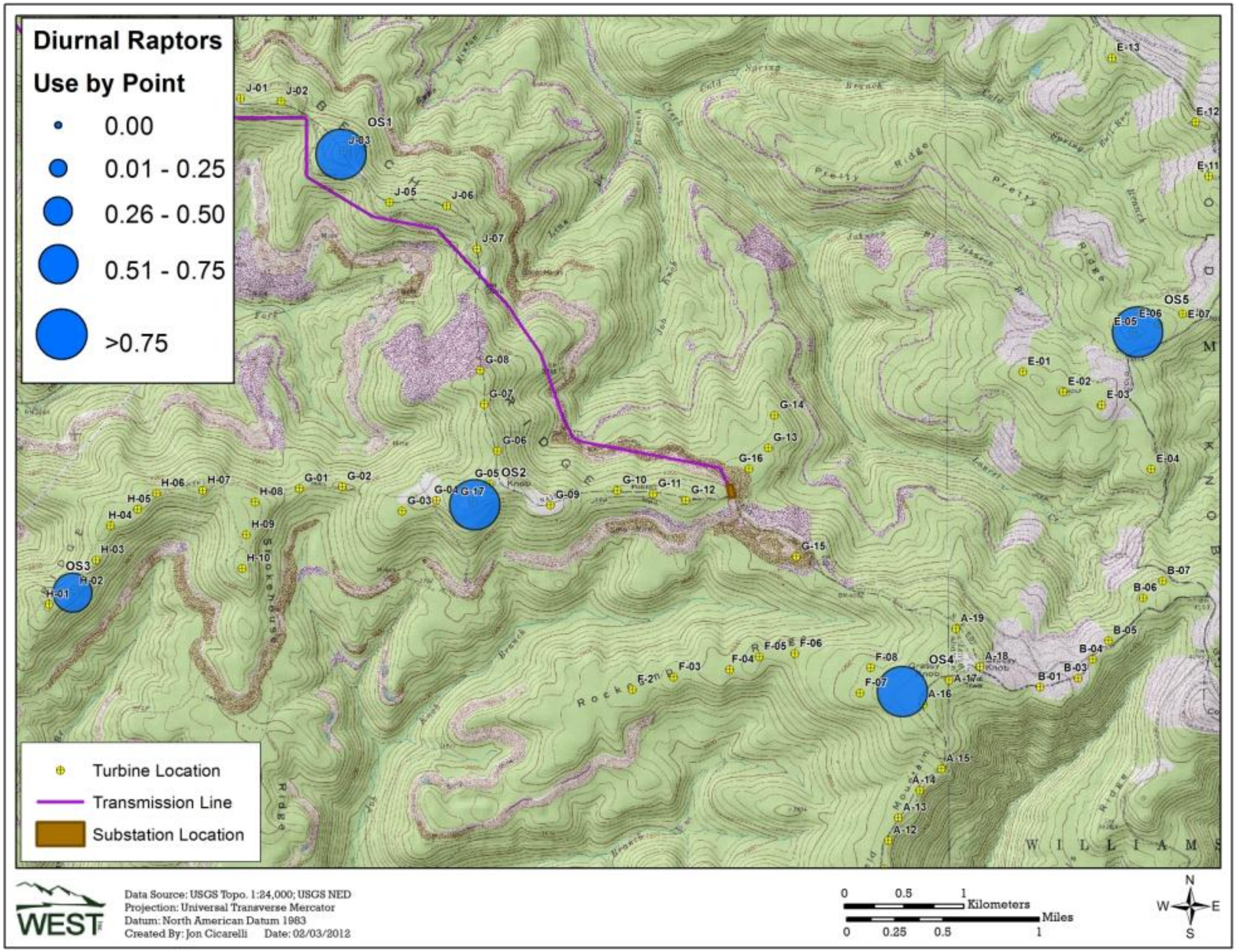


Figure 4b. Bubble plots of diurnal raptor use (number of raptors per observer-hour) by all raptor species during the fall raptor migration surveys.

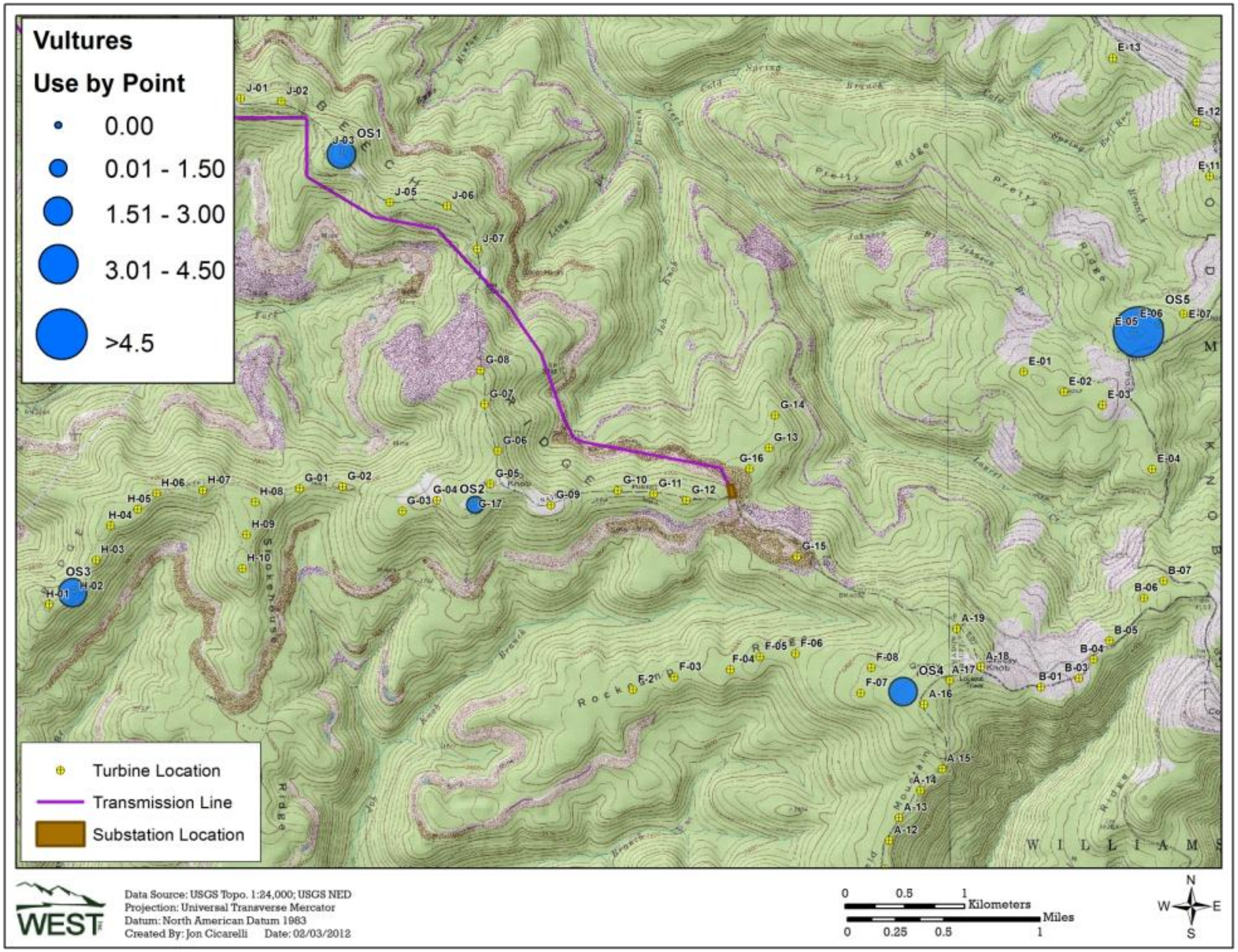


Figure 4c. Bubble plots of vulture use (number of vultures per observer-hour) during the spring raptor migration surveys.

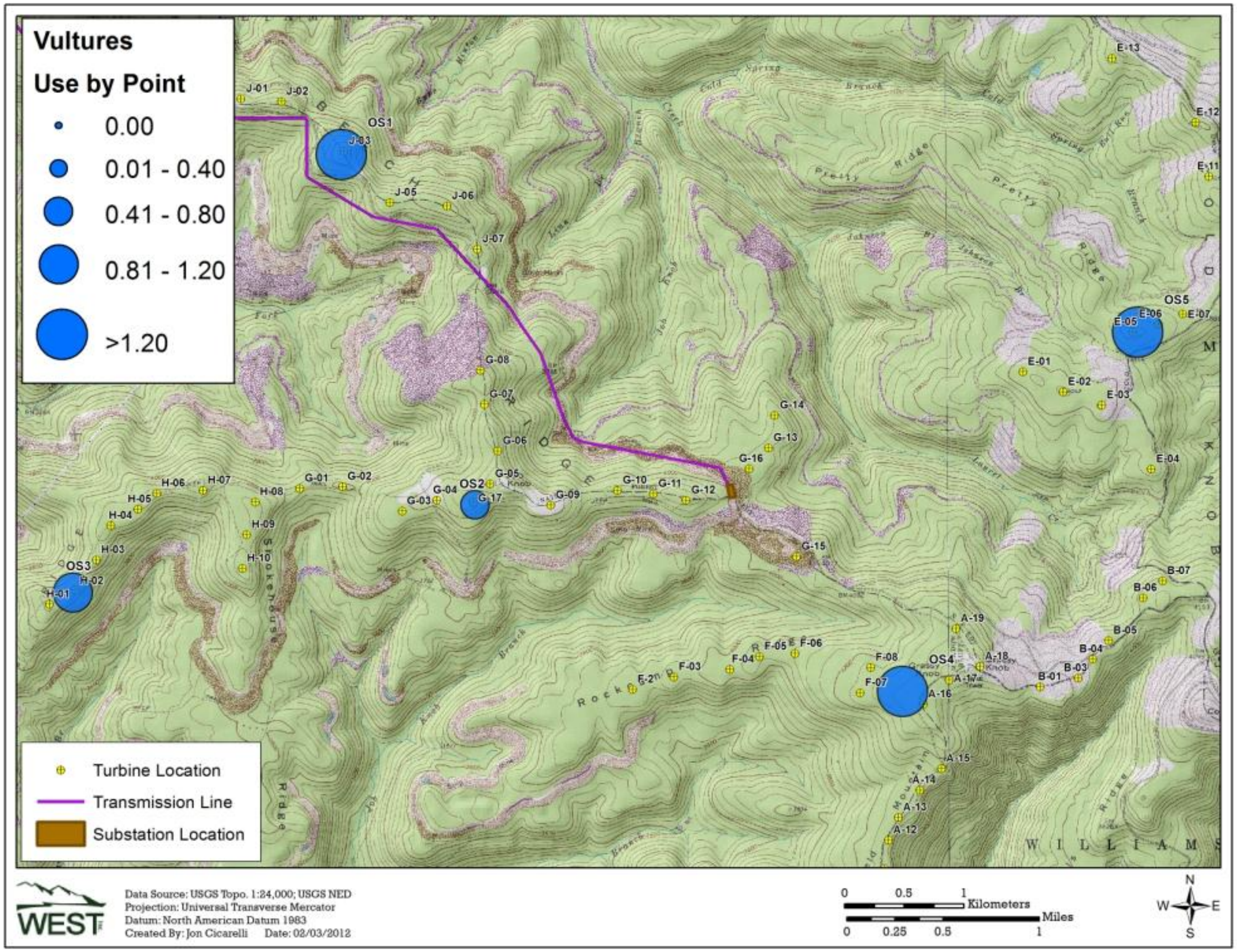


Figure 4d. Bubble plots of vulture use (number of vultures per observer-hour) during the fall raptor migration surveys

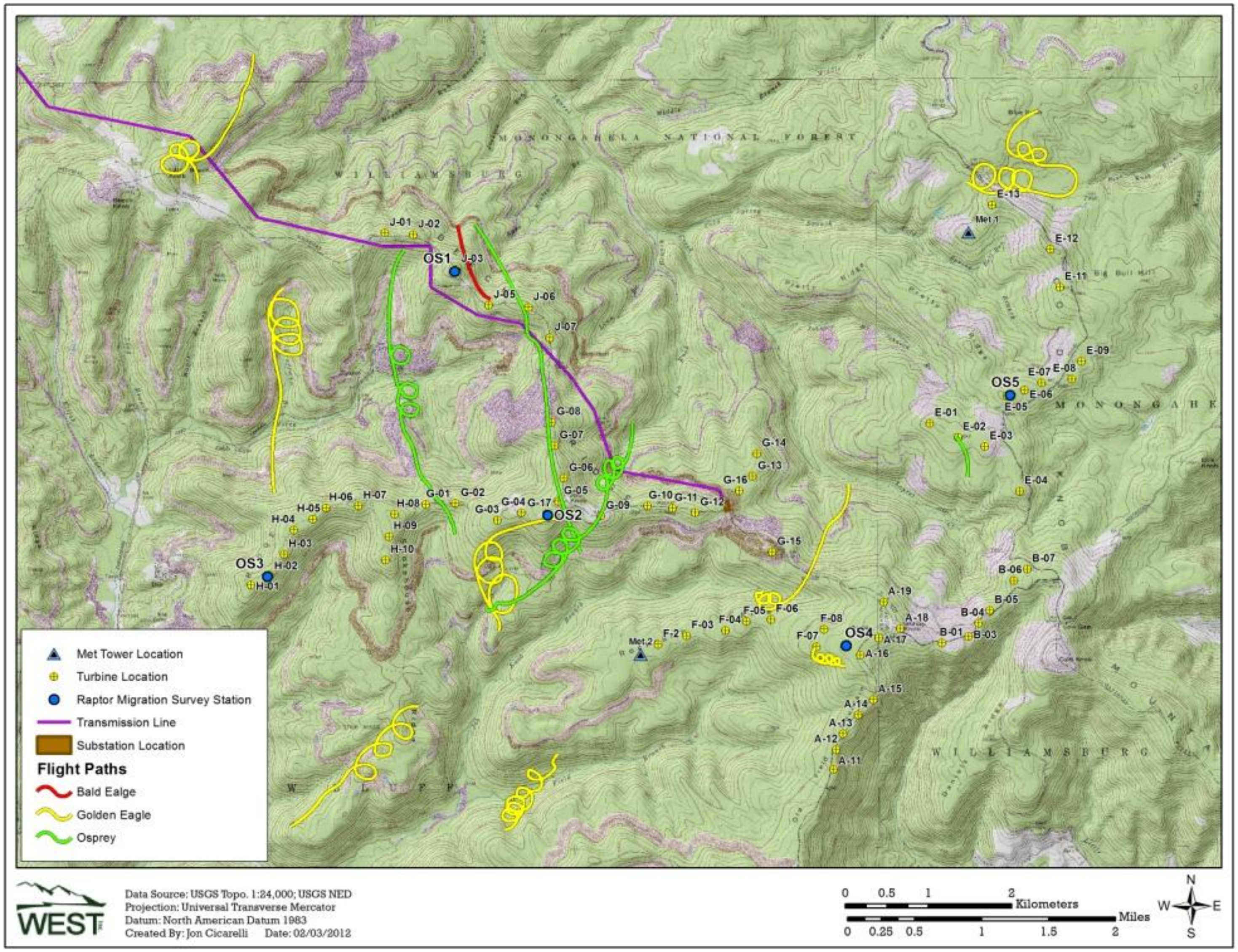


Figure 5. Flight paths of bald eagle, golden eagle, and osprey groups during the spring and fall raptor migration surveys.

Incidental Observations

Seven raptor species were recorded as incidental observations, representing 69 individuals including red-tailed hawk (20 individuals), broad-winged hawk (19 individuals), red-shouldered hawk (*Buteo lineatus;* 11 individuals), American kestrel (*Falco sparverius*; eight individuals), sharp-shinned hawk (*Accipiter striatus*; six individuals), Cooper's hawk (*A. cooperii*; three individuals), and barred owl (*Strix varia*; two individuals; Table 5).

Five mammal species were observed incidentally during the study period including black bear (*Ursus americanus*; 10 individuals), white-tailed deer (*Odocoileus virginianus*; 13 individuals), coyote (*Canis latrans*; two individuals), one red fox (*Vulpes vulpes*), and an unidentified flying squirrel (Table 5).

Table 5. Incidental observations of raptors and other wildlife during the spring and fall raptor migration surveys at the Beech Ridge Wind Energy Project.

Species	Scientific Name	Number of Groups	Number of Individuals
red-tailed hawk	*Buteo jamaicensis*	19	20
broad-winged hawk	*Buteo platypterus*	16	19
red-shouldered hawk	*Buteo lineatus*	11	11
American kestrel	*Falco sparverius*	8	8
sharp-shinned hawk	*Accipiter striatus*	6	6
Cooper's hawk	*Accipiter cooperii*	3	3
barred owl	*Strix varia*	2	2
Bird Subtotal	***7 species***	**65**	**69**
black bear	*Ursus americanus*	8	10
white-tailed deer	*Odocoileus virginianus*	3	13
coyote	*Canis latrans*	2	2
red fox	*Vulpes vulpes*	1	1
unknown flying squirrel		1	1
Mammal Subtotal	***4 species***	**15**	**27**

DISCUSSION

In order to fulfill a permit requirement of the WV PSC for the BRWEP, the principal objective of the study was to provide site-specific osprey and eagle use data during the migration seasons that would be useful in evaluating potential impacts from the project. In general characteristics of raptor migration moving through the BRWEP were similar in the spring and fall. Overall species richness (average number of species per survey) was higher in the spring than fall (1.34 and 1.14, respectively). The total number of all raptors, excluding vultures, was higher in fall than spring (157 and 127, respectively); however, the total number of all observations, including vultures, was higher in spring compared to fall (633 and 335, respectively), since many more turkey vultures were observed in spring. For osprey and eagles, the number of individuals observed was low and they accounted for approximately or less than 1% of the overall raptor use recorded. Three ospreys were observed in fall and only one in the spring, and six golden eagles were observed in spring and four in fall. Only one bald eagle was observed in spring and none in fall.

In order to compare the relative magnitude of raptor migration moving through the BRWEP, the number of raptors (vultures excluded) per observer-hour available from the Hawk Migration Association of North America public website (HMANA 2011) were compiled from sites in the same region and with the same survey dates as the BRWEP and compared with results from the BRWEP (Table 6). Belmont Valley Hawk Watch Site, Virginia, is located approximately 113 miles to the west, near Charlottesville, Virginia. Pilot Mountain Hawk Watch Site, North Carolina, is located approximately 115 miles to the south. Allegheny Front Hawk Watch Site, Pennsylvania, is located approximately 168 miles north-east of the BRWEP, near Central City, Pennsylvania, and Washington Monument State Park Hawk Watch Site, Maryland, is located approximately 185 miles to the north-east, near Boonsboro, Maryland.

The number of raptors per observer-hour at the BRWEP was averaged across the survey dates to calculate a metric comparable to other established hawk watch sites, and resulted in an average of 0.91 raptors per observer-hour in the spring and 1.30 raptors per observer-hour in the fall. These estimates were lower than averages seen at other established regional sites which ranged from 2.58 to 4.39 raptors per observer-hour in the spring and 9.15 to 56.85 raptors per observer-hour in the fall (Table 6). For most of the survey dates, raptor use within the BRWEP was usually lower than raptor use recorded at the other Hawk Watch sites on the same date (Table 6).

In general, results of the studies do not suggest that the magnitude of eagle and osprey migration through the BRWEP, and the overall raptor migration, is great enough that significant impacts to these species would be expected.

Table 6. Number of raptors observed per surveyor hour for each survey date at the Beech Ridge Wind Energy Project and four other established hawk watch sites in the same geographic region.

Date	Beech Ridge, WV	Belmont Valley, VA	Pilot Mountain, NC	Allegheny Front, PA	Wash. Mon. State Park, MD
Spring					
3/16/2011	0		NS	0.17	
3/17/2011	1.00			1.29	2.67
3/18/2011	0.79			1.06	
3/19/2011	1.40			2.67	
3/20/2011	0.60	0.50		7.33	
3/25/2011	0.59	4.80		0.00	2.00
3/26/2011	0.60	5.00		1.60	3.27
3/28/2011	0	0.44		0.67	
3/29/2011	0.20			0.27	3.00
4/1/2011	0			0.00	3.33
4/3/2011	0.20			0.86	10.53
4/4/2011	1.00			4.40	8.44
4/6/2011	0.20	2.00		0.73	2.50
4/10/2011	2.00	2.11		28.10	
4/14/2011	0.60			5.56	5.74
4/15/2011	0.60			25.38	18.40
4/17/2011	0.20	5.40		1.54	5.88
4/21/2011	0.60	1.00		3.33	0.86
4/23/2011	2.00	2.29		0.40	
4/25/2011	0.60	6.00		1.86	4.67
4/26/2011	3.00	1.71		2.36	0.73
4/30/2011	2.00			4.59	
5/2/2011	2.60			6.73	3.43
5/4/2011	0	2.00		0.00	1.00
5/7/2011	1.80	2.18		0.00	0.86
5/8/2011	0.60	2.00			1.33
5/9/2011	0.80	1.33			
5/13/2011	1.40				
Average	**0.91**	**2.58**	**NS**	**4.39**	**4.37**
Fall					
9/7/2011	0.19			0.00	
9/8/2011	0.50			4.00	
9/9/2011	2.00			0.00	
9/10/2011	1.00	2.59		2.22	4.55
9/13/2011	1.00		1.25	6.88	16.78
9/16/2011	0.20	180.84	3.73	269.89	88.40
9/17/2011	0.80	41.33	0.00	71.76	9.92
9/19/2011	0.33	2.40	8.75	4.38	405.41
9/20/2011	1.50	3.14	0.71	13.80	235.82
9/23/2011	0	0.00	0.50	0.00	

Table 6. Number of raptors observed per surveyor hour for each survey date at the Beech Ridge Wind Energy Project and four other established hawk watch sites in the same geographic region.

Date	Beech Ridge, WV	Belmont Valley, VA	Pilot Mountain, NC	Allegheny Front, PA	Wash. Mon. State Park, MD
9/24/2011	1.60	16.27	4.88	75.26	43.70
9/25/2011	1.60		1.88	51.33	180.47
9/28/2011	6.20		64.50	12.40	162.20
9/30/2011	0.60		5.33	1.57	12.00
10/2/2011	0.80			0.00	4.80
10/4/2011	0.20	2.67		0.00	18.21
10/6/2011	1.60	4.89		13.00	3.80
10/10/2011	2.00			11.60	9.24
10/13/2011	0.40			0.00	
10/15/2011	2.80			4.00	12.00
10/16/2011	1.20	5.33		6.00	9.60
10/17/2011	0.80	18.00		5.00	7.31
10/18/2011	4.00			60.24	59.70
10/20/2011	0			0.89	2.48
10/21/2011	0	4.00		0.80	4.24
10/24/2011	3.00			8.50	4.00
10/25/2011	3.50			4.82	8.73
10/27/2011	0			0.00	
10/28/2011	0			19.18	4.16
Average	**1.30**	**23.45**	**9.15**	**22.33**	**56.85**

Daily count data acquired from HMANA (2011)

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Avian Migration Studies for the Beech Ridge Wind Energy Project Expansion Area Greenbrier and Nicholas Counties, West Virginia

March-May and September-November 2011

July 2012

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NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

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1.0 INTRODUCTION

Beech Ridge Energy LLC (BRE), a wholly owned subsidiary of Invenergy LLC, has developed the Beech Ridge Wind Energy Project (BRWEP) in Greenbrier and Nicholas Counties, West Virginia. The BRWEP was granted a Siting Certificate by the West Virginia Public Service Commission (PSC) on August 26, 2006, and on reconsideration, on January 11, 2007. The approval included 124 wind turbine generators (WTG) of 1.5 megawatts each for a total of 186 megawatts of generating capacity. Construction on the BRWEP began in April 2009.

On December 8, 2009, a United States District Court in the State of Maryland enjoined the construction of all but 40 centrally located WTGs (then being constructed) until further specified actions were taken, including securing an Incidental Take Permit (ITP) from the U.S. Fish and Wildlife Service (USFWS). Pursuant to a settlement agreement among the parties to the injunction proceeding, on January 26, 2010, the District Court amended its December 8, 2009 Order to allow the completion of the Project, provided a number of conditions were met including securing the ITP, and including the movement of a number of WTGs from the eastern portion of the project to the west. The amended Order also allowed the immediate completion of an additional 27 WTGs for a total of 67 WTGs. These additional WTGs were completed and brought online, together with the first 40 WTGs, between January and August 2010.

In order to comply with the portion of the Amended Order of the District Court requiring movement of certain WTGs from the eastern portion of the project to locations in the west, BRE has planned for an expansion/modification of the original project proposed to consist of up to 33 WTGs immediately west of the original footprint of the project as approved by the PSC. This expansion/modification will require review and approval by the PSC.

In connection with seeking PSC approval of the BRWEP expansion, BRE must file pre-construction avian migration studies and an avian and bat risk assessment. The original filing with the PSC occurred in 2006. This report has been prepared to comply with the PSC requirement by covering the area proposed for the project expansion and is intended to fulfill the avian migration studies requirement and supplement the results from the 2005 surveys.

1.1 Study Objectives

The principal objectives of the study to fulfill the PSC requirement were to provide site-specific information on avian use and migration though the study area that would 1) be useful in evaluating potential impacts from the proposed expansion of the BRWEP, 2) provide information useful in project planning and design to minimize potential impacts to birds to the extent practical, and 3) supplement and update the previous studies on avian use and migration in the study area.

1.2 Study Area

The BRWEP expansion area is located in Greenbrier and Nicholas counties, West Virginia, approximately 9 miles (mi; 14 kilometers [km]) northeast of Ranielle, West Virginia (Figure 1). The expansion area is located primarily along the intersection of Clear Creek Mountain, Huggins Ridge, Pollock Mountain and adjacent spur ridges located off of Beech Ridge. The proposed expansion area for the BRWEP is located immediately west of the existing project footprint (Figure 1).

The BRWEP expansion area is located within a 63,000-acre tract owned by MeadWestvaco. BRE has agreements on approximately 3,172 acres of land that comprises the project area for the expansion; however, only a portion of the project area actually host wind project facilities (Figure 2). The area of permanent project impacts in the expansion area (the land to be occupied by facilities) for up to 33 turbines, access roads, transmission line, substation and permanent meteorological towers is approximately 21 acres (Figure 2). Approximately 124 acres of temporary land cover conversion (e.g., forest removal to allow for construction) will be required for project construction.

The majority of the study area is deciduous forest habitat, with smaller inclusions of shrub-scrub, grassland, and evergreen forest vegetation types (Figure 3). The primary current land use is commercial timber production. Historic land use included timber production and coal mining activities. The resulting landscape is a mosaic of deciduous forest in various stages of growth. Avian surveys (see below) were located primarily within deciduous forest habitat, although some were located in more open areas of shrub-scrub and grassland vegetation.

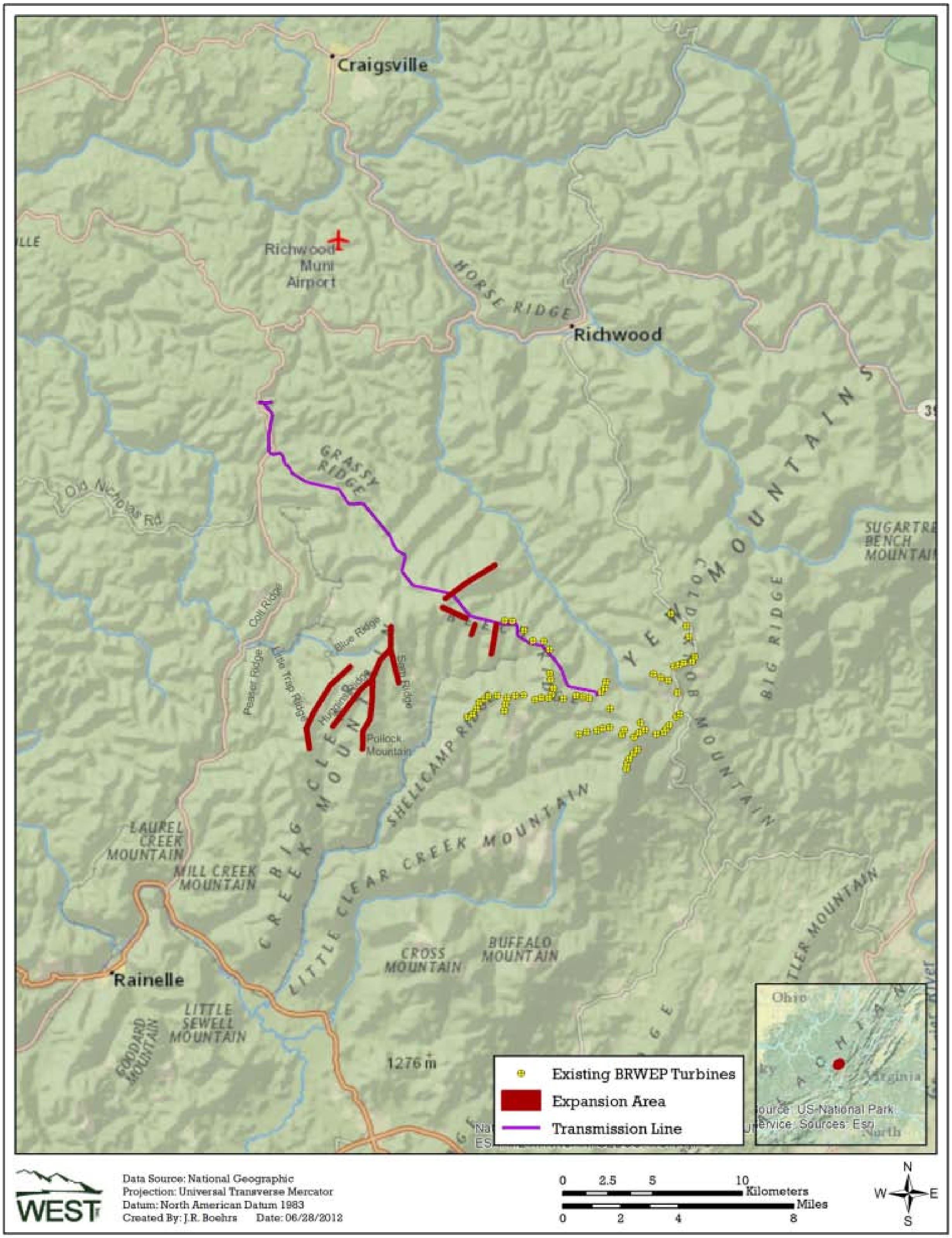


Figure 1. Location of the proposed Beech Ridge Wind Energy Project expansion area.

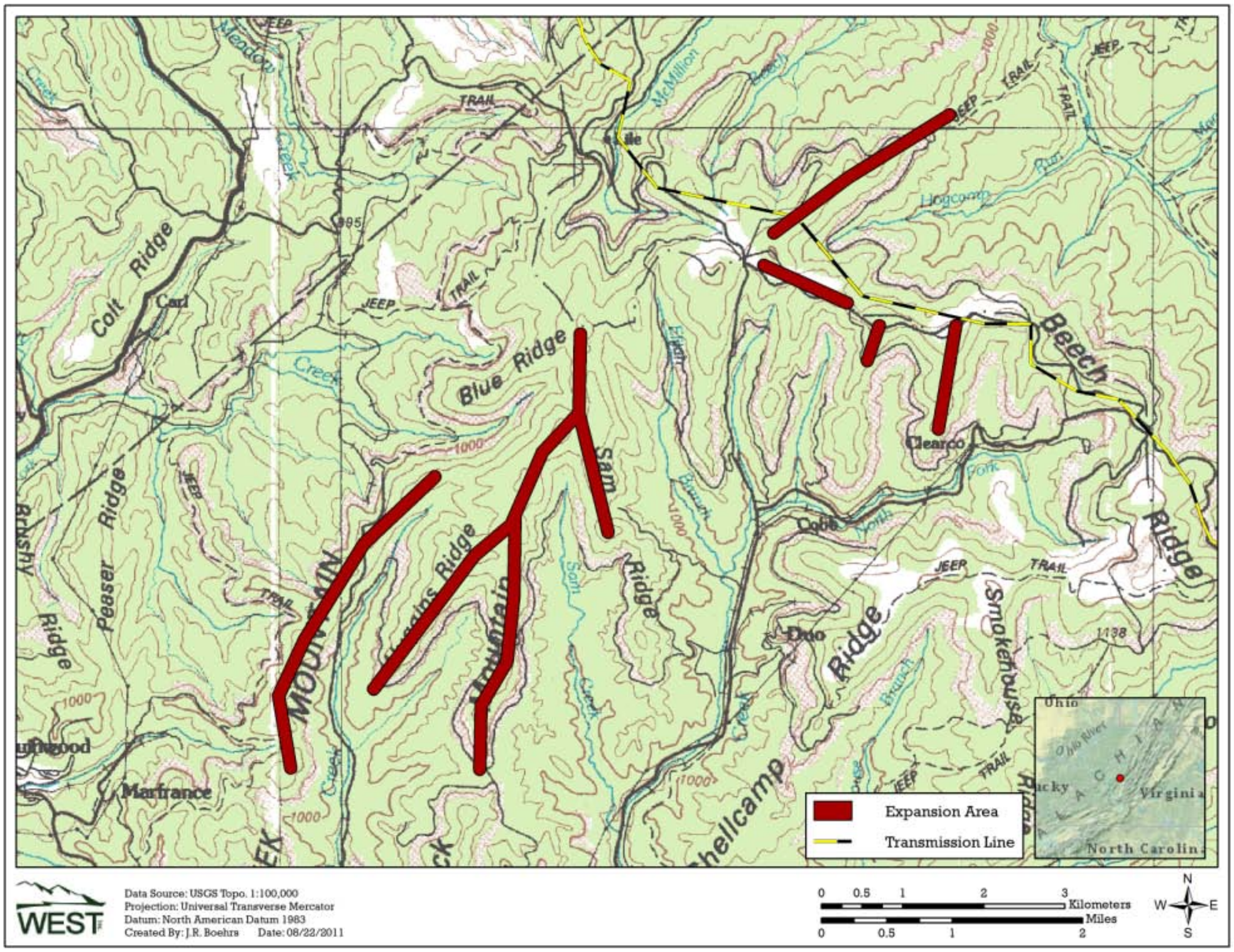


Figure 2. Proposed construction corridors for the Beech Ridge Wind Energy Project expansion area.

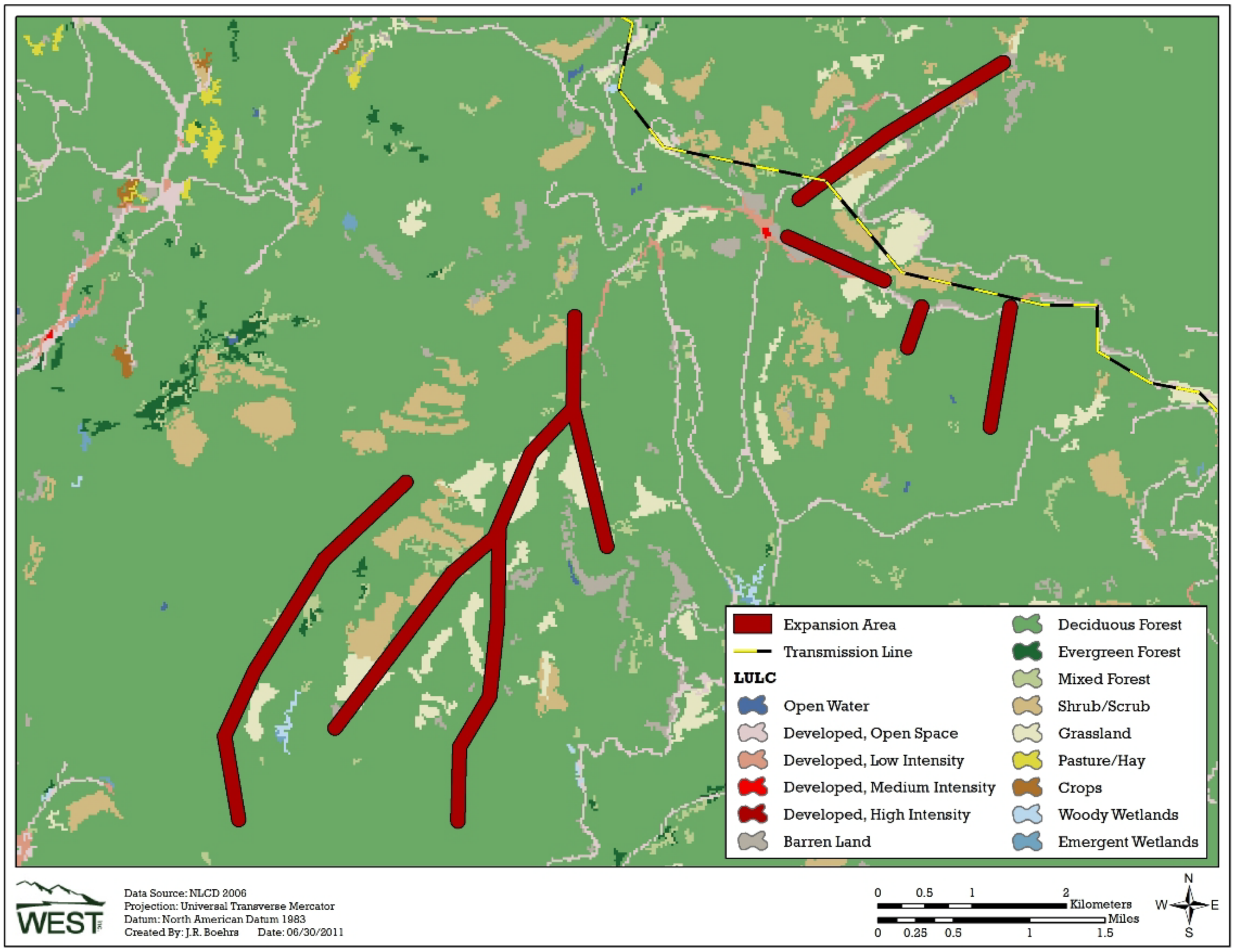


Figure 3. Land cover types within the Beech Ridge Wind Energy Project expansion area (USGS NLCD 2001).

2.0 METHODS

The avian migration studies at the BRWEP expansion area consisted of fixed-point avian surveys and raptor migration surveys during the spring and fall migration seasons. The fixed-point avian surveys were designed to collect data in areas of potential impact by development (at or near proposed turbine locations). The raptor migration surveys were designed to provide visual coverage of large areas by using point-count stations located at prominent vantage points.

2.1 Avian Surveys

Fixed-point surveys were conducted using methods used by Canterbury (2006) during previous studies at the BRWEP site. The fixed-point avian surveys were intended to provide site-specific data that could be used to calculate metrics related to species composition, such as bird diversity and species richness, and species abundance such as bird use, percent of use, and frequency of occurrence, during the migration periods primarily for passerines and other small non-passerine bird species. In addition, data were collected during the surveys on flight height to calculate the percentage of birds observed flying within the potential turbine rotor-swept height.

2.1.1 Survey Plots

Thirty-four fixed points were selected systematically to survey a spatially-representative sample of vegetation types and topography in the study area (Figure 4). Each survey plot was defined as the area within a 50-meter (m; ~164-foot [ft]) radius of the fixed point. Due to the preliminary nature of the project design for the BRWEP expansion area, there was no proposed turbine layout at the time of the surveys; therefore, fixed points were placed in and near proposed development corridors (Figure 4).

2.1.2 Survey Methods

Individual surveys were 10 minutes in duration and were conducted from approximately 30 minutes before sunrise to three hours after sunrise on any given survey day. The date, start and end time of the survey periods, and weather information (e.g., temperature, wind speed, wind direction, and cloud cover) were recorded for each survey. The survey effort was concentrated within the 50-m radius plot; however, all birds observed (seen or heard) during the survey were recorded regardless of the distance from the observer. Observations of birds beyond the 50-m radius plot were not included in the standardized analyses.

Species or best possible identification, number of observations, sex and age class (if possible), distance from the fixed point when first observed, closest distance, activity (behavior), and vegetation (habitat) were recorded for each observation. The behavior of each bird observed and the vegetation type in or over which the bird occurred were recorded for the point of first observation. For birds observed flying in the plot, approximate flight height at the point of first observation was recorded to the nearest 5-m (~16 ft) interval. Observations made by auditory means only were noted as such.

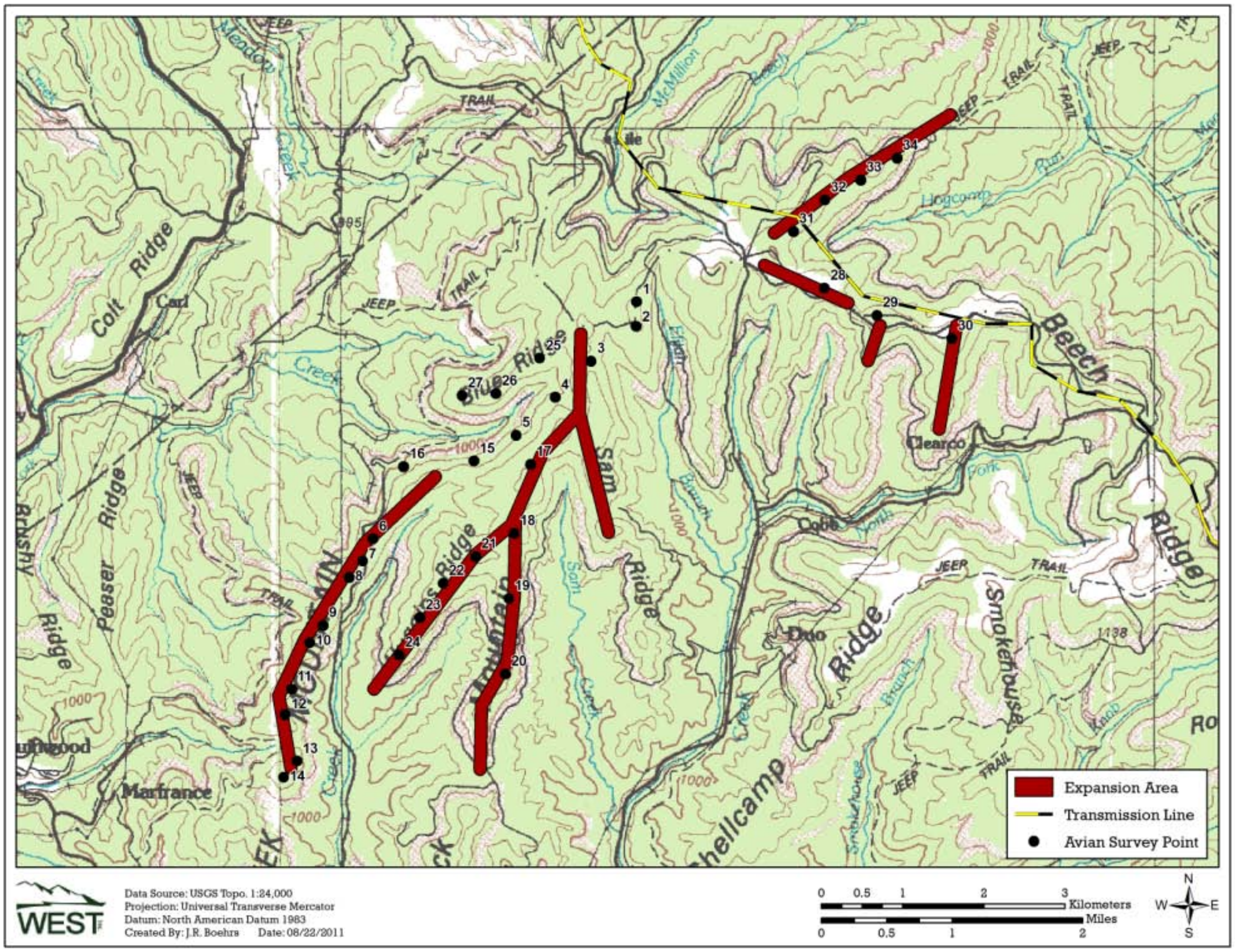


Figure 4. Avian survey points at the Beech Ridge Wind Energy Project expansion area.

2.1.3 Observation Schedule

Sampling intensity was designed to provide enough data to characterize bird diversity, species richness, bird use, percent of use, and frequency of occurrence of birds within the study area during the peak spring (April and May) and fall (September and October) migration periods for passerines. Fixed-point surveys were conducted approximately weekly at all survey stations during the study period. The observation schedule was varied by rotating the starting point on each survey day to ensure that each fixed-point was visited at different times throughout the study period.

2.2 Raptor Migration Surveys

Raptor migration surveys were conducted according to standard methods used by the Hawk Migration Association of North America (HMANA) and Hawk Watch International (HWI). The raptor migration surveys were intended to provide site-specific data on raptor composition such as species diversity and richness, and raptor abundance such as passage rate, percent of overall passage, and frequency of occurrence during the migration periods for diurnal raptors (*Accipiters*, *Buteos*, harriers, eagles, falcons), and vultures. In addition, data were collected during the surveys on flight height to calculate the percentage of raptors observed flying within the potential turbine rotor-swept height.

2.2.1 Survey Stations

Three survey stations were selected within the expansion area to survey for migrant raptors (Figure 5). The stations were established on the tops of ridges within the expansion area and in open non-forest habitats that provided maximal visibility in roughly 360^{o} around the point over long distances.

2.2.2 Survey Methods

Surveys were conducted according to methods used by the HMANA and HWI, with observers continuously scanning overhead for migrating raptors. Binoculars were frequently used throughout each survey period to aid in locating migrating raptors. The date, start and end time of the survey period, and weather information such as temperature, wind speed, wind direction, barometric pressure, percent cloud cover, precipitation, and maximum visibility estimates were recorded for each survey. Weather information was recorded using a Kestrel® 2500 pocket wind meter. Time of observation, species or best possible identification, number of observations, age and sex (if possible), and best estimation of distance from observer, flight height, and flight direction were recorded for each raptor observation. Surveys were conducted only on days when weather conditions were conducive to raptor migration (i.e., warm, clear, high pressure conditions).

2.2.3 Observation Schedule

Sampling intensity was designed to provide enough data to characterize species composition, relative abundance, and passage rates of raptors migrating within the study area during peak spring (March through May) and fall (September through November) migration periods for diurnal raptors. Surveys were conducted at all three stations approximately three times per week during the study period. Individual survey periods were one hour in duration and were conducted between approximately 0900 and 1600 each survey day to cover the peak daily period of diurnal raptor migration activity.

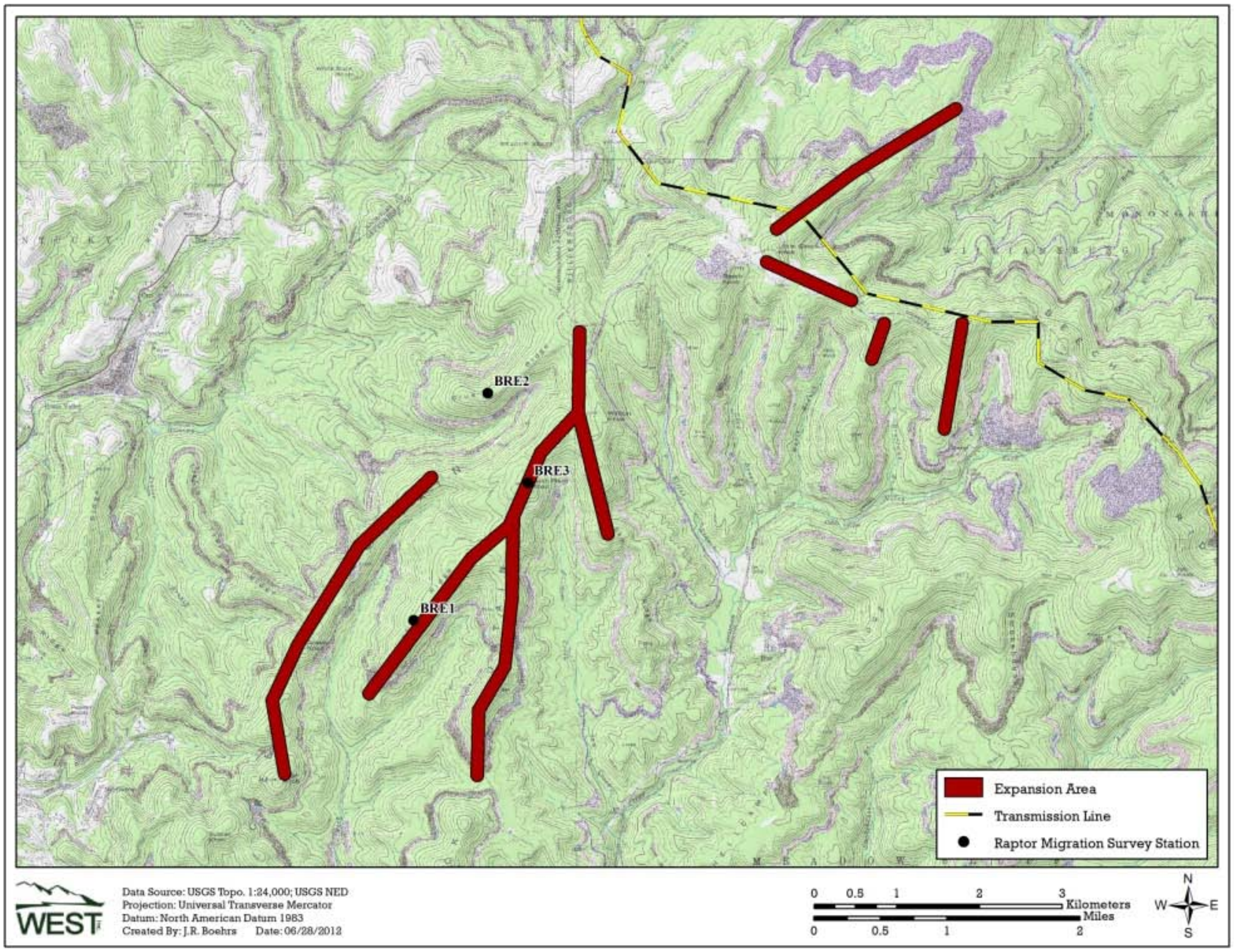


Figure 5. Raptor migration survey stations at the Beech Ridge Wind Energy Project expansion area.

2.3 Statistical Analysis

Following field surveys, observers inspected data forms for completeness, accuracy, and legibility. A Microsoft® ACCESS database was developed to store, organize, and manage survey data. Data were keyed into the electronic database using a pre-defined protocol to facilitate subsequent QA/QC and data analysis. A sample of records from the electronic database was compared to the raw data forms and any errors detected were corrected. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. All data forms, field notebooks compiled, and electronic data files were retained for reference.

2.3.1 Avian Use Surveys

2.3.1.1 Bird Diversity and Species Richness

Bird diversity was represented by the total number of species observed. A species list with the number of groups and observations recorded was generated for the study period and included all observations of birds detected, regardless of their distance from the observer or type of observation (e.g., visual or auditory). Species richness was calculated as the average number of species observed per 10-minute survey per 50-m radius plot.

2.3.1.2 Bird Use, Percent of Use, and Frequency of Occurrence

For standardized avian use estimates, only observations of birds detected within the 50-m radius plot were used in the analysis. Mean use for a survey plot was the average number of bird observations recorded per 10-minute survey per plot. Mean use per visit was calculated as the total number of bird observations recorded within each plot averaged over all plots. A visit was defined as a complete round of surveys at all plots. To calculate overall mean use during each season, the mean use per visit was averaged over all visits during the season. Standardizing estimates of mean bird use for plots, visits, and season allow comparison between bird types and/or species, location, time, or with other studies where similar methods were used.

Percent of use was calculated as the proportion of the overall mean use that is attributable to a particular species or bird type. Frequency of occurrence was calculated as the percent of surveys in which a particular species or raptor type was observed.

2.3.1.3 Bird Flight Height Characteristics

Bird flight height metrics are often used to assess potential exposure of birds to collision risk with turbines. Flight height information was used to calculate the percentage of birds observed flying within the rotor-swept height (RSH; ~44 m to 150 m [~144 ft to 492 ft] [1] above ground level) for turbines potentially used at the expansion area. The flight height recorded at the point

[1] The potential rotor-swept height was derived from a combination of two potential tower heights, either 94 m or 100 m (~308 ft to 328 ft), with 100 m (~328 ft) rotor diameter. This RSH is actually larger than either turbine so provides a conservative estimate of exposure.

of first observation of flying birds was used to calculate the percentage of birds flying within the RSH.

2.3.2 Raptor Migration Surveys

2.3.2.1 Raptor Diversity and Species Richness

Raptor diversity was represented by the total number of species observed. Species richness was calculated as the mean number of raptor species observed per survey. The unit of species richness for raptor migration surveys was just species observed per survey since the survey plot was defined by an unlimited viewshed at each station.

2.3.2.2 Passage Rate, Percent of Overall Passage, and Frequency of Occurrence

For raptor migration surveys, observations of raptors or vultures detected within an unlimited viewshed were used in the analysis. Passage rate was the number of raptor or vulture observations recorded per observer-hour[2] and was calculated by dividing the number of raptors or vultures observed during a survey by the number of hours in the survey. Passage rate per visit was calculated as the total number of raptors or vultures seen averaged over all plots. A visit was defined as a complete round of surveys at all plots. This metric allows standardized comparison between sample locations, time (hours, days, weeks, seasons), or with other studies where similar data exist. Overall passage rates for the season or entire study period was calculated by averaging across all visits. To investigate changes in passage rate over time of day, passage rate was averaged across all stations for 1-hour time blocks (e.g., 1000 – 1100 hours, 1100 – 1200 hours, etc.).

2.3.2.3 Bird Flight Height Characteristics

For observations of raptors within 800 meters (m) of the survey station[3], the approximate flight height was recorded at the point where the bird was first observed. Flight height information was used to calculate the percentage of birds observed flying within the RSH (44 to 150 m [82.0 to 492.1 ft] above ground level) for turbines potentially used at the expansion area.

3.0 RESULTS

The avian use surveys were conducted between April 8 to May 31 and September 12 to November 3, 2011. The raptor migration surveys were conducted from March 17 to May 31 and September 12 to November 29, 2011.

[2] The number of birds per observer-hour is the standard metric used during raptor migration surveys at established HMANA and HWI sites. Because raptors are counted in an unlimited viewshed around the survey station, survey plot boundaries are not used to further standardize or define use estimates.

[3] Due to the difficulty with estimating flight height when there are few reference points, flight height was not estimated for observations of birds greater than 800 m from the survey station.

3.1 Avian Surveys

Seventeen visits were completed for the avian surveys, nine of which occurred in the spring and eight in the fall. In total, 564 10-minute fixed-point avian surveys were conducted at the BRWEP expansion area.

3.1.1 Bird Diversity and Species Richness

Ninety-one species were identified throughout all the fixed-point avian surveys (Appendix A). During the surveys, 4,059 observations were made within 2,875 separate groups, defined as one or more individuals (Appendix A). Overall mean species richness was 2.72 species observed per survey per plot. Species richness was higher in the spring (3.57 species per survey per plot) than fall (1.87 species per survey per plot).

3.1.2 Bird Use, Percent of Use, and Frequency of Occurrence

Overall bird use was higher in spring than in the fall (5.20 and 4.49 bird observations per survey per plot, respectively; Table 1). Passerines accounted for the majority of bird use in either season (96.4 and 88.9 percent of bird use for spring and fall, respectively). Mean use for all other bird types was low relative to passerine use. Of non-passerine bird types, woodpeckers had the highest use in either season. Diurnal raptor use was relatively low in either season (Table 1).

Shorebirds

The only shorebird species observed was American woodcock (*Scolopax minor*), which was only observed in spring (less than 0.01 bird observations per survey per plot; Table 1). The American woodcock accounted for 0.1 percent of spring avian use and was observed during 0.4 percent of spring surveys (Table 1).

Diurnal Raptors

Diurnal raptor use was 0.01 bird observations per survey per plot in the spring and 0.06 in the fall, and composed 0.3 and 1.2 percent of overall bird use in the spring and fall, respectively (Table 1). Within the 50-m plot, diurnal raptor use in spring was attributable to three species (broad-winged hawk [*Buteo platypterus*], northern harrier [*Circus cyaneus*], and unidentified buteo), while four species accounted for all diurnal raptor use in fall (sharp-shinned hawk [*Accipiter striatus*], broad-winged hawk, red-shouldered hawk, and American kestrel [*Falco sparverius*]). Only broad-winged hawk was observed during both seasons. Diurnal raptors were observed during 1.3 percent of surveys in spring and 4.8 percent of fall surveys (Table 1).

Owls

Barred owl (*Strix varia*) was the only owl species observed, and use by this species was less than 0.01 bird observation per survey per plot in the spring; no owls were observed in the fall (Table 1). Barred owl accounted for 0.1 percent of spring bird use and was observed during 0.4 percent of spring surveys (Table 1).

Vultures

Turkey vulture (*Cathartes aura*) was the only vulture species observed, with 57 vulture observations recorded during the study, and use by this species was 0.02 bird observations per survey per plot in the spring and less than 0.01 in the fall (Table 1). Turkey vultures accounted for 0.3 percent of all bird use in the spring and 0.2 percent in the fall. Turkey vultures were observed during 1.0 percent of spring surveys and 0.4 percent of fall surveys (Table 1).

Upland Game Birds

The only upland game bird species observed was ruffed grouse (*Bonasa umbellus*), and this species was only observed in spring (0.04 bird observations per survey per plot; Table 1). Ruffed grouse accounted for 1.0 percent of spring avian use and was observed during 4.0 percent of spring surveys (Table 1).

Doves/Pigeons

Mourning dove (*Zenaida macroura*) was the only dove/pigeon species observed (Table1). Mourning dove use was 0.01 bird observations per survey per plot in the spring. Mourning doves were not observed in the fall. Mourning dove accounted for 0.3 percent of all spring bird use, and mourning doves were observed during 0.7 percent of spring surveys (Table 1).

Passerines

Passerine use was 5.01 and 3.99 birds per survey per plot in the spring and fall, respectively (Table 1). Passerines accounted for 96.4 percent of bird use in spring and 88.9 percent in fall. Passerines were observed during 79.7 percent of spring and 70.0 percent of fall surveys (Table 1). Eastern towhee was the most commonly recorded passerine during the study with 392 observations recorded (Appendix A) and had the highest mean use of all passerines in the spring (0.75 bird observations per survey per plot). Use by eastern towhee in the fall was 0.35 bird observations per survey per plot (Table 1). Eastern towhee accounted for 14.5 percent of bird use during the spring and 7.9 percent in the fall and was observed during 38.8 percent of spring surveys and 17.6 percent of fall surveys. American robin was the second most commonly recorded passerine during the study with 366 observations recorded (Appendix A) and had the highest mean use of all passerines in the fall (0.92 bird observations per survey per plot). American robin use during the spring was 0.13 bird observations per survey per plot. American robin accounted for 20.6 percent of all bird use during the fall season and just 2.6 percent in the spring, and was observed during 10.7 percent of fall surveys and 8.3 percent of spring surveys (Table 1).

Other Small Bird Types

Woodpecker use was 0.12 bird observations per survey per plot in the spring and 0.24 in the fall (Table 1). Woodpeckers accounted for 2.2 percent of all bird use in the spring and 5.2 percent in the fall. Woodpeckers were observed during 9.6 percent of spring and 19.1 percent of fall surveys. The most common woodpecker species recorded was downy woodpecker (*Picoides pubescens*) with 46 observations recorded (Appendix A). Downy woodpecker use was 0.05 bird observations per survey per plot in the spring and 0.11 in the fall. Cuckoo use was less than 0.01 bird per survey in the spring and 0.04 in the fall. Cuckoos accounted for 0.1 percent and

0.8 percent of bird use in the spring and fall, respectively (Table 1). Cuckoos were observed during 0.3 percent of spring and 3.3 percent of fall surveys. Ruby-throated hummingbird (*Archilochus colubris*) was the only swift/hummingbird species observed, with an estimated use of less than 0.01 bird observations per survey per plot in both the spring and fall (Table 1). Use by ruby-throated hummingbirds accounted for 0.1 percent and 0.2 percent of bird use in the spring and fall, respectively, and they were observed during 0.3 percent of spring surveys and 0.7 percent of fall surveys (Table 1).

Table 1. Mean bird use, percent of use, and frequency of occurrence for bird types and species observed during the avian use surveys at the Beech Ridge Wind Energy Project expansion area.

Type / Species	Mean Use Spring	Mean Use Fall	Percent of Use Spring	Percent of Use Fall	Frequency of Occurrence Spring	Frequency of Occurrence Fall
Shorebirds	**<0.01**	**0**	**0.1**	**0**	**0.4**	**0**
American woodcock	<0.01	0	0.1	0	0.4	0
Raptors	**0.01**	**0.06**	**0.3**	**1.2**	**1.3**	**4.8**
sharp-shinned hawk	0	0.02	0	0.4	0	1.8
broad-winged hawk	<0.01	<0.01	0.1	0.2	0.3	0.7
red-shouldered hawk	0	0.01	0	0.2	0	1.1
unidentified Buteo	<0.01	0	0.1	0	0.7	0
northern harrier	<0.01	0	0.1	0	0.3	0
American kestrel	0	0.02	0	0.4	0	1.8
Owls	**<0.01**	**0**	**0.1**	**0**	**0.4**	**0**
barred owl	<0.01	0	0.1	0	0.4	0
Vultures	**0.02**	**<0.01**	**0.3**	**0.2**	**1.0**	**0.4**
turkey vulture	0.02	<0.01	0.3	0.2	1.0	0.4
Upland Game Birds	**0**	**0.04**	**0**	**1.0**	**0**	**4.0**
ruffed grouse	0	0.04	0	1.0	0	4.0
Doves/Pigeons	**0.01**	**0**	**0.3**	**0**	**0.7**	**0**
mourning dove	0.01	0	0.3	0	0.7	0
Passerines	**5.01**	**3.99**	**96.4**	**88.9**	**79.7**	**70.0**
alder flycatcher	<0.01	0	0.1	0	0.7	0
American crow	0	0.08	0	1.9	0	2.9
American goldfinch	0.16	0.17	3.0	3.7	10.6	10.7
American redstart	<0.01	0.03	0.2	0.7	1.0	0.7
American robin	0.13	0.92	2.6	20.6	8.3	10.7
barn swallow	<0.01	0	0.1	0	0.3	0
bay-breasted warbler	<0.01	0	0.2	0	1.0	0
Bicknell's thrush	<0.01	0	0.1	0	0.3	0
black-and-white warbler	0.15	<0.01	2.8	0.2	11.0	0.7
black-capped chickadee	0.08	0.17	1.6	3.7	5.4	10.7
black-throated blue warbler	0.02	0.12	0.3	2.6	1.6	7.4
black-throated green warbler	0.39	0.06	7.6	1.2	25.6	2.6
Blackburnian warbler	<0.01	<0.01	0.1	0.2	0.7	0.7
blackpoll warbler	<0.01	<0.01	0.1	0.1	0.3	0.4
blue-gray gnatcatcher	<0.01	<0.01	0.1	0.1	0.7	0.4
blue-headed vireo	0.19	0.10	3.7	2.1	14.7	5.9

Table 1. Mean bird use, percent of use, and frequency of occurrence for bird types and species observed during the avian use surveys at the Beech Ridge Wind Energy Project expansion area.

	Mean Use		Percent of Use		Frequency of Occurrence	
Type / Species	Spring	Fall	Spring	Fall	Spring	Fall
blue jay	0.02	0.22	0.3	4.8	1.7	19.5
brown-headed cowbird	0.06	0.14	1.2	3.1	4.0	0.7
brown thrasher	0.01	0	0.3	0	1.3	0
Canada warbler	0.02	0	0.4	0	2.3	0
Cape May warbler	0.01	<0.01	0.3	0.1	1.3	0.4
Carolina wren	0	<0.01	0	0.2	0	0.7
cedar waxwing	0.11	0.30	2.1	6.7	3.3	7.7
cerulean warbler	0.05	0.01	1.0	0.2	4.6	1.1
chestnut-sided warbler	0.43	0	8.3	0	26.5	0
chipping sparrow	<0.01	0.01	0.1	0.3	0.3	0.7
common grackle	0	0.19	0	4.3	0	0.7
common yellowthroat	0.06	0.03	1.1	0.6	4.9	1.5
common raven	<0.01	0.03	0.2	0.7	1.0	2.2
dark-eyed junco	0.21	0.44	4.1	9.7	16.1	20.6
eastern bluebird	<0.01	0.01	0.1	0.2	0.3	0.4
eastern phoebe	<0.01	0	0.1	0	0.3	0
eastern towhee	0.75	0.35	14.5	7.9	38.8	17.6
eastern wood-pewee	<0.01	0.01	0.2	0.2	1.0	0.7
European starling	0.02	0.06	0.4	1.2	1.3	0.7
field sparrow	0.09	0	1.8	0	6.8	0
golden-crowned kinglet	<0.01	0	0.1	0	0.3	0
golden-winged warbler	0.02	<0.01	0.4	0.1	2.0	0.4
gray catbird	0	<0.01	0	0.1	0	0.4
great crested flycatcher	0	<0.01	0	0.1	0	0.4
hermit thrush	0.05	0	0.9	0	3.7	0
hooded warbler	0.14	<0.01	2.6	0.1	12.7	0.4
house wren	<0.01	0	0.1	0	0.3	0
indigo bunting	0.25	<0.01	4.9	0.1	19.1	0.4
Kentucky warbler	<0.01	<0.01	0.1	0.1	0.3	0.4
least flycatcher	0.03	<0.01	0.6	0.2	2.9	0.7
magnolia warbler	0.13	0.03	2.4	0.6	8.9	2.2
mourning warbler	0.03	0	0.6	0	2.9	0
Nashville warbler	0.02	0	0.4	0	1.6	0
ovenbird	0.31	0.01	5.9	0.2	18.4	0.4
palm warbler	0.02	0.03	0.3	0.7	1.6	0.7

Table 1. Mean bird use, percent of use, and frequency of occurrence for bird types and species observed during the avian use surveys at the Beech Ridge Wind Energy Project expansion area.

	Mean Use		Percent of Use		Frequency of Occurrence	
Type / Species	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**
red-eyed vireo	0.43	0.01	8.2	0.2	28.5	1.1
rose-breasted grosbeak	0.09	0.02	1.7	0.4	8.3	1.8
scarlet tanager	0.10	0	1.9	0	9.3	0
song sparrow	0.02	0.03	0.3	0.6	1.7	1.5
Swainson's thrush	0	<0.01	0	0.1	0	0.4
Swainson's warbler	<0.01	0	0.1	0	0.3	0
tree swallow	0	0.02	0	0.5	0	0.7
unidentified passerine	0	0.30	0	6.7	0	12.1
unidentified sparrow	0	<0.01	0	0.1	0	0.4
unidentified warbler	<0.01	0.06	0.2	1.2	0.7	3.3
veery	0.11	0	2.1	0	7.7	0
white-breasted nuthatch	0.01	0.05	0.2	1.1	1.0	4.4
white-crowned sparrow	0	<0.01	0	0.1	0	0.4
white-throated sparrow	0	<0.01	0	0.1	0	0.4
wood thrush	0.03	<0.01	0.5	0.1	2.8	0.4
worm-eating warbler	0.01	<0.01	0.2	0.1	1.0	0.4
yellow-breasted chat	<0.01	0.01	0.2	0.3	1.0	1.1
yellow-rumped warbler	0.14	0.02	2.7	0.5	12.0	1.5
yellow warbler	<0.01	0	0.1	0	0.3	0
Cuckoos	**<0.01**	**0.04**	**0.1**	**0.8**	**0.3**	**3.3**
black-billed cuckoo	0	<0.01	0	0.1	0	0.4
yellow-billed cuckoo	<0.01	0.03	0.1	0.7	0.3	2.9
Swifts/Hummingbirds	**<0.01**	**<0.01**	**0.1**	**0.2**	**0.3**	**0.7**
ruby-throated hummingbird	<0.01	<0.01	0.1	0.2	0.3	0.7
Woodpeckers	**0.12**	**0.24**	**2.2**	**5.2**	**9.6**	**19.1**
downy woodpecker	0.05	0.11	1.0	2.4	4.0	10.3
hairy woodpecker	0.03	0.06	0.6	1.4	2.3	5.9
northern flicker	0.03	0.03	0.5	0.7	2.6	3.3
pileated woodpecker	0	0.03	0	0.7	0	2.9
unidentified woodpecker	0.01	<0.01	0.2	0.1	0.8	0.4
Overall	**5.20**	**4.49**	**100**	**100**		

3.1.3 Bird Flight Height Characteristics

Overall, the number of birds observed flying was low (Table 2). During the avian surveys, 194 groups of birds were observed flying, totaling 278 observations (approximately 6.8 percent of all birds observed). Due to the vegetation type in the study area (primarily deciduous forest), the vertical viewshed was somewhat limited, but nearly all flying birds observed within the 50-m radius plot were flying below the RSH. Only 1.6 percent of flying passerines were observed within the RSH; all other flying birds were observed flying within the 50-m radius plot were below the RSH (Table 2).

Table 2. Flight height by bird type during avian use surveys at the Beech Ridge Wind Energy Project expansion area.

Bird Type	Number of Groups Flying	Number of Flying Bird Observations	Mean Flight Height (m)	Percent Flying	Percent within Flight Height Categories		
					0 - 44 m	44 - 150 m[b]	> 150 m
Shorebirds	1	2	4.00	100	100	0	0
Diurnal Raptors	2	2	14.50	10.5	100	0	0
Accipiters	0	0	0	0	0	0	0
Buteos	1	1	14.00	12.5	100	0	0
Northern harrier	1	1	15.00	100	100	0	0
Falcons	0	0	0	0	0	0	0
Owls	1	1	1.00	100	100	0	0
Vultures	3	5	11.33	71.4	100	0	0
Upland Game Birds	0	0	0	0	0	0	0
Doves/Pigeons	2	4	2.50	100	100	0	0
Large Corvids	2	2	9.50	5.9	100	0	0
Passerines	171	246	6.47	9.5	98.4	1.6	0
Cuckoos	0	0	0	0	0	0	0
Swifts/Hummingbirds	1	1	2.00	33.3	100	0	0
Woodpeckers	9	13	11.22	13.3	100	0	0
Overall	**194**	**278**	**5.68**				

[a.] The potential “rotor-swept height” for turbines likely used in the expansion area development, or 44 to 150 m (144 to 492 ft) above ground level.

3.2 Raptor Migration Surveys

Raptor migration surveys were conducted at the three stations, three times weekly, within the BRWEP expansion area. Each station was surveyed 68 or 69 times, for a total of 206 raptor migration surveys (Table 3). Mean passage rate (number of raptor observations recorded per observer-hour) across all species within the area varied from 3.50 to 4.91 raptor observations recorded per observer-hour and averaged 3.98 raptor observations recorded per observer-hour (Table 3; Table 4).

Table 3. Summary of raptor passage rate and species richness during the raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

Station	Number of Surveys	Number of Species	Mean Use	Number of Species per Survey
1	69	11	4.02	1.64
2	68	12	4.91	1.84
3	69	10	3.50	1.38
Overall	**206**	**15**	**3.98**	**1.59**

3.2.1 Raptor Diversity and Species Richness

In total, 1,109 raptors of 15 species were recorded during raptor migration surveys (Table 4). Eleven raptor species were recorded during the spring and 13 during the fall. Diurnal raptors, excluding vultures, accounted for 37.2 percent of all birds observed (Table 4). Turkey vultures were the most commonly recorded species, accounting for approximately 62.6 percent of all birds recorded (Table 4). Average species richness was 1.59 species per survey.

Table 4. Total number of groups and observations for each raptor type and species observed during the raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

	Spring		Fall		Total	
Type / Species	**Groups**	**Observations**	**Groups**	**Observations**	**Groups**	**Observations**
Diurnal Raptors	**141**	**176**	**166**	**236**	**307**	**412**
Accipiters	*16*	*17*	*15*	*17*	*31*	*34*
Cooper's hawk	2	3	5	5	7	8
sharp-shinned hawk	14	14	10	12	24	26
Buteos	*116*	*145*	*126*	*193*	*242*	*338*
broad-winged hawk	38	47	33	80	71	127
red-shouldered hawk	60	71	26	30	86	101
red-tailed hawk	18	27	66	82	84	109
rough-legged hawk	0	0	1	1	1	1
Eagles	*2*	*6*	*7*	*7*	*9*	*13*
bald eagle	0	0	2	2	2	2
golden eagle	2	6	4	4	6	10
unidentified eagle	0	0	1	1	1	1
Falcons	*3*	*4*	*16*	*17*	*19*	*21*
American kestrel	1	1	13	13	14	14
merlin	2	3	3	4	5	7
Other Raptors	*4*	*4*	*2*	*2*	*6*	*6*
northern harrier	4	4	0	0	4	4
osprey	0	0	2	2	2	2
Owls	**2**	**2**	**0**	**0**	**2**	**2**
barred owl	2	2	0	0	2	2
Vultures	**224**	**483**	**119**	**212**	**343**	**695**
black vulture	0	0	1	1	1	1
turkey vulture	224	483	118	211	342	694
Overall	**367**	**661**	**285**	**448**	**652**	**1,109**

3.2.2 Passage Rate, Percent of Overall Passage, and Frequency of Occurrence

For all stations and all species combined (diurnal raptors, owls, and vultures), mean passage rate was 4.88 bird observations recorded per observer-hour in the spring and 2.99 bird observations recorded per observer-hour in the fall (Table 5). During the spring, mean passage rate was highest at station RM2 with 6.82 bird observations recorded per observer-hour, followed by RM1 with 4.86 bird observations recorded per observer-hour, and RM3 with 4.36 bird observations recorded per observer-hour (Table 6). For the fall, passage rate was highest at station RM1 with 3.26 bird observations recorded per observer-hour, followed by RM2 with 3.21 bird observations recorded per observer-hour, and RM3 with 2.72 bird observations recorded per observer-hour (Table 6).

<u>Diurnal Raptors</u>
Mean diurnal raptor passage rate within the study area was 1.25 raptor observations recorded per observer-hour in the spring and 1.47 in the fall (Table 5). Spring diurnal raptor passage rate among stations ranged from 0.65 raptor observations recorded per observer-hour at station RM3 to 1.87 at station RM2, while fall raptor passage rate use ranged from 1.71 raptor observations recorded per observer-hour at station RM2 to 1.37 at station RM1 (Table 6). Diurnal raptors composed 25.7 percent of the overall passage rate in the spring and 49.1 percent of the passage rate in the fall (Table 5). Diurnal raptors were observed during 61.7 percent of spring surveys and 64.9 percent of fall surveys (Table 5).

The bulk of the diurnal raptor passage was from *Buteos*; overall mean *Buteo* passage rate was 1.08 *Buteo* observations recorded per observer-hour in spring and 1.23 in fall. *Buteos* were observed during 55.4 percent of spring surveys and 52.3 percent of fall surveys (Table 5). Broad-winged hawk and red-shouldered hawk had the highest passage rate of any raptors in the spring (0.40 and 0.47 hawk observations recorded per observer-hour, respectively), and broad-winged hawk and red-tailed hawk had the highest passage rate for diurnal raptors in fall (0.51 and 0.54 hawk observations recorded per observer-hour respectively; Table 5). Excluding broad-winged hawks, red-shouldered hawks, and red-tailed hawks, use by other diurnal raptor subtypes was relatively low. Combined, *Accipiters,* northern harrier, eagles, and falcons accounted for five to 10 percent of the total passage during the spring and fall (Table 5) and accounted for five to 10 percent of the passage at any station during either season (Table 6).

<u>Owls</u>
Two barred owls were observed during spring raptor migration surveys (Table 4), resulting in a passage rate of 0.01 owl observations recorded per observer-hour; no owls were observed during the fall surveys (Table 5). Barred owls accounted for 0.2 percent of overall spring passage and were observed during 2.1 percent of spring surveys (Table 5). Barred owls were only observed at station RM2 (Table 6).

Vultures

Turkey vulture was the most common species observed during the raptor migration surveys (Table 4). Spring vulture passage rate was 3.62 vulture observations recorded per observer-hour, and fall passage rate was 1.52 vulture observations recorded per observer-hour (Table 5). Turkey vultures composed 74.1 percent of overall spring passage and 50.7 percent of fall passage, and turkey vultures were recorded during 70.8 percent of spring surveys and 42.3 percent of fall surveys. In the spring, most turkey vulture passage was recorded at station RM2 (4.92 vulture observations recorded per observer-hour), while in the fall, most passage was recorded at station RM1 (1.88 vulture observations recorded per observer-hour).

Table 5. Passage rate, percent of passage rate, and frequency of occurrence for each raptor type and species observed during the raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

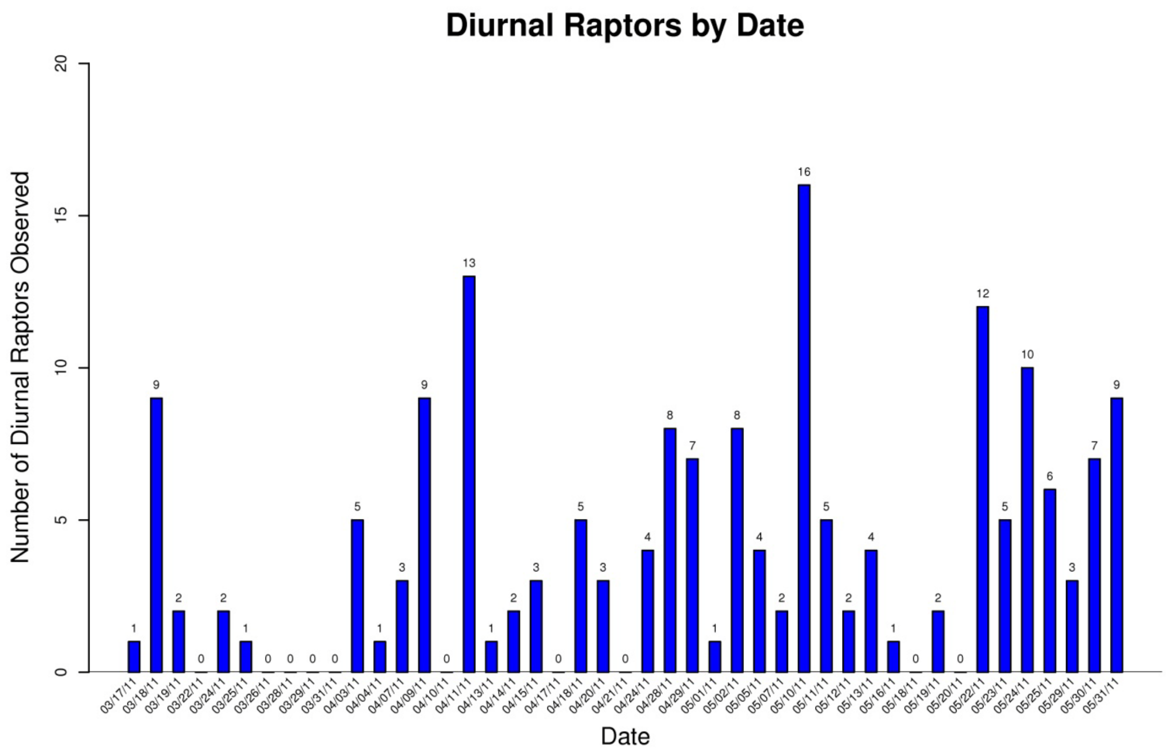
	Mean Passage Rate		Percent of Passage Rate		Frequency of Occurrence	
Type / Species	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**
Diurnal Raptors	**1.25**	**1.47**	**25.7**	**49.1**	**61.7**	**64.9**
Accipiters	0.09	0.11	1.9	3.8	15.0	13.5
Cooper's hawk	0.03	0.02	0.6	0.8	3.3	4.5
sharp-shinned hawk	0.06	0.09	1.3	3.1	11.7	9.9
Buteos	1.08	1.23	22.1	41.1	55.4	52.3
broad-winged hawk	0.40	0.51	8.2	16.9	26.3	15.3
red-shouldered hawk	0.47	0.19	9.7	6.2	35.4	17.1
red-tailed hawk	0.21	0.54	4.2	17.9	13.8	33.3
rough-legged hawk	0	<0.01	0	0.2	0	0.9
Eagles	0.05	0.03	1.0	1.1	2.5	5.4
bald eagle	0	<0.01	0	0.3	0	0.9
golden eagle	0.05	0.02	1.0	0.6	2.5	3.6
unidentified eagle	0	<0.01	0	0.2	0	0.9
Falcons	0.02	0.09	0.4	2.9	2.9	13.5
American kestrel	<0.01	0.06	0.1	2.0	1.3	11.3
merlin	0.01	0.03	0.3	0.8	1.7	2.3
Other Raptors	*0.02*	*<0.01*	*0.3*	*0.3*	*3.3*	*1.8*
northern harrier	0.02	0	0.3	0	3.3	0
osprey	0	<0.01	0	0.3	0	1.8
Owls	**0.01**	**0**	**0.2**	**0**	**2.1**	**0**
barred owl	0.01	0	0.2	0	2.1	0
Vultures	**3.62**	**1.52**	**74.1**	**50.9**	**70.8**	**42.3**
black vulture	0	<0.01	0	0.2	0	0.9
turkey vulture	3.62	1.52	74.1	50.7	70.8	42.3
Overall	**4.88**	**2.99**	**100**	**100**		

Table 6. Passage rate, percent of overall passage, and frequency of occurrence for each raptor type observed during the raptor migration surveys by survey station at the Beech Ridge Wind Energy Project expansion area.

Species	Passage Rate Spring	Passage Rate Fall	Percent of Overall Passage Spring	Percent of Overall Passage Fall	Frequency of Occurrence Spring	Frequency of Occurrence Fall
			Station RM1			
Diurnal Raptors	**1.28**	**1.37**	**26.4**	**42.1**	**66.7**	**61.1**
Accipiters	*0.09*	*0.01*	*1.9*	*0.4*	*18.2*	*2.8*
Buteos	*1.04*	*1.27*	*21.5*	*39.1*	*54.5*	*55.6*
Northern harrier	*0.03*	*0*	*0.6*	*0*	*6.1*	*0*
Eagles	*0.11*	*0*	*2.3*	*0*	*6.1*	*0*
Falcons	*0*	*0.08*	*0*	*2.6*	*0*	*13.9*
Vultures	**3.58**	**1.88**	**73.6**	**57.9**	**69.7**	**50**
Overall	**4.86**	**3.26**	**100**	**100**		
			Station RM2			
Diurnal Raptors	**1.87**	**1.71**	**27.4**	**53.3**	**75**	**63.9**
Accipiters	*0.15*	*0.16*	*2.2*	*4.9*	*21.9*	*19.4*
Buteos	*1.69*	*1.36*	*24.7*	*42.4*	*71.9*	*55.6*
Eagles	*0*	*0.06*	*0*	*1.7*	*0*	*8.3*
Falcons	*0.03*	*0.11*	*0.5*	*3.5*	*3.1*	*13.9*
Osprey	*0*	*0.03*	*0*	*0.9*	*0*	*5.6*
Owls	**0.03**	**0**	**0.5**	**0**	**6.2**	**0**
Vultures	**4.92**	**1.50**	**72.1**	**46.7**	**84.4**	**38.9**
Overall	**6.82**	**3.21**	**100**	**100**		
			Station RM3			
Diurnal Raptors	**0.65**	**1.39**	**14.9**	**51.5**	**51.5**	**66.7**
Accipiters	*0.03*	*0.14*	*0.7*	*5.1*	*6.1*	*13.9*
Buteos	*0.56*	*1.16*	*12.8*	*42.8*	*45.5*	*50.0*
Northern Harrier	*0.03*	*0*	*0.7*	*0*	*6.1*	*0*
Eagles	*0*	*0.04*	*0*	*1.5*	*0*	*8.3*
Falcons	*0.03*	*0.06*	*0.7*	*2.1*	*6.1*	*11.1*
Vultures	**3.71**	**1.31**	**85.1**	**48.5**	**66.7**	**41.7**
Overall	**4.36**	**2.71**	**100**	**100**		

3.2.3 Temporal Passage Rate

Temporal activity was variable throughout each season for both diurnal raptors and vultures (Figures 6a and 6b). In spring, the number of diurnal raptors observed per survey day ranged from zero on several survey days to 16 on May 10, while the number of turkey vultures ranged from zero on several days to 38, 41, and 34 vultures on April 7, April 24, and May 22, respectively (Figure 6a). In fall, 17 or fewer raptors were observed on all survey days except September 22, when 51 diurnal raptors were observed (Figure 6b). The number of turkey vultures ranged from zero to 15 in the fall, except on October 23 (21 observations) and November 2 (19 observations; Figure 6b). On a daily basis, overall passage rate peaked in the early afternoon at 1300 hours, but remained relatively high from 1100 to 1700 hours (Figure 7). This trend was similar for diurnal raptors and vultures, with passage rate peaking at 1100 and 1300 hours (Figure 7).



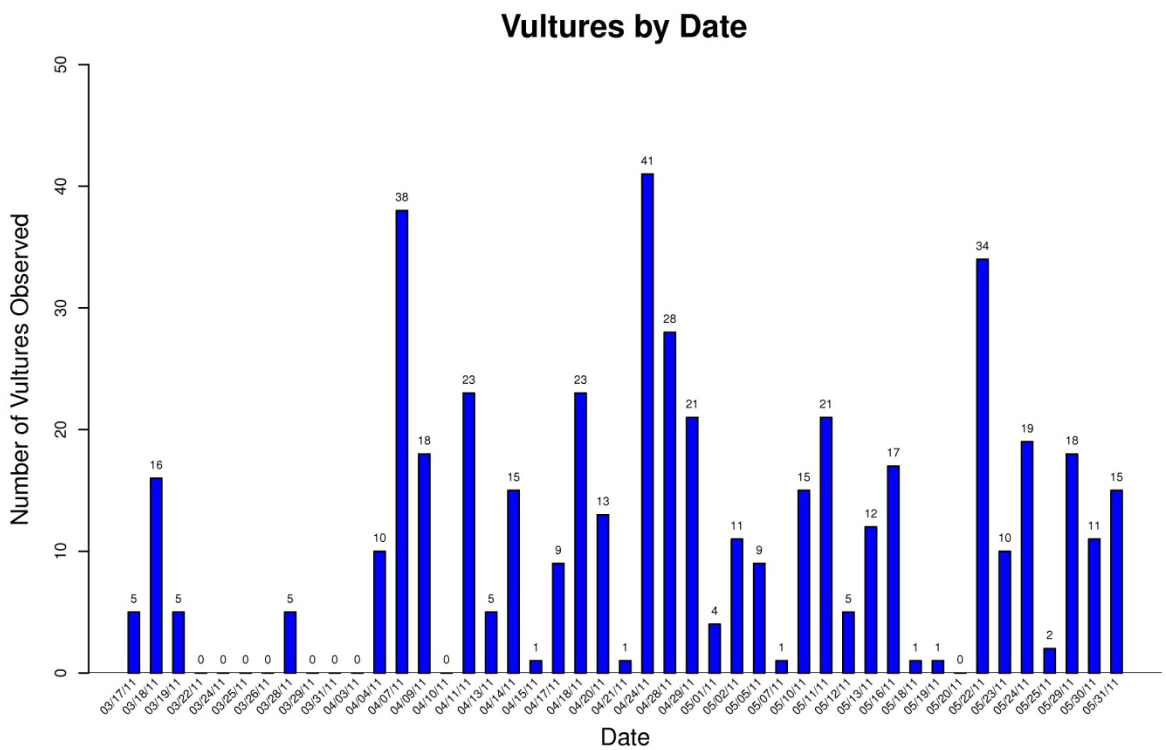
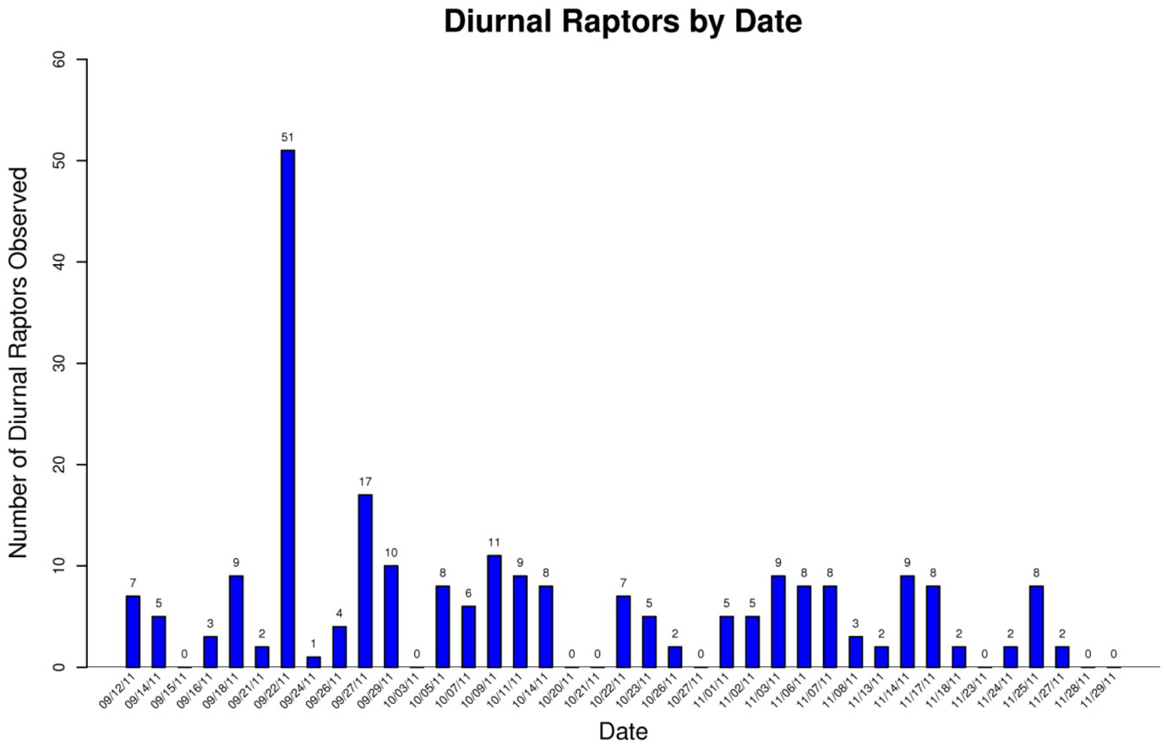


Figure 6a. Number of raptor and vulture observations recorded by survey day during the spring raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.



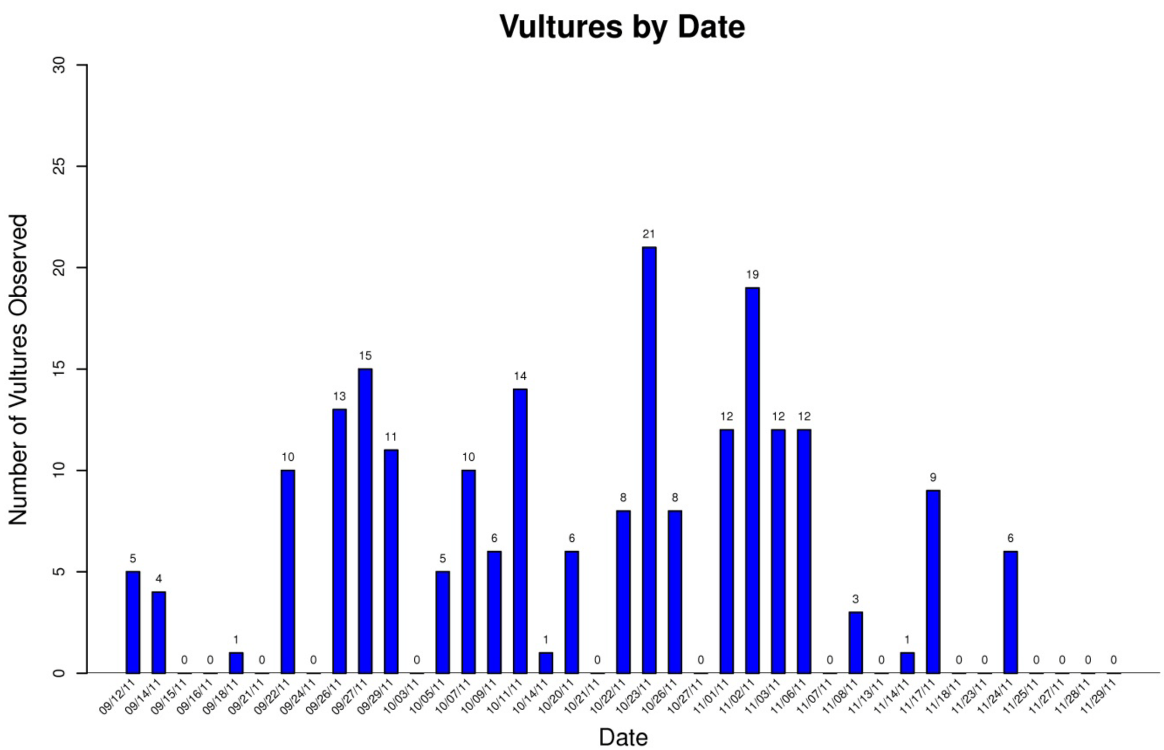
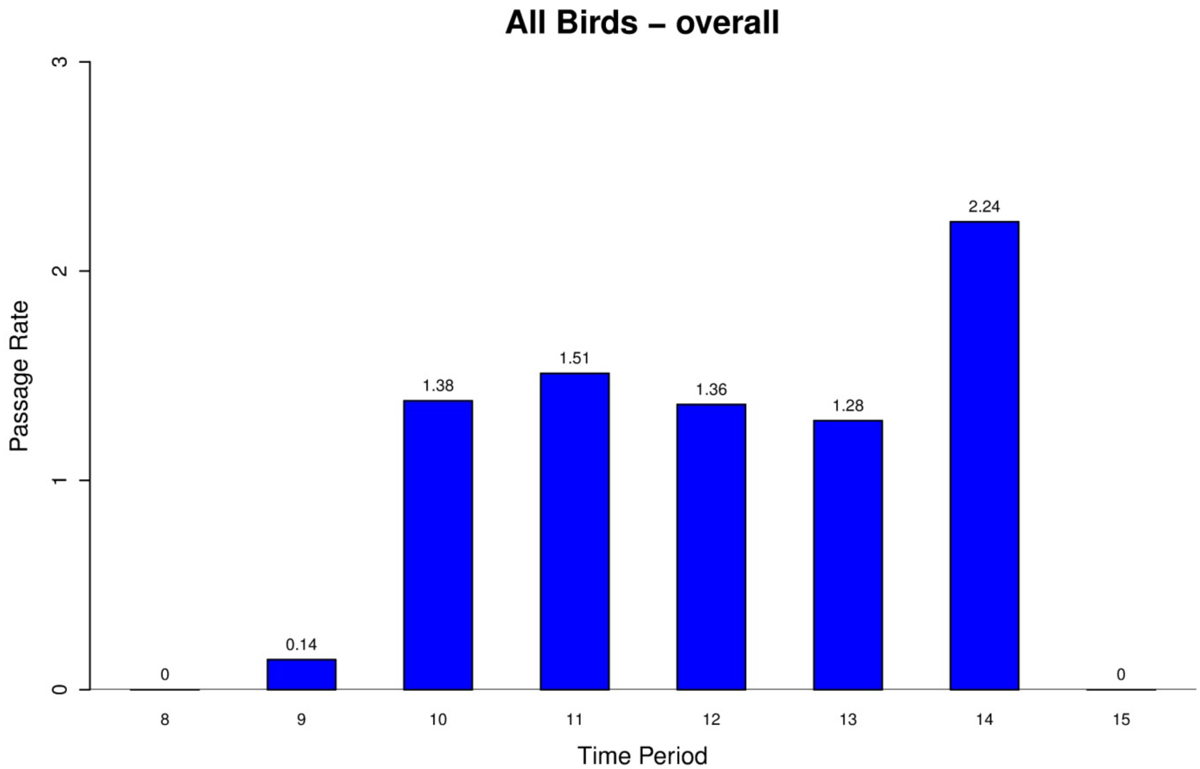


Figure 6b. Number of raptor and vulture observations recorded by survey day during the fall raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.



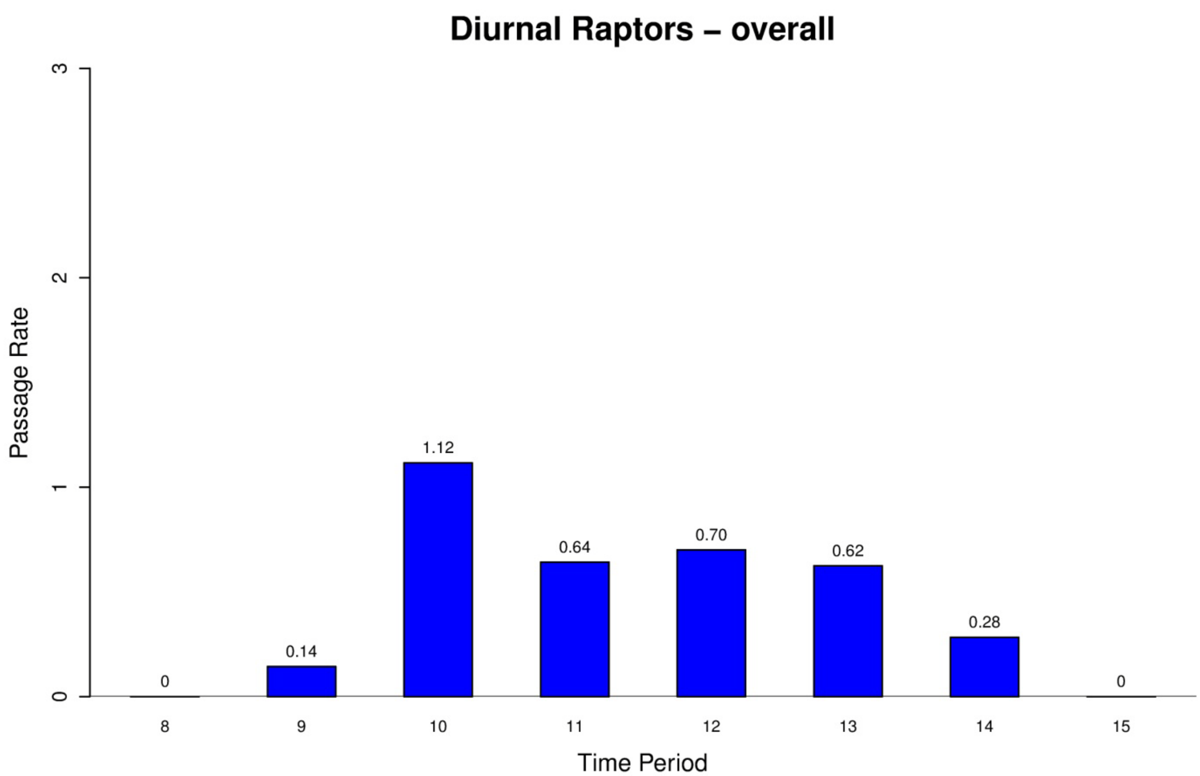


Figure 7. Mean passage rate by time of day (hour) for the raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

3.2.4 Flight Height Characteristics

For diurnal raptors, approximately 25% of raptor observations were recorded flying in the RSH, based on the flight height recorded at point of first observation for observations with 800 m of the station (Table 7). For *Buteos*, the most common diurnal raptor subtype, 28.5 percent were observed flying within the RSH. Fewer than 25 *Buteo* observations were recorded within an 800-m radius of the survey station for each other raptor subtypes, which limits the utility of the flight height analysis to characterize exposure to turbines for those raptor subtypes. For example, the small sample size may not be representative of the true flight height distribution for these subtypes or species. About 19 percent of flying vulture observations were recorded within the RSH (Table 7).

Table 7. Flight height characteristics of birds observed during the raptor migration surveys[a] at the Beech Ridge Wind Energy Project expansion area.

Species/Type	Number of Groups Flying	Number of Flying Bird Observations	Mean Flight Height (m)	Median Flight Height (m)	Percent Within Rotor-Swept Height[b]
Diurnal Raptors	**137**	**183**	**37.26**	**25**	**25.1**
Accipiters	22	24	26.41	23	16.7
Buteos	95	137	42.53	30	28.5
Northern harrier	1	1	40	40	0
Eagles	2	2	60	60	50.0
Falcons	17	19	19.06	13	10.5
Vultures	**155**	**315**	**33.88**	**20**	**19.4**

[a] Limited to observations within 800 m of the survey station
[b] RSH=potential rotor-swept heights for turbine blades, or 44 to 150 m (144 to 492 ft) above ground level.

3.3 Sensitive Species Observations

Several observations of sensitive or rare species were recorded during the avian surveys or raptor migration surveys (Table 8). Two species federally protected under the Bald and Golden Eagle Protect Act (BGEPA) were observed, primarily during raptor migration surveys: golden eagle (11 observations) and bald eagle (two observations). The bald eagle is also listed as a state imperiled species by the West Virginia Department of Natural Resources (www.wvdnr.gov/wildlife/endangered.shtm). Two additional state imperiled species (golden winged warbler [10 observations] and osprey [two observations] and three state critically imperiled species (Nashville warbler [six observations], northern harrier [five observations], and white-throated sparrow [one individual]) were observed within the study area. Five state species of concern were recorded throughout surveys, of which four were observed during avian surveys: Blackburnian warbler (four observations), alder flycatcher (three observations), Swainson's thrush (one individual), and Swainson's warbler (one individual); and one during raptor migration surveys: black vulture (one individual; Table 8).

Table 8. Summary of sensitive species observed during avian surveys and raptor migration surveys at the Beech Ridge Wind Energy Project expansion area.

Species	Status	Avian Use Surveys Groups	Avian Use Surveys Observations	Raptor Migration Surveys Groups	Raptor Migration Surveys Observations	Total Groups	Total Observations
golden eagle	EA	1	1	6	10	7	11
golden-winged warbler	S2	10	10	0	0	10	10
Nashville warbler	S1	5	6	0	0	5	6
Northern harrier	S1	1	1	4	4	5	5
Blackburnian warbler	S3	4	4	0	0	4	4
alder flycatcher	S3	3	3	0	0	3	3
bald eagle	S2, EA	0	0	2	2	2	2
osprey	S2	0	0	2	2	2	2
black vulture	S3	0	0	1	1	1	1
Swainson's thrush	S3	1	1	0	0	1	1
Swainson's warbler	S3	1	1	0	0	1	1
white-throated sparrow	S1	1	1	0	0	1	1

EA = Bald and Golden Eagle Protection Act.
S1= West Virginia State critically imperiled and/or extremely rare species (less than five known occurrences; West Virginia DNR 2003)
S2= West Virginia State imperiled or rare species (five to 20 known occurrences)
S3= West Virginia State species of concern (21 to 100 known occurrences)

4.0 DISCUSSION

The principal objectives of the study to fulfill the PSC requirement were to provide site-specific information on avian use and migration though the study area that would; (1) be useful in evaluating potential impacts from the proposed expansion of the BRWEP, (2) provide information useful in project planning and design to minimize potential impacts to birds to the extent practical, and (3) supplement and update the previous studies on avian use and migration in the study area.

The entire expansion area was not originally included in the PSC application but is located immediately adjacent to the existing BRWEP where land cover is predominately deciduous forest interspersed with inclusions of shrub/scrub; grassland, and reclaimed mined areas due to current and past land uses (see Figure 3). Canterbury (2006) described the land cover of the BRWEP as deciduous forest of varying age structure due to timber harvest, prior mining activity, and reclamation management. There are no detectable differences between the expansion area and the existing project in terms of vegetation, land cover, or topography based on land cover types (Canterbury USGS NLCD 2001). Because of the common land cover, topography, and vegetation characteristics throughout the expansion area and surrounding region, the expansion area does not provide unique habitat characters that would be expected to concentrate migrating birds or raptors. Raptors and songbirds will be present during migration seasons, and raptors may utilize updrafts associated with the area ridge lines, however, the expansion area is not likely to experience or concentrate use by migrating birds greater than surrounding areas.

To investigate potential impact from the proposed expansion of the BRWEP, standardized bird surveys were conducted during the spring and fall migration periods. Exposure to project infrastructure is affected by how much a species utilizes an area (use), as well as how often use occurs (frequency of occurrence). The surveys were designed to collect data on bird species composition, species richness, bird use, and frequency of occurrence in the study area that is useful for characterizing the bird community and potential exposure or risk to the proposed development. Use and percent of use provide relative measures of species exposure to the proposed project compared to other species. Percent of use was calculated as the proportion of overall use that was attributable to a particular bird type or species. Frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. Frequency of occurrence provides a relative measure of how often a species is observed in the study area compared to other species.

4.1 Avian Surveys

To help estimate potential impacts from the proposed expansion of the BRWEP relative to the original facility, avian use surveys were conducted and compared to the previous avian studies at BRWEP (Canterbury 2006). The intent was to evaluate similarities or differences in the expansion area and whether changes in bird use, species composition and relative abundance had occurred over time. Diurnal avian point counts surveys are reliable and repeatable methods for estimating the relative abundance and spatial and temporal use by birds, and in particular for small birds such as passerines and other songbirds. Fixed-point avian surveys were conducted in 2005 at the BRWEP project site (Canterbury 2006) and again in 2011 throughout the expansion area (this study). Survey and analytical methods were conducted in the same fashion during both studies which allowed comparison of results between the study years.

When comparing the fixed-point avian surveys between 2005 and 2011, the overall use estimates by bird types and sub-groups were similar. For example, while use by individual species was somewhat more variable, overall mean use by passerines in spring 2005 was 4.29 bird observations per 10-minute survey per 50-m radius plot and for this study, mean passerine use was 5.01 bird observations per 10-minute survey per 50-m radius plot. In the fall 2005, means use by all passerines was 3.69 bird observations per survey per plot and in 2011 was 4.0 bird observations per survey per plot. Seventy-nine species of passerines were observed during the 2005 study and 69 passerine species were observed in 2011. In both years, eight of the ten most common species based on use estimates were the same: eastern towhee, American robin, dark-eyed-junco, cedar waxwing, black-throated green warbler, red-eyed vireo, blue jay, and American crow. These eight species made up over 30% of all bird use recorded during each study year.

Eight of the 21 state species of concern (http://www.wvdnr.gov/Wildlife/RareSpecList.shtm) detected in 2005 were detected during 2011 surveys: Alder flycatcher, Blackburnian warbler, golden-winged warbler, Northern harrier, osprey, Swainson’s thrush, sharp-shinned hawk, and black vulture. State species of concern detected in 2005 but not detected during the 2011 study period included: northern waterthrush, vesper sparrow, yellow-rumped warbler, yellow-bellied flycatcher, Cooper’s Hawk, Northern goshawk, red-headed woodpecker, yellow-bellied sapsucker, black-billed cuckoo, brown creeper; common nighthawk, and northern saw-whet owl

(Canturbury 2006). One currently listed species of concern that was observed during 2005 surveys, but not listed during that time, and recorded again in 2011 was white-throated sparrow.

In general, avian use and species composition recorded in 2005 studies were similar to that recorded for the BRWEP expansion area. Use estimates for the most common species and the different bird types were similar between the years, although the decrease in the number of sensitive species observed in 2011 compared to 2005 suggests potential changes in abundance of some species.

4.2 Raptor Migration Surveys

Results from the raptor migration surveys were similar between 2005 and 2011 in terms of species composition but different in terms of passage rate due to the observation of large numbers of broad-winged hawks migrating through in 2005 (Canterbury 2006). Overall spring diurnal raptor passage rate in 2005 was 1.01 raptor observations recorded per observer-hour and in 2011 was 1.25 raptor observations recorded per observer-hour. Overall fall diurnal raptor use was 6.85 raptor observations recorded per observer-hour in 2005 and 1.47 raptor observations recorded per observer-hour in 2011. The high use estimate in 2005 was driven by 481 observations of broad-winged hawks recorded over the fall study period (Canterbury 2006). Overall species composition was similar between 2005 and 2011, although Canterbury recorded three species of owl during the raptor migration surveys (eastern screech owl, great-horned owl, and barred owl; Canterbury 2006) compared to only one species in 2011 (barred owl).

To investigate the uniqueness of the expansion area compared to regional raptor migration, data from established hawk watch sites in the same geographic region as the BRWEP was gathered. The number of raptor observations recorded per observer-hour, vultures excluded, were compiled from the Hawk Watch HMANA (2010) public website and compared to raptor migration through the expansion area (Appendix B). Belmont Valley Hawk Watch Site, Virginia is located 113 miles (181.9 km) west of the Site, near Charlottesville, Virginia. Allegheny Front Hawk Watch Site, Pennsylvania is located 168 miles (270.4 km) north-east of the Site, near Central City, Pennsylvania, and Washington Monument State Park Hawk Watch Site, Maryland is located 185 miles (297.7 km) north-east of the Site, near Boonsboro, Maryland.

When averaged across the survey dates, to calculate a metric comparable to other established hawk watch sites, the overall average number of raptor observations recorded per observer-hour at the expansion area was lower than the averages seen at other established sites (Appendix B). For each survey date, the overall raptor passage rate within the expansion area appears to be comparable to or lower than raptor passage rate recorded at the other evaluated Hawk Watch sites on the same date; although the average number of raptors observed was variable from one site to the next on some dates (Appendix B).

When comparing raptor migration overall, based on the total survey effort at each site from March through May and September through November, raptor passage rates appeared to be much lower at BRWEP expansion area (2.00 raptor observations recorded per observer-hour) compared to the three other Hawk Watch sites in the same geographic region, ranging from

23.26 to 33.34 raptor observations recorded per observer-hour (Table 9). Based on the survey results, raptors migrated through the BRWEP expansion area in much lower numbers during the migration seasons when compared to other sites representative of the region (Table 9). In general, based on the study results, the BRWEP expansion area does not receive higher raptor migration traffic when compared to the other regional sites (Table 9, Appendix B).

Table 9. Diurnal raptor passage rate (number of raptors observed per observer-hour) at the Beech Ridge Wind Energy Project expansion area and four other established hawk watch sites for the study period.

Site	Total Observer Hours	Total Diurnal Migrant Observations	Passage Rate
Beech Ridge expansion area, WV	205.50	412	2.00
Belmont Valley, VA	75.25	1,750	23.26
Allegheny Front, PA	601.33	12,689	21.10
Washington Monument State Park, MD	379.25	12,645	33.34

4.3 Conclusions

Results of the avian surveys and raptor migration surveys suggest that there are no unique or extraordinary concentrations or bird use features within the BRWEP expansion study area, and overall the results were typical of bird communities in the eastern Appalachian Mountain deciduous forest habitat as evidenced by the previous site surveys (Canterbury 2006). In general, results of the surveys do not suggest that development of the expansion area would have greater impacts than other wind developments in the region or expose any unusual or unique bird communities to impact risk from the development.

5.0 REFERENCES

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Appendix A: Summary of observations and groups recorded at the Beech Ridge Wind Energy Project Expansion Area by species and bird type for avian use surveys from April 8 to May 31, 2011 & September 12, to November 3, 2011.

		Spring		Fall		Total	
Type / Species	**Scientific Name**	**Groups**	**Observations**	**Groups**	**Observations**	**Groups**	**Observations**
Shorebirds		**2**	**3**	**0**	**0**	**2**	**3**
American woodcock	*Scolopax minor*	2	3	0	0	2	3
Diurnal Raptors		**23**	**24**	**24**	**24**	**47**	**48**
Accipiters		*2*	*2*	*5*	*5*	*7*	*7*
sharp-shinned hawk	*Accipiter striatus*	2	2	5	5	7	7
Buteos		*19*	*20*	*13*	*13*	*32*	*33*
broad-winged hawk	*Buteo platypterus*	4	5	3	3	7	8
red-shouldered hawk	*Buteo lineatus*	13	13	8	8	21	21
red-tailed hawk	*Buteo jamaicensis*	0	0	2	2	2	2
unidentified *Buteo*		2	2	0	0	2	2
Northern Harrier		*1*	*1*	*0*	*0*	*1*	*1*
northern harrier	*Circus cyaneus*	1	1	0	0	1	1
Eagles		*1*	*1*	*0*	*0*	*1*	*1*
golden eagle	*Aquila chrysaetos*	1	1	0	0	1	1
Falcons		*0*	*0*	*6*	*6*	*6*	*6*
American kestrel	*Falco sparverius*	0	0	6	6	6	6
Owls		**1**	**1**	**0**	**0**	**1**	**1**
barred owl	*Strix varia*	1	1	0	0	1	1
Vultures		**20**	**47**	**7**	**10**	**27**	**57**
turkey vulture	*Cathartes aura*	20	47	7	10	27	57
Upland Game Birds		**21**	**21**	**11**	**12**	**32**	**33**
ruffed grouse	*Bonasa umbellus*	16	16	11	12	27	28
wild turkey	*Meleagris gallopavo*	5	5	0	0	5	5
Doves/Pigeons		**7**	**10**	**0**	**0**	**7**	**10**
mourning dove	*Zenaida macroura*	7	10	0	0	7	10
Large Corvids		**66**	**71**	**107**	**153**	**173**	**224**
American crow	*Corvus brachyrhynchos*	25	27	62	98	87	125
common raven	*Corvus corax*	41	44	45	55	86	99
Passerines		**1,860**	**2,298**	**564**	**1,213**	**2,424**	**3,511**
alder flycatcher	*Empidonax alnorum*	3	3	0	0	3	3
American goldfinch	*Carduelis tristis*	53	70	33	50	86	120
American redstart	*Setophaga ruticilla*	3	3	2	8	5	11
American robin	*Turdus migratorius*	71	91	53	275	124	366
barn swallow	*Hirundo rustica*	2	6	0	0	2	6
bay-breasted warbler	*Dendroica castanea*	4	4	0	0	4	4
Bicknell's thrush	*Catharus bicknelli*	1	1	0	0	1	1
black-and-white warbler	*Mniotilta varia*	57	64	2	2	59	66
black-capped chickadee	*Poecile atricapilla*	31	42	33	46	64	88
black-throated blue warbler	*Dendroica caerulescens*	7	7	24	32	31	39
black-throated green warb.	*Dendroica virens*	133	160	7	15	140	175
Blackburnian warbler	*Dendroica fusca*	2	2	2	2	4	4
blackpoll warbler	*Dendroica striata*	1	1	1	1	2	2
blue-gray gnatcatcher	*Polioptila caerulea*	2	2	1	1	3	3
blue-headed vireo	*Vireo solitaries*	83	93	23	28	106	121
blue jay	*Cyanocitta cristata*	17	52	85	92	102	144
brown-headed cowbird	*Molothrus ater*	21	30	3	38	24	68

Appendix A:
Summary of observations and groups recorded at the Beech Ridge Wind Energy Project Expansion Area by species and bird type for avian use surveys from April 8 to May 31, 2011 & September 12, to November 3, 2011.

		Spring		Fall		Total	
Type / Species	**Scientific Name**	**Groups**	**Observations**	**Groups**	**Observations**	**Groups**	**Observations**
brown thrasher	*Toxostoma rufum*	8	8	0	0	8	8
Canada warbler	*Wilsonia canadensis*	7	7	0	0	7	7
Cape May warbler	*Dendroica tigrina*	6	6	1	1	7	7
Carolina wren	*Thryothorus ludovicianus*	0	0	4	4	4	4
cedar waxwing	*Bombycilla cedrorum*	20	68	25	111	45	179
cerulean warbler	*Dendroica cerulean*	16	17	3	3	19	20
chestnut-sided warbler	*Dendroica pensylvanica*	142	168	0	0	142	168
chipping sparrow	*Spizella passerine*	4	4	2	4	6	8
common grackle	*Quiscalus quiscula*	0	0	2	52	2	52
common yellowthroat	*Geothlypis trichas*	42	45	4	7	46	52
dark-eyed junco	*Junco hyemalis*	91	104	62	119	153	223
eastern bluebird	*Sialia sialis*	1	1	2	4	3	5
eastern phoebe	*Sayornis phoebe*	1	1	0	0	1	1
eastern towhee	*Pipilo erythrophthalmus*	208	292	62	100	270	392
eastern wood-pewee	*Contopus virens*	10	10	2	3	12	13
European starling	*Sturnus vulgaris*	9	12	2	15	11	27
field sparrow	*Spizella pusilla*	33	41	0	0	33	41
golden-crowned kinglet	*Regulus satrapa*	2	2	0	0	2	2
golden-winged warbler	*Vermivora chrysoptera*	9	9	1	1	10	10
gray catbird	*Dumetella carolinensis*	0	0	1	1	1	1
great crested flycatcher	*Myiarchus crinitus*	0	0	1	1	1	1
hermit thrush	*Catharus guttatus*	20	23	0	0	20	23
hooded warbler	*Wilsonia citrine*	62	62	1	1	63	63
house wren	*Troglodytes aedon*	1	1	0	0	1	1
indigo bunting	*Passerina cyanea*	83	91	2	2	85	93
Kentucky warbler	*Oporornis formosus*	1	1	1	1	2	2
least flycatcher	*Empidonax minimus*	15	15	2	2	17	17
magnolia warbler	*Dendroica magnolia*	40	46	8	9	48	55
mourning warbler	*Oporornis philadelphia*	10	10	0	0	10	10
Nashville warbler	*Vermivora ruficapilla*	5	6	0	0	5	6
ovenbird	*Seiurus aurocapillus*	140	184	1	3	141	187
palm warbler	*Dendroica palmarum*	6	6	5	8	11	14
prairie warbler	*Dendroica discolor*	1	1	0	0	1	1
red-breasted nuthatch	*Sitta canadensis*	1	1	0	0	1	1
red-eyed vireo	*Vireo olivaceus*	117	148	3	3	120	151
rose-breasted grosbeak	*Pheucticus ludovicianus*	63	65	5	5	68	70
scarlet tanager	*Piranga olivacea*	44	45	0	0	44	45
song sparrow	*Melospiza melodia*	7	8	5	7	12	15
Swainson's thrush	*Catharus ustulatus*	0	0	1	1	1	1
Swainson's warbler	*Limnothlypis swainsonii*	1	1	0	0	1	1
tree swallow	*Tachycineta bicolor*	0	0	2	6	2	6
tufted titmouse	*Baeolophus bicolor*	1	1	2	2	3	3
unidentified passerine		0	0	47	101	47	101
unidentified sparrow		0	0	1	1	1	1
unidentified warbler		3	4	9	15	12	19
veery	*Catharus fuscescens*	58	66	0	0	58	66
white-breasted nuthatch	*Sitta carolinensis*	7	7	15	16	22	23

Appendix A: Summary of observations and groups recorded at the Beech Ridge Wind Energy Project Expansion Area by species and bird type for avian use surveys from April 8 to May 31, 2011 & September 12, to November 3, 2011.

		Spring		Fall		Total	
Type / Species	**Scientific Name**	**Groups**	**Observations**	**Groups**	**Observations**	**Groups**	**Observations**
white-crowned sparrow	*Zonotrichia leucophrys*	0	0	1	1	1	1
white-throated sparrow	*Zonotrichia albicollis*	0	0	1	1	1	1
winter wren	*Troglodytes troglodytes*	2	2	0	0	2	2
wood thrush	*Hylocichla mustelina*	20	21	1	1	21	22
worm-eating warbler	*Helmitheros vermivorus*	6	6	1	1	7	7
yellow-breasted chat	*Icteria virens*	3	3	3	4	6	7
yellow-rumped warbler	*Dendroica coronate*	42	47	4	6	46	53
yellow warbler	*Dendroica petechia*	1	1	0	0	1	1
Cuckoos		**2**	**2**	**14**	**14**	**16**	**16**
black-billed cuckoo	*Coccyzus erythropthalmus*	0	0	2	2	2	2
yellow-billed cuckoo	*Coccyzus americanus*	2	2	12	12	14	14
Swifts/Hummingbirds		**1**	**1**	**2**	**2**	**3**	**3**
ruby-throated hummingbird	*Archilochus colubris*	1	1	2	2	3	3
Woodpeckers		**65**	**74**	**78**	**79**	**143**	**153**
downy woodpecker	*Picoides pubescens*	14	17	29	29	43	46
hairy woodpecker	*Picoides villosus*	13	15	17	18	30	33
northern flicker	*Colaptes auratus*	13	14	11	11	24	25
pileated woodpecker	*Dryocopus pileatus*	22	24	20	20	42	44
unidentified woodpecker		3	4	1	1	4	5
Overall		**2,068**	**2,552**	**807**	**1,507**	**2,875**	**4,059**

[a] Regardless of distance from observer.

Appendix B: Average number of raptor observations recorded per observer-hour by date at the Beech Ridge Wind Energy Project expansion area and four other established hawk watch sites in the Appalachian Mountain Region.

Date	Beech Ridge Expansion, WV	Belmont Valley, VA	Allegheny Front, PA	Washington Monument State Park, MD
3/17/2011	0.50	NS	1.29	2.67
3/18/2011	4.50	NS	1.06	NS
3/19/2011	1.00	NS	2.67	NS
3/22/2011	0	2.40	0.50	9.00
3/24/2011	0.67	1.0	0.33	0
3/25/2011	1.00	4.80	NS	2.00
3/26/2011	0	5.00	1.60	3.27
3/28/2011	0	0.44	0.67	NS
3/29/2011	0	NS	0.27	3.00
3/31/2011	0	NS	NS	NS
4/3/2011	5.00	NS	0.86	10.53
4/4/2011	0.50	NS	4.40	8.44
4/7/2011	1.00	2.86	4.89	2.67
4/9/2011	3.00	NS	NS	NS
4/10/2011	0	2.11	28.10	4.42
4/11/2011	4.33	NS	3.86	55.50
4/13/2011	1.00	NS	NS	NS
4/14/2011	1.00	NS	5.56	5.74
4/15/2011	3.00	NS	25.38	18.40
4/17/2011	0	5.40	1.54	5.88
4/18/2011	1.68	20.53	7.20	18.00
4/20/2011	1.00	4.67	0.53	65.91
4/21/2011	0	1.00	3.33	0.86
4/24/2011	1.19	11.00	1.71	8.00
4/28/2011	2.67	4.00	1.25	5.33
4/29/2011	2.33	1.60	NS	4.25
5/1/2011	0.33	NS	1.07	NS
5/2/2011	4.00	NS	6.73	3.43
5/5/2011	1.33	NS	0	NS
5/7/2011	2.00	2.18	0	0.86
5/10/2011	5.33	NS	NS	NS
5/11/2011	1.67	0.40	NS	NS
5/12/2011	1.00	NS	NS	NS
5/13/2011	4.00	NS	NS	NS
5/16/2011	0.50	NS	NS	NS
5/18/2011	0	NS	NS	NS
5/19/2011	1.00	NS	NS	NS
5/20/2011	0	NS	NS	NS
5/22/2011	4.00	1.00	NS	NS
5/23/2011	2.50	4.00	NS	NS
5/24/2011	3.33	NS	NS	NS
5/25/2011	5.81	NS	NS	NS
5/29/2011	1.00	NS	NS	NS
5/30/2011	2.33	NS	NS	NS
5/31/2011	3.00	NS	NS	NS

Appendix B:
Average number of raptor observations recorded per observer-hour by date at the Beech Ridge Wind Energy Project expansion area and four other established hawk watch sites in the Appalachian Mountain Region.

Date	Beech Ridge Expansion, WV	Belmont Valley, VA	Allegheny Front, PA	Washington Monument State Park, MD
9/12/2011	2.33	0.00	23.88	15.41
9/14/2011	1.67	0.80	57.22	24.57
9/15/2011	0	16.44	8.00	10.20
9/16/2011	3.00	180.84	269.89	88.40
9/18/2011	3.00	289.00	175.47	71.77
9/21/2011	1.00	NS	2.94	235.82
9/22/2011	17.00	NS	6.33	14.89
9/24/2011	1.00	16.27	75.26	43.70
9/26/2011	1.33	NS	20.22	47.52
9/27/2011	5.67	NS	75.40	18.86
9/29/2011	3.33	NS	12.40	42.82
10/3/2011	0	NS	5.87	NS
10/5/2011	2.67	NS	6.38	9.94
10/7/2011	2.00	NS	20.50	6.75
10/9/2011	3.67	NS	28.13	3.26
10/11/2011	3.00	NS	29.18	15.75
10/14/2011	2.67	NS	4.00	3.14
10/20/2011	0	NS	0.89	2.48
10/21/2011	0	4.00	0.80	4.24
10/22/2011	2.33	1.33	5.89	8.44
10/23/2011	1.67	0.71	12.24	3.25
10/26/2011	0.67	NS	1.29	2.57
10/27/2011	0	NS	NS	NS
11/1/2011	1.67	NS	58.00	4.71
11/2/2011	1.67	NS	22.00	11.09
11/3/2011	3.00	NS	6.33	26.89
11/6/2011	2.67	NS	3.33	1.60
11/7/2011	2.67	NS	3.13	NS
11/8/2011	1.00	NS	3.53	NS
11/13/2011	0.92	NS	0.75	NS
11/14/2011	3.00	NS	0.57	0.00
11/17/2011	8.00	NS	1.20	6.67
11/18/2011	1.00	NS	1.63	1.23
11/23/2011	0	NS	NS	NS
11/24/2011	0.67	NS	1.07	1.50
11/25/2011	2.67	NS	1.63	NS
11/27/2011	0.67	NS	0.46	NS
11/28/2011	0	NS	7.38	NS
11/29/2011	0	NS	6.00	NS
Average	**1.98**	**21.62**	**17.16**	**18.93**

Avian and Bat Risk Assessment:
Beech Ridge Wind Energy Project Expansion Area
Greenbrier and Nicholas Counties, West Virginia.

February 2012

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NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

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1.0 INTRODUCTION

Beech Ridge Energy LLC (BRE), a wholly owned subsidiary of Invenergy LLC, has developed the Beech Ridge Wind Energy Project (BRWEP) in Greenbrier and Nicholas Counties, West Virginia. The BRWEP was granted a Siting Certificate by the West Virginia Public Service Commission (PSC) on August 26, 2006, and on reconsideration, on January 11, 2007. The approval included 124 wind turbine generators (WTG) of 1.5 megawatts each for a total of 186 megawatts of generating capacity. Construction on the BRWEP began in April 2009.

On December 8, 2009, a United States District Court in the State of Maryland enjoined the construction of all but 40 centrally located WTGs (then being constructed) until further specified actions were taken, including securing an Incidental Take Permit (ITP) from the U.S. Fish and Wildlife Service (USFWS). Pursuant to a settlement agreement among the parties to the injunction proceeding, on January 26, 2010, the District Court amended its December 8, 2009 Order to allow the completion of the Project, provided a number of conditions were met including securing an ITP, and including the movement of a number of WTGs from the eastern portion of the project to the west. The amended Order also allowed the immediate completion of an additional 27 WTGs for a total of 67 WTGs. These additional WTGs were completed and brought online, together with the first 40 WTGs, between January and August 2010.

In order to comply with the portion of the Amended Order of the District Court requiring movement of certain WTGs from the eastern portion of the project to locations in the west, BRE has planned for an expansion/modification of the original project proposed to consist of 33 WTGs immediately adjacent to the west of the original footprint of the project as approved by the PSC. This expansion/modification will require review and approval by the PSC.

In connection with seeking PSC approval of the BRWEP expansion, BRE must file pre-construction avian migration studies and an avian and bat risk assessment. The original filing with the PSC occurred in 2006. This report has been prepared in an effort to comply with the PSC requirement by covering the area proposed for the project expansion and is intended to fulfill the avian and bat risk assessment requirement and supplement the results from the 2005 surveys.

1.1 Study Objectives

The purpose of this risk assessment is to conduct an early screening of bird and bat resources of the BRWEP expansion area and surrounding environs that may be impacted by the Project. The principal objectives of the risk assessment are to: (1) provide site-specific bird and bat resource data based on available information and; (2) evaluate potential impacts from the proposed wind energy project based on the available information. The protocol for the risk assessment was similar to those used previously at the BRWEP (Canterbury 2006), and follow national guidance and recommendations for study of wind energy facilities (Anderson et al. 1999, WTGAC 2010, Strickland et al. 2011).

The scope for the risk assessment included the following components:

- Evaluation of mapped data to identify and characterize key resources, land cover, land use, and habitat within the study area including identification of protected, sensitive or special bird or bat habitat (e.g., Important Bird Areas, bat hibernacula).
- Characterization of avian and bat species potentially affected by development within the BRWEP expansion area;
- Evaluation of sensitive or protected avian and bat resources potentially affected by the proposed project (e.g., State or Federally listed species).

1.2 Methods

The area evaluated in this risk assessment includes the area proposed for new project facilities within the BRWEP expansion area, defined as the Project Area, and the area encompassed by a 2-mile (3.2 kilometer) buffer around the Project Area, defined as the Evaluation Area. The Project Area and Evaluation Area collectively, are referred to as the study area.

Several sources of available information and data were used to identify and characterize potential bird and bat resources within the study area, including existing public data sources, a reconnaissance field visit, results from wildlife surveys conducted within the study area, existing technical reports, published literature, field guides, and internet resources.

The study area was visited on March 12, 2011 by a Research Wildlife Biologist, David Tidhar, from WEST Inc., to evaluate habitat, current land use and condition, presence of unique habitat or features that may elevate use by birds and bats, and record general wildlife notes or observations such as raptor nests, prey populations, or physiographic features important to wildlife. All wildlife species observed during the field visit were recorded and representative photographs were taken within the study area (Appendix B).

1.3 Environmental Setting

The BRWEP expansion area is located in West Virginia near the towns of Duo and Quinwood and immediately adjacent to the existing BRWEP (Figures 1.1). The study area lies within the Central Appalachians Ecoregion (EPA 2010), which stretches from central Pennsylvania to northern Tennessee. The Central Appalachians Ecoregion is primarily a high, dissected, rugged plateau composed of sandstone, shale, conglomerate and coal. The high hills and low mountains of the region are covered by a mixed mesophytic northern hardwood forest. The study area is within the Forested Hills and Mountains subsection of the Central Appalachians (EPA 2010). Topography within the project area is generally a series of rolling ridges dropping into valleys at an elevation of approximately 2,300 – 4,699 feet (700-1400 meters; Figures 1.2 and 1.3)

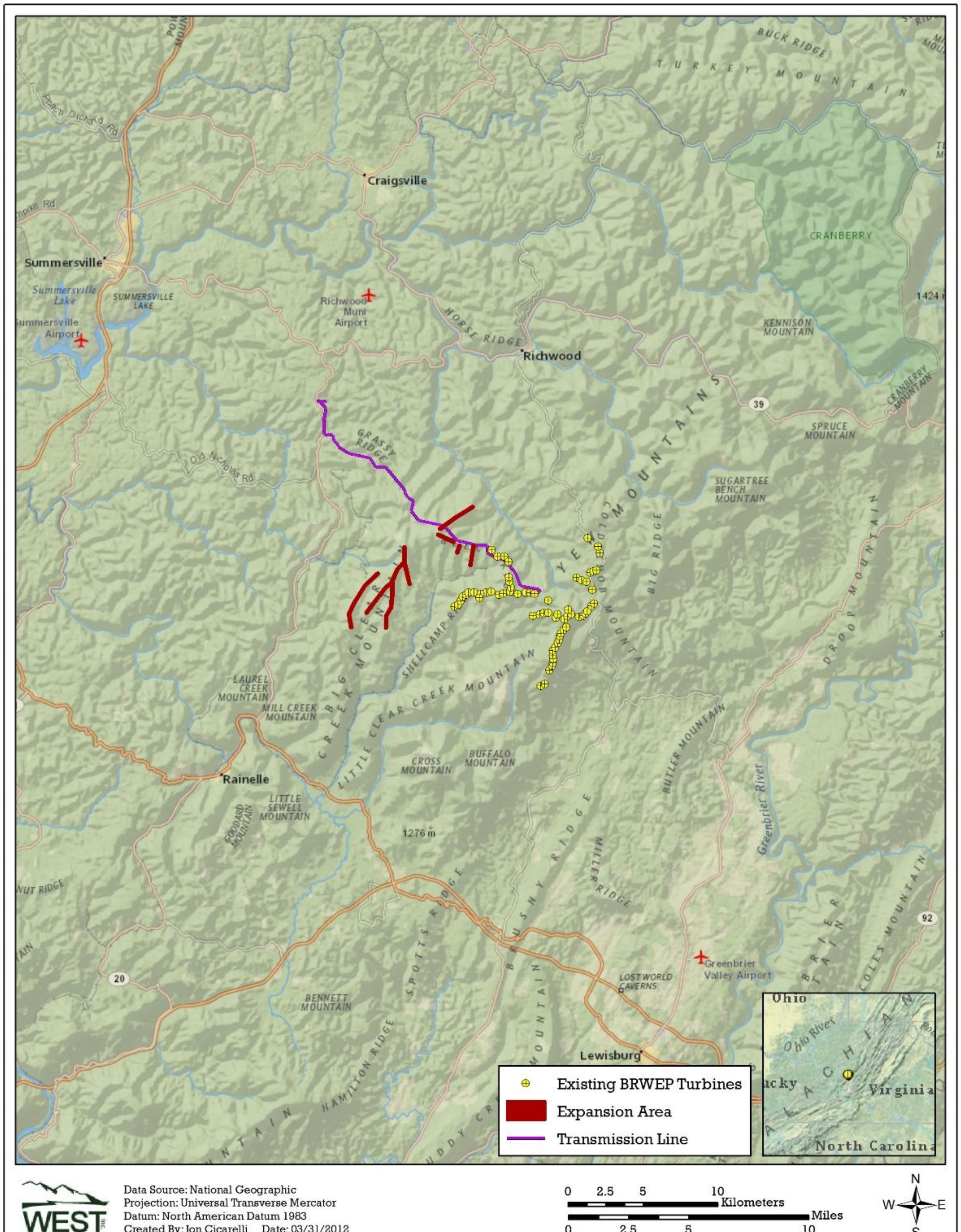

Figure 1.1 Location of the existing proposed BRWEP expansion area.

The field visit on March 12, 2011 revealed that ridge-top and areas of adjacent slopes throughout the study area have been clear-cut (similar to the existing BRWEP). Typically, the potential development areas for wind project facilities are restricted to upper elevation ridge-tops while the overall Evaluation Area encompasses additional ridge-tops and valley bottoms. There were a few small areas of mixed deciduous/coniferous forest in the south-east portion of the Evaluation Area associated with abandoned surface mines. No open mine shafts were observed during the field visit. Most of the evidence of past mining appeared to be surface mining, and the potential for open vertical or horizontal shafts in the study area is considered low. Some rocky outcrops were detected along one development corridor of the Project Area and intermittently elsewhere in the study area. No obvious caves were observed and there was a lack of extensive talus fields and rocky outcrops. There were numerous areas of open exposure in all aspects due to clear-cutting. Additionally, because of the extensive clear-cutting, there is little intact mature forest and most forest observed was in various successional stages of growth.

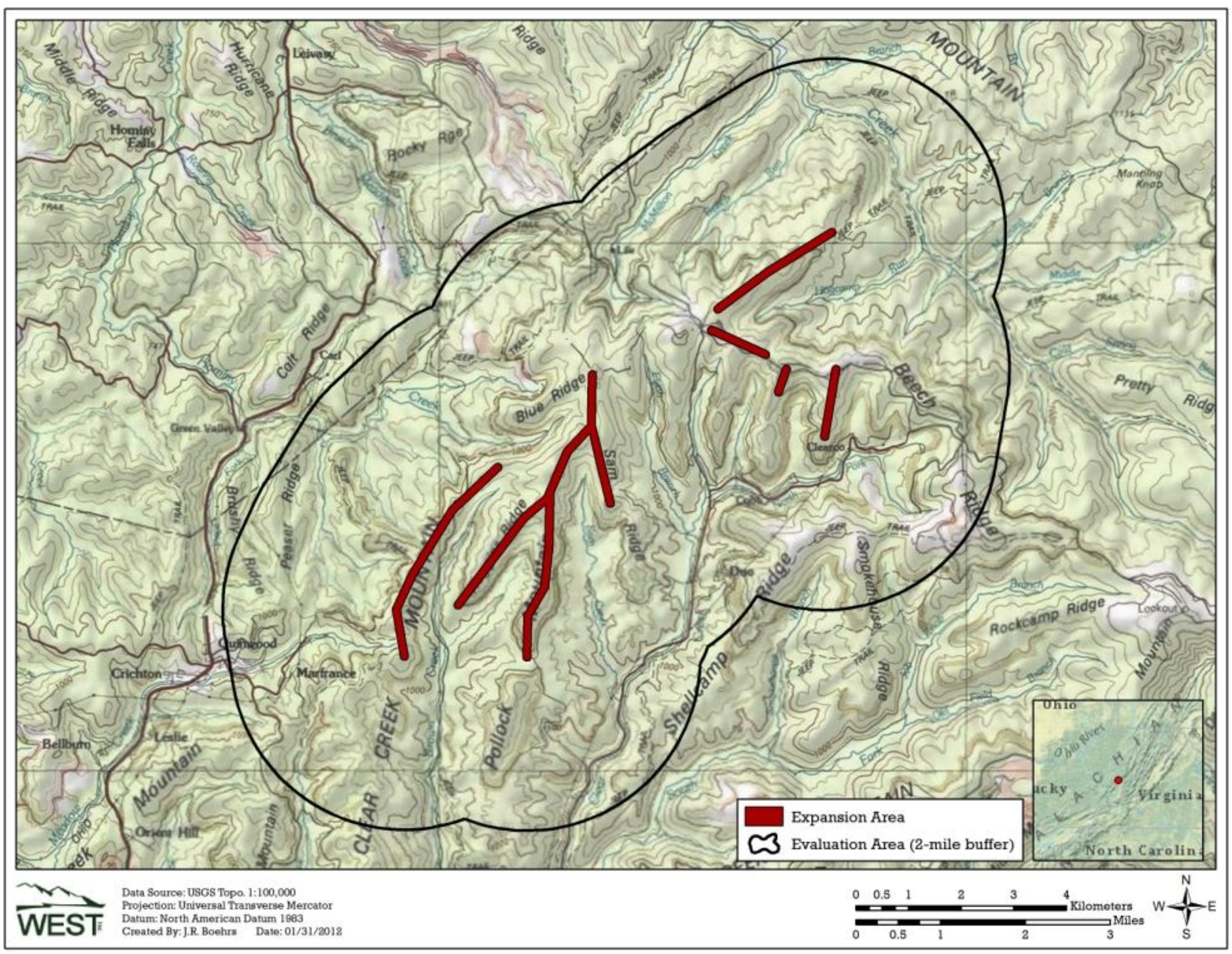

Figure 1.2 Site location and topographic map of the BRWEP expansion Project Area and Evaluation Area.

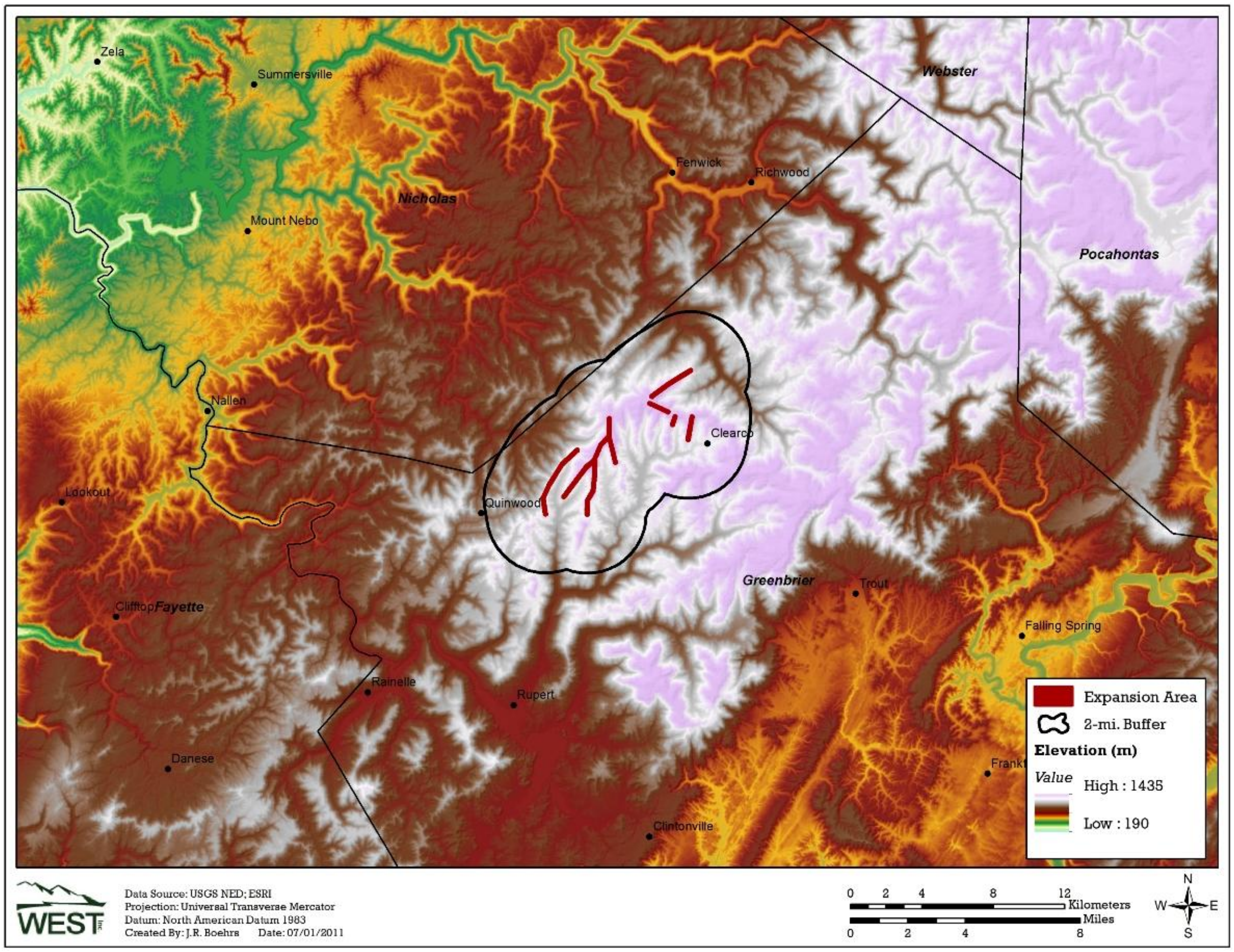

Figure 1.3 Digital elevation map of the proposed BRWEP expansion area and surrounding region.

Land Cover and Land Use

The proposed BRWEP expansion area, defined as the proposed corridors where project facilities may be constructed (Figure 1.2), encompasses approximately 765 acres. According to the National Landcover database (2001; Table 1.1; Figure 1.4) the Project Area is predominately deciduous forest [607 acres (79.4%)] with small inclusions of mixed forest, shrub/scrub, grassland, and developed areas (Table 1.1). The data obtained from the National Landcover database (NLCD 2001) may not directly reflect the current condition due to land management activities, but provides a general assessment of landcover and habitat types present and the relative proportions of each. Additional information from site specific surveys, such as the wetland delineation surveys (Potesta & Associates, Inc, 2010), provide more specific information and ground-truthing of existing data.

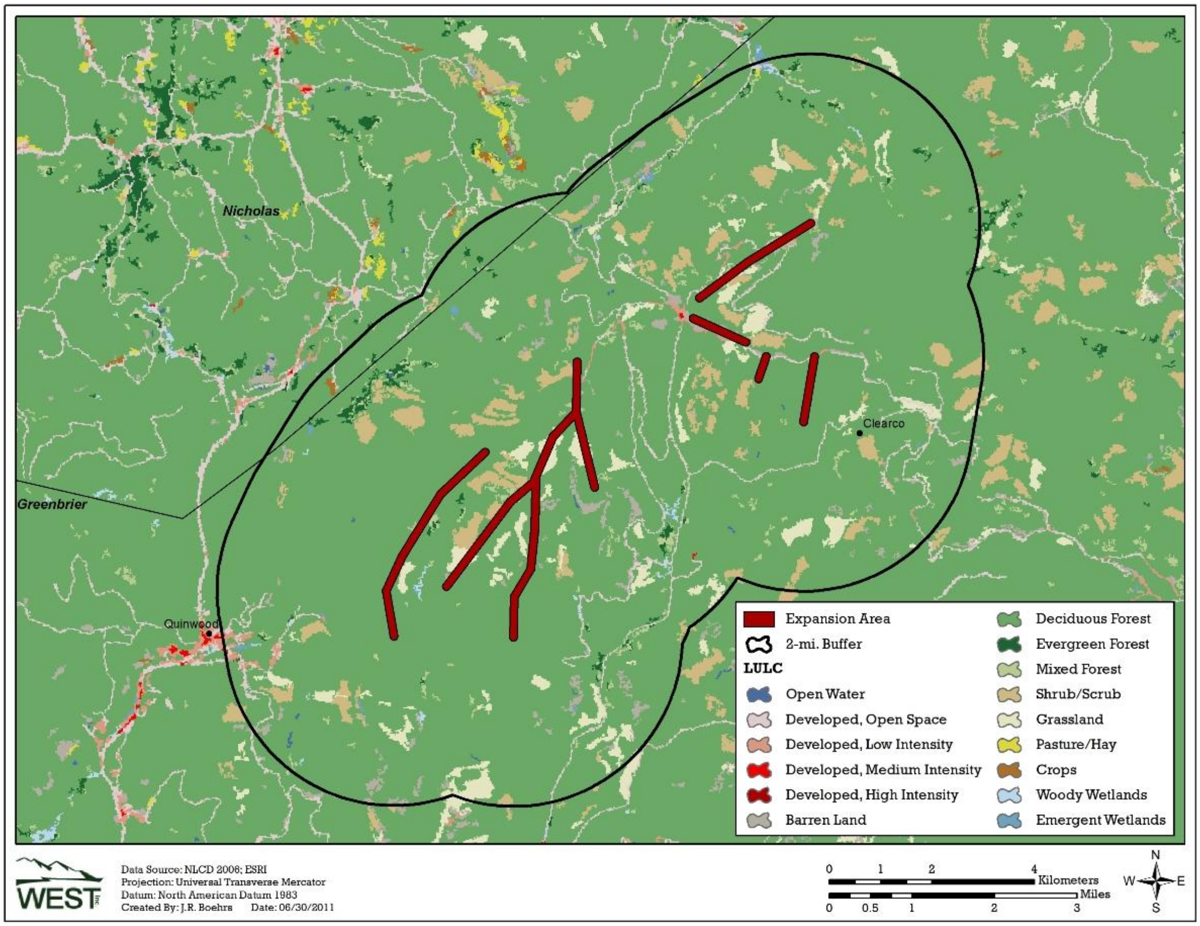

Figure 1.4 Land cover types within the proposed BRWEP expansion area and surrounding region.

Table 1.1 Land use/land cover types present within the Project and Evaluation areas (Source: NLCD 2001).

	Project Area		Evaluation Area	
Cover Type	**Acreage**	**% Composition**	**Acreage**	**% Composition**
Open Water	-	-	18.82	0.05
Developed, Open Space	7.38	0.96	565.52	1.60
Developed, Low Intensity	4.16	0.54	97.37	0.28
Developed, Medium Intensity	-	-	5.10	0.01
Barren	33.85	4.42	508.51	1.44
Deciduous Forest	607.32	79.36	30,844.28	87.51
Evergreen Forest	-	-	169.93	0.48
Mixed Forest	10.34	1.35	328.80	0.93
Scrub/Shrub	27.83	3.64	1,449.07	4.11
Grassland	74.36	9.72	1,156.29	3.28
Pasture/Hay	-	-	3.50	0.01
Crops	-	-	9.42	0.03
Woody Wetlands	-	-	46.35	0.13
Emergent Wetlands	-	-	41.78	0.12
Total	**765.24**	**100**	**35,244.74**	**100**

The larger Evaluation Area, defined as the area encompassed by a 2-mile (3.2 kilometer) buffer surrounding the Project Area, encompassing over 35,000 acres, is comparable to the Project Area in land cover composition (Table 1.1). The predominant land use class is deciduous forest, accounting for 30,844 acres (87.5%); with smaller inclusions of evergreen and mixed forest (Table 1.1). Within the Evaluation Area there are small streams and ponds accounting for approximately 18.8 acres of open water, agricultural land (pasture/hay and crops), and either woody or emergent wetland areas accounting for approximately 87 acres combined, which are land cover types not mapped within the Project Area (Table 1.1; Figure 1.4, NLCD 2001).

Wetlands and Riparian Areas
General information regarding wetlands and other aquatic habitats is based on data from the USFWS National Wetlands Inventory (Table 1.2; Figure 1.5), land-use data (Table 1.1; Figure 1.4), the field visit, and formal wetland surveys conducted in the Project Area. Formal wetland delineations for the Project Area were conducted between September 21 and October 1, 2010 (Potesta & Associates, Inc. 2010). Results of the field surveys identified ten streams (five perennial, four ephemeral, and one intermittent) and five wetlands. Of the five wetlands, 0.44 acre was considered jurisdictional, and 0.66 acre was considered isolated in nature. The total area of wetland is relatively small, and is not expected to result in disproportionately greater use by avian and bat resources than surrounding areas. To the extent practical, the jurisdictional waters will be avoided during development of the BRWEP expansion area (Beech Ridge Energy LLC, 2011 p.33).

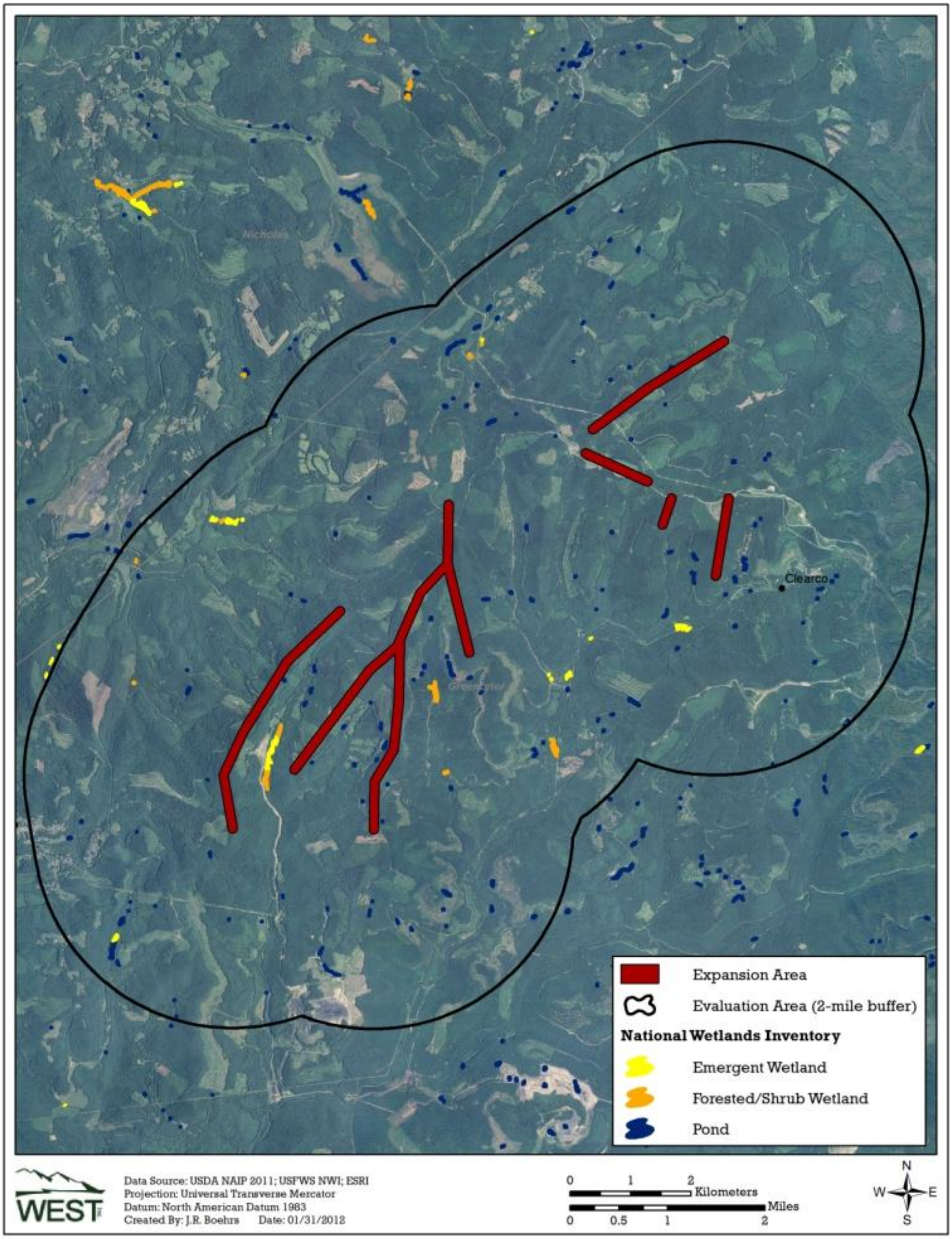

Figure 1.5 National Wetlands Inventory map of the proposed BRWEP expansion area and surrounding region.

Based on USFWS National Wetland Inventory data there are 101 acres within the Evaluation Area that are classified as wetland. The majority of wetlands within the evaluation area are classified as ponds, comprising approximately 60 acres (~59% of wetland areas). The remaining 41 acres are classified as emergent wetlands (~21 acres) and scrub/shrub forested wetlands (~20 acres). Over the entire evaluation area, wetlands comprise approximately 0.30 percent of the land cover.

Table 1.2 Wetland types present within the evaluation area. (USFWS National Wetlands Inventory).

Wetland Type	Evaluation Area	
	Acreage	**Percent**
Emergent Wetland	20.85	20.6
Forested/Shrub Wetland	20.50	20.2
Pond	60.09	59.2
Total	**101.44**	**100**

Public Lands

The Project is primarily located on a 63,000-acre tract privately owned by MeadWestvaco. BRE has leased approximately 3,172 acres and additional road rights-of-way from this landowner for the construction and operation of the expansion area. Only a small portion of the 3,172-acre Project Area will host wind project facilities.

The study area does not contain any state, federal, or tribal lands, nor does it contain any conservation lands as identified by The Nature Conservancy (TNC) or Important Bird Areas (IBA) as identified by the National Audubon Society (NAS).

There are no TNC preserves or IBAs in Greenbrier or Nicholas Counties. The nearest TNC preserve is the Slaty Mountain Preserve in Monroe County, West Virginia located approximately 35 miles southwest of the study area. The nearest IBAs are Dutch River and New River Gorge – Garden Ground Mountain located approximately 42 miles northwest and 40 miles southwest of the study area, respectively. While information from these resources is applicable to the Appalachian Mountain region, due to the distance from the study area, these resources are not likely to be impacted by the project nor are the resources at those locations likely to influence bird and bat abundance or composition in the study area. The proposed expansion of the BRWEP will not impact any state, federal, or tribal lands, or any TNC lands or NAS IBAs.

2.0 Avian Resources

2.1 Raptors

From available migration (NACFRP 2010; AFMO 2007; HRMO 2011; Canterbury 2006) and breeding bird data (WVBBA 2011), fourteen diurnal raptor species, six owl species, and two vulture species could occur in the study area at some time during the year (Table 2.1).

Table 2.1 Raptor species and potential seasonal occurrence in the study area.

Common Name	Scientific Name	Winter	Spring	Summer	Fall
Raptors					
Red-shouldered hawk	*Buteo lineatus*	X	X	X	X
Red-tailed hawk	*Buteo jamaicensis*	X	X	X	X
Broad-winged hawk	*Buteo platypterus*		X	X	X
Rough-legged hawk	*Buteo lagopus*	X			
Sharp-shinned hawk	*Accipiter striatus*	X	X	X	X
Cooper’s hawk	*Accipiter cooperii*	X	X	X	X
Northern goshawk	*Accipiter gentilis*	X	X		X
American kestrel	*Falco sparverius*	X	X	X	X
Peregrine falcon	*Falco peregrinus*		X		X
Merlin	*Falco columbarius*	X	X		X
Northern harrier	*Circus cyaneus*		X	X	X
Golden eagle	*Aquila chrysaetos*	X	X		X
Bald eagle	*Haliaeetus leucocephalus*		X		X
Osprey	*Pandion haliaetus*		X		X
Owls					
Great-horned owl	*Bubo virginianus*	X	X	X	X
Barred owl	*Strix varia*	X	X	X	X
Eastern screech-owl	*Megascops asio*	X	X	X	X
Long-eared owl	*Asio otus*	X	X		X
Northern saw-whet owl	*Aegolius acadicus*		X	X	X
Barn owl	*Tyto alba*	X	X	X	X
Vultures					
Black vulture	*Coragyps atratus*		X	X	X
Turkey vulture	*Cathartes atratus*		X	X	X

Potential Migrant Raptors

Two geographical features primarily used by raptors during migration are ridgelines and shorelines of large bodies of water. Updrafts formed as the wind hits the ridges, and thermals created over land and not water make for energy-efficient travel over long distances (Liguori 2005). In addition to mountain ridges, rivers and associated riparian areas, which often attract and concentrate large numbers of potential prey for migrants, may also be used as travel corridors or stopover locations (Bildstein, 2006).

There are three well-established bird banding and/or raptor migration observatories within 100 miles of the study area. The Allegheny Front Migration Observatory (AFMO) located within the

Dolly Sods Wilderness Area located approximately 93 miles north of the study area has a yearly banding station and flyover count. The AFMO was established in 1958 and annually gathers data from August to October. The Hanging Rock Migration Observatory (HRMO) is located on Peters Mountain 40 miles south/south-east of the study area. The HRMO has collected yearly fall raptor migration counts since 1952. Three Rivers Migration Observatory (TRMO) is located approximately 43 miles to the southwest of the study area. Mist-netting and banding data have been collected annually at TRMO since 1995. The TRMO mist-netting site is in the Allegheny Plateau at elevations of 2400-2600 ft. (~750-812 m) containing old fields, upland mixed deciduous forest and areas with clear-cuts (Canterbury 2006). Results of surveys from these bird migration observatories (Appendix D) provide information on species composition most likely to be present in the study area during migration seasons (Table 2.1).

There have been several survey efforts within the study area that have included or focused on avian migration:

- Avian surveys were conducted for the original Beech Ridge Project Area prior to construction in 2005 (Canterbury 2006);
- Raptor migration surveys were conducted for BRWEP post-construction in the spring and fall of 2011 to fulfill PSC requirements (Young et al. 2012a);
- Raptor Migration and Avian Use surveys were conducted pre-construction for the proposed Beech Ridge expansion area during spring and fall 2011 (Young et al. 2012b).

Results of these studies documented the following raptor species, including vultures and owls, within either the existing BRWEP or the expansion area: turkey vulture; black vulture; osprey; bald eagle; golden eagle; northern harrier; sharp-shinned hawk; cooper's hawk; red-shouldered hawk, broad-winged hawk, red-tailed hawk, American kestrel, merlin, eastern screech owl, northern saw-whet owl, and barred owl.

Radio telemetry studies, monitoring golden eagle and bald eagle conducted by the National Aviary Conservation and Field Research Project (NACFRP 2010), show that both species have been tracked into West Virginia and provide confirmation that eagles from more northern latitudes are likely to migrate through and potentially spend the winter throughout the region and potentially within the study area. For example, a map showing movement patterns of golden eagle during the winter of 2010 indicates that at least three tagged individuals have been observed moving as far south as southern West Virginia, eastern Kentucky, and western North Carolina (Figure 2.1).

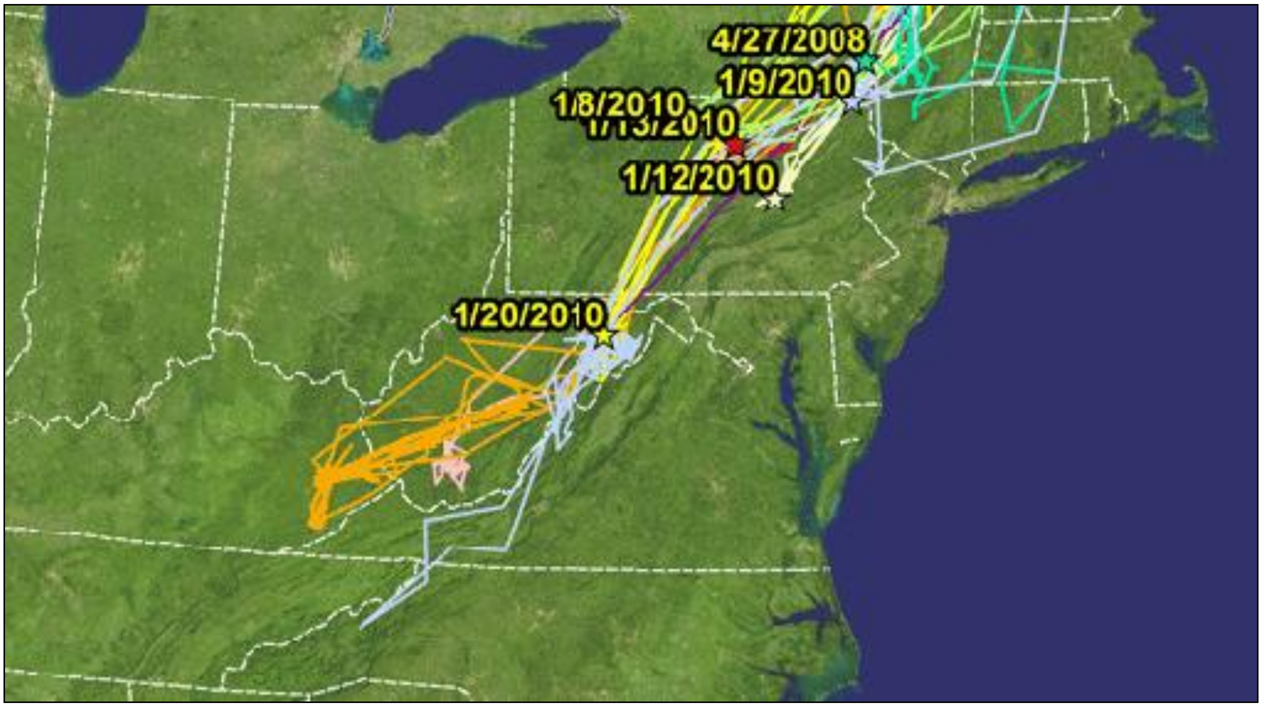

Figure 2.1 National Aviary golden eagle radio telemetry summary map, 2010

The size of the eastern North American population of golden eagles is believed to be small and many of the golden eagles migrating and wintering within areas of the Central Appalachians are summer breeding residents of Canada. This species, like other raptors, commonly uses slope soaring and ridge updrafts during migration and foraging (Barrios & Rodriguez 2004; Hoover & Morrison 2005). Available monitoring data and modeling suggest that eastern golden eagles migrate through a narrow corridor in south-central Pennsylvania (particularly during spring; Brandes & Ombalski 2004), and likely extends southward through Maryland into West Virginia.

Potential Breeding Raptors

The study area is made up of large tracts of deciduous forest. Based on this habitat type, forest-dwelling species such as accipiters and some buteos (e.g., broad-winged hawk, red-shouldered hawk), and a variety of owls are likely to nest within the study area. Grassland and scrub/shrub areas are less common in the study area, but may provide nesting habitat for species such as northern harrier. Observations during the field visit on March 12, 2011, indicate that the overall nesting potential for raptors is likely low due to clear-cutting. There was one active red-shouldered hawk territorial display observed within the Project Area (Appendix A). A nest was not recorded but an adult was observed defending territory and showing early breeding season display behavior. During spring 2005, a raptor study using broadcasting techniques was conducted to determine potential nesting raptors within the Beech Ridge Project Area (Canterbury 2006). The study results confirmed nesting of Cooper's hawk, broad-winged hawk and eastern screech owl. Red-shouldered hawk, red-tailed hawk, northern harrier and

American kestrel also responded to broadcast calls; however nesting sites were not observed (Canterbury 2006). These species are considered possible breeders in the area.

The West Virginia Breeding Bird Atlas (WVBBA) has two databases available online; one published for 1984-89 and one in progress for 2009-14. Within Greenbrier and Nicholas Counties, West Virginia, there are confirmed breeding records in the 2009-14 WVBBA for: red-shouldered hawk, red-tailed hawk, American kestrel, barn owl, and barred owl. Other raptor, vulture, and owl species with probable or possible breeding records in Greenbrier and Nicholas Counties include: black vulture; turkey vulture, bald eagle, osprey, northern harrier, eastern screech owl, and great horned owl. Results from the USGS Breeding Bird Survey routes closest to the study area, Richwood and Smoot routes, confirm the above listed raptors as having the greatest potential nest in the study area.

Raptor Prey Availability

Some studies indicate that raptor mortality at wind-energy facilities (for example, Altamont Pass, California) may be in part due to habitat conditions such as prey availability and behavioral differences between species, influencing the susceptibility of some species for collision with turbines. Orloff and Flannery (1992, 1996) suggested that high golden eagle mortality at Altamont Pass was in part due to the apparently high densities of ground squirrels (*Spermophilus beecheyi*) in the area (Thelander and Smallwood 2007). Continued research at the site revealed that the degree of aggregation of pocket gopher (*Thomomy bottae*) burrows around the turbines was positively correlated to red-tailed hawk fatality rates (Smallwood et al. 2001, Thelander et al. 2003, Thelander and Smallwood 2007). In addition, features providing cover for cottontails (*Sylvilagus audubони*) appeared to be associated with areas where golden eagles were killed.

Types of prey species present within the study area are likely to be rodent species associated with woodlands, edge habitat, and clear cuts, such as mice and voles, and species associated with deciduous forests, such as squirrel and chipmunk species. During the field visit the presence of cottontail rabbit (*Sylvilagus transitionalis)* was recorded (Appendix A). Songbirds and other small birds are also prey for a number of raptor species and occur throughout the study area. While the Project Area provides suitable habitat for a variety of raptor prey species, based on the vegetation type and habitat characteristics, the Project Area is similar to the surrounding Evaluation Area and overall prey densities within the Project Area are not expected to be above average relative to the surrounding Evaluation Area. Therefore, it is not expected that the Project Area would attract or concentrate raptor use above surrounding areas.

In general, impacts to raptors from wind projects have been low based on results from monitoring studies in the Appalachian Mountains. For example, at the Mount Storm wind project a total of 3 red-tailed hawks, 2 sharp-shinned hawks, 1 broad-winged hawk, and 21 turkey vulture fatalities have been observed during 12,252 turbine searches over a four year period (Young et al. 2009a, 2009b, 2010a, 2010b, 2011a, 2011b, 2012). Similarly at the Mountaineer Wind Project one red-tailed hawk, one sharp-shinned hawk, and three turkey vulture fatalities were observed over a two year period (Kerns and Kerlinger 2004, Arnett et al.

2005), and no hawks or vulture fatalities were observed at the Myersdale or Casselman wind project during monitoring studies within a one year period (Arnett et al. 2005; Arnett et al 2009). Mumma and Capouillez (2011) summarized 11 monitoring studies for nine wind projects in Pennsylvania and report that from 0-2 raptors were found at all sites, and raptors and vultures combined (Accipitriformes) comprised only 2% of avian fatalities found during turbine searches. Potential raptor mortality at the proposed expansion of the BRWEP is not expected to be different that results from these other wind projects within the Appalachian Mountain region.

2.2 Migratory Birds

Avian migration studies conducted in 2005 at the existing BRWEP recorded 100 species during the spring study and 121 species during the fall (Canterbury 2006). Avian Use and Raptor Migration surveys conducted in 2011 within the proposed Project Area recorded 83 avian species during the spring study and 70 species during the fall (Young et al. 2012).

Many species of songbirds migrate at night and collision related impacts with tall man-made structures have been documented. It is generally believed that nocturnal migrating passerines move in broad front patterns rather than along specific topographical or physiographic features (Gauthreaux et al. 2003, NRC 2007). Large numbers of songbirds have collided with lighted communication towers and buildings when foggy conditions and spring or fall migration coincide. Birds appear to become confused by the lights during foggy or low ceiling conditions, flying circles around lighted structures until they become exhausted or collide with the structure (Erickson et al. 2001). Large mortality events observed at communication towers are often attributed to the guy wires on these structures, and the height of the structure, often greater than 500 feet (~150 m) in height (Erickson et al. 2001), likely because most birds migrate at elevations of 885 feet (~270 m) or higher (Young et al. 2004).

There have been large mortality events reported at wind projects, however, the causes of these have apparently been due to lights and not simply collisions with the turbines. For example, in October 2011, 475 passerines, 4 cuckoos, 2 rails, 1 heron, 1 grebe, and 1 grouse fatalities were recovered at the Laurel Mountain wind project substation over a 15 day period, which were apparently collision related fatalities (Stantec 2011). The substation was lit during the night with high-pressure sodium lamps. In May 23, 2003, 27 songbird fatalities were recovered at the Mountaineer wind project substation and an adjacent turbine (Kerns and Kerlinger 2004). As with the Laurel Mountain incident, sodium vapor lights at the substation and foggy weather during migration season were the apparent causal factors in the incident.

Marine radar surveys conducted at many sites proposed for wind power development help to assess the risk of wind turbines to nocturnal migrants (see Young and Erickson 2006). The range of spring mean passage rates across sites in the northeast was 110 to 409 targets per kilometer per hour (targets/km/hr) with a mean of 281 targets/km/hr. For the fall, the range was from 170 to 380 with a mean of 202 targets/km/hr. For studies in the northeast where target altitude was calculated using a vertical sampling method, the mean altitude of targets was approximately 1341 ft (~409 m) above ground level in the spring and approximately 1463 ft

(~446 m) in the fall. Because mean flight height is higher than turbine height, nocturnal migrant birds may be at greater risk of turbine collision when ascending and descending from stopover habitats or when weather conditions results in lower altitude flights.

The primary habitat type of the study area, deciduous forest, is likely used by forest-dwelling species as foraging or stopover habitat during migration. Other minor habitat types in the study area, such as clear-cuts, grass/shrubland, and wetland may also be used, but due to low relative abundance of these habitats (see Table 1.1), they are not expected to concentrate large numbers of shrubland and wetland dwelling species during migration. While migrant birds will fly over the study area and utilize habitat within the Project Area during migration, the habitat types within the Project Area are similar and available throughout the surrounding Evaluation Area; therefore, the Project Area itself is unlikely to have greater attraction for migrant birds than surrounding areas.

2.3 Breeding Birds

Songbirds (order Passeriformes) are the most abundant bird group in terrestrial ecosystems and are the most often reported as fatalities at wind power facilities (NRC 2007). There are numerous bird species potentially breeding in the study area, most of which are common and have large ranges. The proposed expansion of the BRWEP could impact breeding birds; however, in general, impacts are expected to be similar to other wind projects in the Appalachian Region and are not expected to be significant due to the impacts being spread over numerous species with large populations. As part of the USFWS mandate to protect and conserve trust resources, the USFWS developed a list of Birds of Conservation Concern (BCC) which are those species thought to be vulnerable to population declines, and without additional conservation actions are likely to become candidates for listing under the Endangered Species Act. These are the species thought to be at greatest risk from development, including wind power development. The breeding bird assessment focuses on the potential for the expansion of the BRWEP to impact these species, which could be the most vulnerable to population impacts.

There are 25 species listed as birds of conservation concern within the Appalachian Mountains Bird Conservation Region 28 (Table 2.2; USFWS 2008). These species have been identified as vulnerable to population declines in the region by the USFWS (2008), but do not currently receive special protection above the Migratory Bird Treaty Act and, for bald eagles, the Bald and Golden Eagle Protection Act.

Table 2.2 List of Birds of Conservation Concern in the Appalachian Mountain Region and species records from various data sources.

Common Name	Scientific Name	Site Surveys[1]	USGS BBS[2]	WV BBA[3]
Bald eagle	*Haliaeetus leucocephalus*	X		X
Peregrine falcon	*Falco peregrinus*			
Upland sandpiper	*Bartramia longicauda*			
Northern saw-whet owl (S)	*Aegolius acadicus*	X		
Whip-poor-will	*Caprimulgus vociferus*	X		X
Red-headed woodpecker	*Melanerpes erythrocephalus*	X		X
Yellow-bellied sapsucker (S)	*Sphyrapicus varius*	X		
Olive-sided flycatcher	*Contopus cooperi*		X	
Loggerhead shrike	*Lanius ludovicianus*			X
Black-capped chickadee (S)	*Poecile atricapilla*	X	X	X
Bewick’s wren	*Thryomanes bewickii*			
Sedge wren (nb)	*Cistothorus platensis*			
Wood thrush	*Hylocichla mustelina*	X	X	X
Blue-winged warbler	*Vermivora pinus*	X	X	X
Golden-winged warbler	*Vermivora chrysoptera*	X	X	X
Prairie warbler	*Dendroica discolor*	X	X	X
Cerulean warbler	*Dendroica cerulean*	X	X	X
Worm-eating warbler	*Helmitheros vermivora*	X	X	X
Swainson’s warbler	*Limnothlypis swainsonii*			
Louisiana waterthrush	*Seiurus motacilla*		X	X
Kentucky warbler	*Oporornis formosus*	X	X	X
Canada warbler	*Wilsonia canadensis*	X	X	X
Henslow's sparrow	*Ammodramus henslowii*			
Rusty blackbird (nb)	*Euphagus carolinus*			
Red crossbill (S)	*Loxia curvirostra*			

Source: USFWS 2008 BCC 2008 list; (S) = Southern Appalachian population; . (nb) = non-breeding in the BCR
[1]Canterbury 2006; Young et al. 2012
[2]Richwood and Smoot BBS routes
[3]Greenbriar and Nicholas Counties

Several sources of available data were used to address the potential for these species to occur in the study area during the breeding season including the site specific surveys, the USGS Breeding Bird Survey (BBS), and the West Virginia Breeding Bird Atlas (BBA). Based on these sources, 17 of the 25 BCC for the Appalachian Region have been recorded in the study area or nearby (Table 2.2). The most applicable data are likely those from the site specific surveys which recorded 14 of the BCC; however, at least one of those species bald eagle is not considered a potential breeding resident due to habitat (Canterbury 2006).

The closest BBS routes to the study area are the Richwood and Smoot Routes (Figure 2.3). Richwood Route lies just north-east of the study area and passes approximately 2.5 miles outside the western edge of the Evaluation Area, running north to south. Smoot Route runs due south with the northernmost and closest portion located approximately 7 miles to the southwest of the Evaluation Area. These routes have been monitored in most years between 1980 and 2010. One-hundred and four (104) species of birds have been observed along the Richwood Route, and 100 species have been observed along the Smoot Route. Information gathered from the surveys along these routes is considered applicable as an indication of species that may utilize the study area during the spring and summer breeding season and the potential presence of the BCC because these routes are located within a few miles of the study area (USGS 2001).

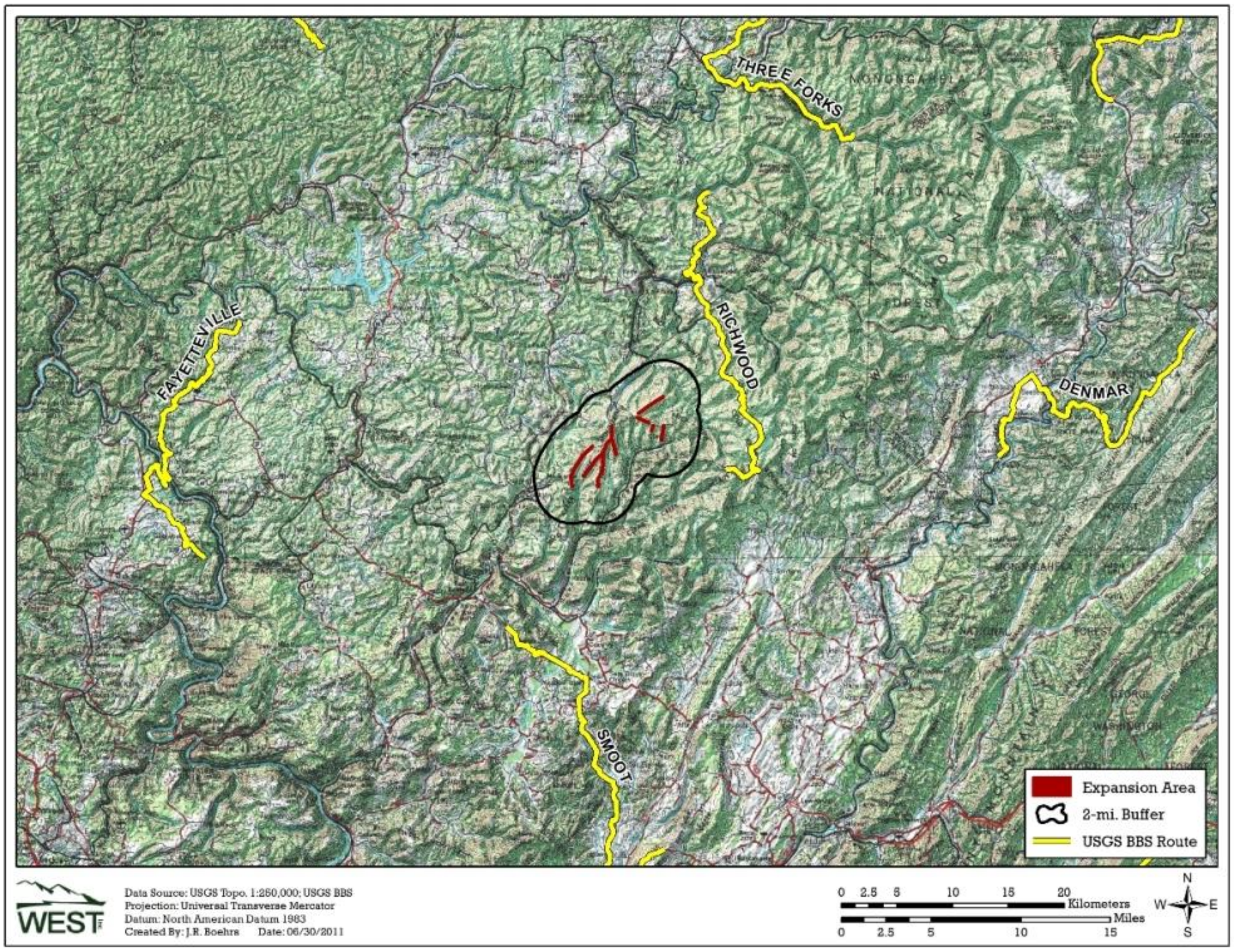

Figure 2.2 USGS Breeding Bird Survey Routes near the study area.

The West Virginia BBA has two databases available online; one published for 1984-89 and one unpublished BBA (2009-14), which is in progress. There are breeding records within the West Virginian BBA for 14 species listed as BCC within Greenbrier and Nicholas Counties, West Virginia (Table 2.2; WVBBA 2011). There are confirmed breeding records as reported in the BBA for: red-headed woodpecker, loggerhead shrike, wood thrush, black-capped chickadee, blue-winged warbler, golden-winged warbler, Kentucky warbler, worm-eating warbler, Louisiana waterthrush, and Canada warbler. Other BCC-listed species with probable or possible breeding records in Greenbrier and Nicholas Counties as reported in the BBA include: whip-poor-will, prairie warbler, cerulean warbler; and bald eagle.

One of the most prevalent concerns with wind projects is the potential for direct impacts (mortality) of migratory birds through collisions with turbines. In general, impacts to birds from regional wind projects have been in the range of approximately 4-8 birds per turbine per study period[1] (Table 2.3). Impacts to birds in general, which would include birds migrating through the project and summer breeding residents at the BRWEP expansion area are not expected to be different than impacts at the other regional projects and will likely fall in the range of 4-8 birds per turbine per year. This level of impact would not be significant given that these impacts are typically spread over many species with large geographic ranges and large populations.

Table 2.3 Summary of bird casualties from post-construction fatality monitoring studies conducted at wind-energy facilities in the vicinity of the Project.

Project Name, State	Project size (No. of Turbines)	No. of Turbine Searches	Estimated # birds/turbine/ study period[1]	90% CI	Study Year(s)	Reference
Mountaineer, WV	44	998	4.04	2.41, 8.33	2003	Kerns & Kerlinger 2004
Buffalo Mtn, TN	3	nr	7.28	1.20, 13.34	2001-03	Nicholson et al. 2005
Buffalo Mtn, TN	18	720	1.80	nr	2005	Fiedler *et al.* 2007
Casselman, PA	23	2,040	4.69	1.25, 14.31[2]	2008	Arnett *et al.* 2009
Casselman, PA	23	nr	4.30	2.7, 6.4[2]	2009	Capouillez and Mumma 2010
Mt Storm, WV	132	2,520	8.74[3]	5.12, 12.77	2009	Young *et al*. 2009b, 2010a
Mt Storm, WV	132	4,401	6.74[3]	3.92, 10.03	2010	Young *et al.* 2010b, 2011a
Mt Storm, WV	132	3,794	8.04[3]	6.59, 12.36	2011	Young *et al*. 2011b, 2012
Average			5.70			

nr = not reported
[1]study period is approximately the period from April through October or November, [2]estimated based on the reported as 95% CI. ; [3]estimate was derived by combining the results from two non-overlapping study periods (spring and fall) which used the same study plots

While some BCC are likely to be at risk from the proposed development based on their documented occurrence in the study area, impacts are not expected to be significant at a population scale. For example, at the Mount Storm wind project, where 12,252 turbine searches have been conducted over a four-year period, seven wood thrush, three Canada warbler, two Kentucky warbler, two yellow-bellied sapsucker, one blue-winged warbler, and one whip-poor-will fatalities have been reported (Young et al. 2009a, 2009b, 2010a, 2010b, 2011a, 2011b, 2012). Based on the date of the find for many of these fatalities, they were likely migrants through the area and may not have been breeding residents in the Appalachian Mountain BCR. At other monitored wind projects in the BCR, three wood thrush and one Canada warbler fatalities were reported for the Mountaineer project (Kerns and Kerlinger 2004), one yellow-

[1] Most regional monitoring studies have occurred from April to October or November which generally covers the primary spring and fall migration periods and the summer breeding season. These studies do not account for potential winter mortality which in general is expected to be lower due to lower density of birds on the landscape during the winter season.

bellied sapsucker was reported for the Casselman project (Arnett et al. 2009), and one cerulean warbler fatality was reported for the Buffalo Mountain Project (Fiedler et al. 2007). Overall the very low fatality rates observed at these projects for BCC, are not likely to have an impact on the BCR population of these species.

The presence of wind turbines may alter the landscape so that wildlife habitat use patterns are altered, thereby displacing wildlife away from project facilities. Typically the greatest concern with displacement impacts for wind energy projects has been in grasslands and other prairie habitats where tall structures create contrast with normal conditions. The proposed study area is situated in a predominantly forested area where there are a number of woodland breeding birds, some of conservation concern. There is similar habitat in the surrounding area and the area is actively managed for timber production. While there is the potential for the project to displace woodland species where forested areas are converted to open space, the abundance of forested habitat in the area will continue to provide habitat for woodland species.

3.0 BAT RESOURCES

3.1 Bat Species

Fourteen bat species have been documented in West Virginia (Table 1.7; see also www.batcon.org, WVDNR 2010). Ten species are believed to have the potential to occur within the study area as year-round residents or during certain seasons: big brown bat, eastern red bat, hoary bat, Seminole bat, silver-haired bat, tri-colored bat, eastern small-footed myotis, Indiana bat*,* little brown bat, and northern myotis (Table 1.7). Evening bat, Virginia big-eared bat, gray bat, and Rafinesque's big-eared bat are not expected to occur in the project area due to the species ranges in West Virginia (Table 1.7)

Mist-net surveys for bats were conducted in 2005 and 2006 in what was the proposed Beech Ridge Project Area from July 22-26, 2005 and along the proposed transmission line right-of-way from June 12-22, 2006 (BHE 2005, 2006). Both areas where mist-net surveys were conducted are within the current study area for the proposed BRWEP expansion. Results from both surveys combined (both 2005 and 2006) found little brown bats (n=18; 27.3%); big brown bats (n=9; 13.6%); red bats (n=5; 7.6%); tri-colored bat (n=16; 24.2%); and northern long-eared bats (n=16; 24.2%). Additional mist net surveys were conducted in 2010 within the existing BRWEP and the proposed expansion area to document species composition and survey for the presence of the Indiana bat and Virginia big-eared bat (Table 1.8; Young and Gruver 2011). Mist netting surveys occurred during the summer and again in the fall in 2010 (Table 1.8). No Indiana bats or Virginia big-eared bats were captured during any mist-netting surveys conducted at either the existing or proposed Project Areas (see BHE 2005 and 2006; Young and Gruver 2011).

Table 3.1. Bat species recorded in West Virginia.

Species	Description
†Big brown bat *Eptesicus fuscus*	Sedentary. A fairly common generalist species that forms maternity colonies beneath loose tree bark in forests and woodlands, or in buildings, barns and bridges. Uses a variety of habitats including woodlands, riparian areas, and open farmlands. May forage over meadows and trees in pastures or along streams. Hibernates in caves, mines, houses, hollow trees, and rock crevices. Documented throughout West Virginia and a year-round resident. Have been captured during mist-netting in the study area.
†Eastern red bat *Lasiurus borealis*	Long distance migrant. Solitary tree bat. Roosts in the foliage of deciduous or evergreen trees. Generally uses woodland habitats. Forages along forest edge, flood plain timber, fence rows, and other wooded habitats. Documented throughout West Virginia. Expected presence during summer and migration periods. Have been captured during mist-netting in the study area.
†Eastern small-footed myotis *Myotis leibii*	Regional migrant. Generally found in remote, heavily forested mountain regions up to 2000 ft. Hibernates in caves usually in cracks and crevices. Summer roost areas usually associated with rocky outcrops and talus slopes in mountainous areas. Documented in the mountainous regions of WV including Greenbrier and Nicholas Counties and a year round resident. Have been captured during mist-netting in the study area.
Evening bat *Nycticeius humeralis*	Regional migrant: A forest bat that roosts primarily in trees and is almost never encountered in caves. Maternity colonies are in hollow trees, behind loose bark, and sometimes in buildings and attics. Records of the species in the WV are isolated and rare. Very little to no potential to occur in the Project Area.
†Hoary bat *Lasiurus cinereus (cinereus)*	Long distance migrant. Solitary tree bat. Roost in trees along forest borders and edges of forest clearings. Typically forages over water and forest openings such as grassy meadows. Documented throughout West Virginia. Expected presence during summer and migration periods. Have been captured during mist-netting in the study area.
†Indiana bat *Myotis sodalis*	Regional migrant. Forms maternity colonies and roosts during summer under loose bark or in hollow trees in summer. Hibernates in caves or mines in dense clusters. Generally feeds in wooded habitats. Documented throughout WV year-round. Known winter hibernacula in Greenbrier County. Have not been captured during mist-netting in the study area.
†Little brown myotis *Myotis lucifugus (lucifugus)*	Regional migrant. Forms maternity colonies and roosts during summer under loose bark, in buildings, attics, and other man-made structures. Uses a variety of habitats. Hibernates in caves or mines communally in clusters. Forages around trees and in open areas around water. Documented throughout WV year-round. Have been captured during mist-netting in the study area.
†Northern long-eared myotis *Myotis septentrionalis*	Regional migrant. Summer roosts and maternity colonies are typically in trees but have also been found in manmade structures. Typically forages on in wooded areas such as forested hillsides and ridges. Hibernates in caves and mines. Documented throughout WV year-round. Have been captured during mist-netting in the study area.
†Silver-haired bat *Lasionycteris noctivagans*	Long distance migrant. Solitary tree-roosting bat. Forms small maternity colonies in tree cavities, crevices, and small hollows. Roosts and hibernates beneath lose bark, in snags and in manmade structures. Generally forages in forested areas near streams and lakes. Documented throughout West Virginia,

	Expected presence primarily migration periods but may be uncommon summer resident.
†Seminole bat *Lasiurus seminolus*	Long distance migrant. Solitary tree bat. Roosts in the foliage of deciduous or evergreen trees and generally uses woodland habitats or mixed forested and open areas. Forages along forest edges, flood plain timber and fence rows. A single individual was captured in Pendleton County and also documented in Grant County at the Mt. Storm wind project. Generally considered very rare or accidental in West Virginia. Little potential to occur in the Project Area during migration.
†Tri-colored bat *Perimyotis subflavus*	Regional migrant. Roosts in tree foliage or in tree crevices. Generally prefers edge habitats adjacent to agricultural settings near water. Hibernates in caves or mines. In summer, roosts in foliage, cliff crevices or manmade structures. Documented throughout West Virginia year-round. Have been captured during mist-netting in the study area.
†Virginia big-eared bat *Corynorhinus townsendii virginianus*	Sedentary. Forms maternity colonies in mines, caves and buildings. Hibernates in caves and mines. Maternity caves are rarely found greater than 20 miles from winter caves. Forages over a variety of habitats including forested areas around occupied caves or mines. Usually inhabits caves mostly in oak-hickory forest. Recorded year-round in West Virginia. No records for Nicholas or Greenbrier Counties. Little to no potential to occur in the Project Area.
Gray bat *Myotis grisescens*	Regional migrant: Cave-dwelling bat. Summer colonies may occupy a home range that contains several roosting caves scattered along rivers or lakes. Wintering caves are typically deep vertical caves and maybe hundreds of kilometres from summer range. Rare and typically found in the south-western portions of West Virginia. Little to no potential to occur in the Project Area.
Rafinesque's big-eared bat *Corynorhinus rafinesquii*	Regional migrant. Typically forms maternity colonies in hollow trees but have also been found in old buildings and attics. Typically forages near or over water. Hibernates in caves and mines. The species range most closely approximates the historical range of great cypress swamps. Rare and found in very western portion of West Virginia. Little to no potential to occur in the Project area.

†Potential to occur in the study area.

Table 3.2. Summary of bat captures during the summer and fall season mist-net surveys conducted within the BRWEP and expansion areas, 2010.

Species	Summer 2010		Fall 2010	
	n	%	n	%
Little brown bat	51	24.4	14	12.1
Northern long-eared bat	37	17.7	22	19.0
Eastern small-footed bat	12	5.7	11	9.5
Big brown bat	20	9.6	2	1.7
Tri-colored bat	14	6.7	4	3.4
Red bat	74	35.4	53	45.7
Hoary bat	1	0.5	3	2.6
Silver-haired bat	-	-	7	6.0

Acoustic surveys for bats using AnaBat bat detectors were also conducted in 2010 (Young and Gruver 2011). The acoustic surveys were intended to provide information on the seasonal timing and magnitude of bat activity in the study area during the summer maternity and fall migration seasons; and supplement the species composition information from the mist net surveys, to the extent possible. Results for similar species composition as the mist-netting results, with only two exceptions; no hoary bat calls were identified, but eight bat calls were identified as potential Indiana bat calls by two or more quantitative analysis techniques . The potential Indiana bat calls were recorded on July 28, 29, 30 and Aug 5, 2010 (Young and Gruver 2011).

Results of the 2010 acoustic data analysis suggest that Indiana bats were possibly recorded in the study area but in very low numbers. Given the very low number of potentially recorded calls relative to the overall number of recorded calls (6 out of 12,431, or 0.04%), and the fact that acoustic analyses do not provide 100% positive identifications, it is possible that no Indiana bats were actually recorded during the acoustic survey (i.e., detections were false positives). Furthermore, none of the potential Indiana bat calls (selected by two or more screens) were recorded at the two detectors mounted on turbine nacelles; all were recorded at ground level where fatalities with operating rotors would not occur (Beech Ridge Energy , LLC, 2011).

Bat fatalities at wind-energy facilities were first noted during avian surveys in the early 1990s (Orloff & Flannery 1992); however, reports of high numbers of bat fatalities at sites in West Virginia (Kerns & Kerlinger 2004) and Tennessee (Fiedler 2004) elevated concern over potential impacts. The Bats and Wind Energy Cooperative (BWEC) was established in 2005 to determine the extent of bat mortality at wind power facilities and to seek solutions to the problem (Arnett 2007). In 2007, the National Research Council published the findings of the

Committee on Environmental Impacts of Wind Energy Projects whose task was to provide a comprehensive review of scientific literature pertaining to the effects of wind power facilities on the local environment (NRC 2007). Though some wind power facilities have high numbers of bat fatalities there is substantial variation in impacts across regions of the country (Arnett 2008).

Migratory tree bats, such as hoary bat, eastern red bat, and silver-haired bat, comprise most of the bats killed at wind-energy facilities in North America with the majority of collisions occurring in the months of August and September, commonly thought of as the fall migration season for bats (Gruver 2002, Johnson et al. 2003, Arnett et al. 2008). The reason for disproportionate mortalities during this period are unknown; however it may be that behavior of tree bats during the fall puts them at greater risk or they may fly at lower altitudes or behave differently during spring migration than during fall migration. For example, hoary bats fly 1-5 m from the ground while migrating through New Mexico in the spring, but apparently not in the fall (Cryan & Veilleux 2007). In contrast, a hoary bat collided with an aircraft above Oklahoma at an altitude of 2,438 m in October (Peurach 2003).

At least nineteen bat species have been recovered incidentally or during carcass searches at wind-energy facilities throughout the U.S. (Table 3.3; see also Johnson 2005; Kunz et al. 2007; NRC 2007; Arnett et al. 2008; WEST 2011).

Table 3.3 Species composition of bat fatalities from wind-energy facilities in the U.S. based on publicly available data from monitoring studies throughout North America through 2011.

Common Name	Scientific Name	Total Number of Fatalities	Total Percent of Total
†hoary bat	*Lasiurus cinereus*	3,270	39.8
†silver-haired bat	*Lasionycteris noctivagans*	1,659	20.2
†eastern red bat	*Lasiurus borealis*	1,296	15.8
†little brown bat	*Myotis lucifugus*	646	7.9
†big brown bat	*Eptesicus fuscus*	365	4.4
Mexican free-tailed bat	*Tadarida brasiliensis*	325	4.0
†tricolored bat	*Perimyotis subflavus*	325	4.0
unidentified bat		237	2.9
unidentified myotis	*Myotis sp.*	42	0.5
†northern long-eared bat	*Myotis septentrionalis*	12	0.1
western red bat	*Lasiurus blossevillii*	7	0.1
western yellow bat	*Lasiurus xanthinus*	6	0.1
†Seminole bat	*Lasiurus seminolus*	4	<0.1
pocketed free-tailed bat	*Nyctinomops femorosacca*	3	<0.1
†Indiana bat	*Myotis sodalis*	3	<0.1
†eastern small-footed bat	*Myotis leibii*	2	<0.1
big free-tailed bat	*Nyctinomops macrotis*	2	<0.1
unidentified free-tailed bat		2	<0.1
cave myotis	*Myotis velifer*	1	<0.1
canyon bat	*Pipistrellus hesperus*	1	<0.1
long-legged bat	*Myotis volans*	1	<0.1
long-eared bat	*Myotis evotis*	1	<0.1
Total	**19 species**	**8,208**	**100**

†Potential to occur in the study area

Due to the current lack of understanding of bat populations in North America, the species and relative abundance of bats occurring within the study area are difficult to determine. Seasonal movements of bats vary widely. Based on categories described by Fleming and Eby (2005) species can be divided into three movement categories. (1) Sedentary species breed and hibernate in the same local areas usually moving < 50 km (30 mi) between summer and winter roosts; (2) Regional migrants migrate moderate distances (~ 100 to 500 km, 60 to 310 mi); and (3) Long-distance migrants have highly developed migratory behavior sometimes travelling > 1,000 km (620 mi) between summer and winter roosts.

3.3 Bat Hibernacula

There are no known caves or hibernacula in the study area. In June 2006, a Chiropteran Risk Assessment was conducted for the BRWEP and included results of cave surveys conducted near the existing BRWEP (BHE 2006). The study focused on caves within five miles of turbine locations formerly proposed for the BRWEP. Given the proposed expansion area is adjacent to the existing facility (see Figure 1.1); the results of the study are directly relevant to assessing presence of potential hibernacula near the BRWEP expansion area. A summary of results from the BHE cave study (2006) identified 140 known caves within five miles of the then proposed turbines at BRWEP. The majority (115 caves) were deemed unsuitable for winter habitat for bats due to cave size and the expected air temperatures in these smaller caves. Twenty-four caves were field evaluated. Of these, 12 were found to be unsuitable because entrances to these caves were blocked, or the caves exhibited evidence of flooding to the ceiling. The 12 remaining caves were surveyed for bats in March 2012 and data collected included number and species of bats present, characteristics of the cave entrance, floor and ceiling temperatures, nature of air flow, and amount of water within the cave.

Of the 12 caves surveyed, Portal Cave, Bransford's Cave and Bob Gee Cave contained the greatest number of bats (n=637, 224 and 206, respectively). Seven caves contained 50 or fewer bats and no bats were found in two of the 12 caves. No Indiana bats, Virginia big-eared bats, or other federally-listed or otherwise rare or uncommon species were identified in any of the 12 caves surveyed. Four bat species were observed (in descending order of occurrence): tri-colored bat (n=566), little brown bat (n=490), big brown bat (n=86), and northern long-eared bat (n=3).

Hellhole Cave, which is a regionally significant bat hibernaculum, is located within Pendleton County, approximately 75 miles to the northeast of the study area. This cave is one of the largest hibernation sites in the Appalachian Mountain Recovery Unit for Indiana bat and Virginia big-eared bat. In addition, the cave is one of the world's three or four largest hibernation sites for little brown bat, estimated at holding over 100,000 bats during the winter hibernation season. The cave is also used as a hibernaculum for several other bat species including big brown bat, eastern small-footed bat, northern myotis, and tri-colored bat.

In general, impacts to bats from the expansion of the BRWEP are expected to be similar to the regional average (Table 3.4) in the absence of minimization measures. Hoary bat and red bat are expected to be the two most commonly impacted species (Table 3.5). However, BRE is developing a Habitat Conservation Plan in consultation with the USFWS that includes turbine operational constraints during the period when impacts to bats are greatest, July 15 to October 15. These measures are expected to reduce impacts to bats by 44-93%, based on the best available science.

Table 3.4 Summary of Bat Mortality Reported from Wind Project Monitoring Studies in the Eastern U.S.

Project Name, State	No. of Turbines	Estimated No. Bats/ Turbine/yr	95% Confidence Interval	Study Period	Reference
Buffalo Mountain, TN	3	20.8	19.5-22.1[4]	9/29/00-9/30/03	Fiedler 2004
Buffalo Mountain, TN	18	63.9	nr	4/12/05	Fiedler et al. 2007
Mountaineer, WV	44	47.5	31.8-91.6[4]	4/4/03-11/22/03	Kerns and Kerlinger 2004
Mountaineer, WV	44	37.7[1]	31.2-45.1[4]	8/2/04-9/13/04	Arnett et al. 2005
Myersdale, PA	20	25.1[1]	20.1-32.7[4]	8/2/04-9/13/04	Arnett et al. 2005
Maple Ridge, NY	120	24.5	14.3-34.7	6/17/06-11/15/06	Jain et al. 2007
Maple Ridge, NY	195	15.5	14.1-17.0	4/30/07-11/14/07	Jain et al. 2008
Maple Ridge, NY	195	8.2	7.4-9.0	4/05/08-11/9/08	Jain et al. 2009
Pennsylvania, PA	10	30.1	28.1-33.4[5]	2007	Capouillez and Librandi-Mumma 2008
Casselman, PA	23	32.2	20.8-51.4	7/26/08-10/10/08	Arnett et al. 2009a
Mount Storm, WV	82	24.2[2]	17.1-33.1	7/18/08-10/17/08	Young et al. 2009a
Mount Storm, WV	132	28.6[3]	18.7-40.5	3/23/09-6/14/09 & 7/16/09-10/8/09	Young et al. 2009b, 2010a
Average		29.9			

[1] estimate for the 6-week study period
[2] estimate for the 12-week study period
[3] estimate based on combination of spring and fall results
[4] reported as 90% CI
[5] reported as 99% CI
nr = not reported by authors

Table 3.5 Bat Fatalities Species Composition Found at Wind Project Monitoring Studies in the Eastern U.S.

Species	Project Number (Percentage)			
	Buffalo Mountain	Mountaineer	Mount Storm	Myersdale
Hoary Bat	44 (12.1)	244 (25.9)	305 (32.6)	138(46.2)
Red Bat	222 (61.2)	312 (33.2)	327 (34.9)	82 (27.4)
Silver-haired Bat	20 (5.5)	52 (5.5)	107 (11.4)	18 (6.0)
Tri-colored Bat	71 (19.6)	199 (21.1)	91 (9.7)	23 (7.7)
Little Brown Bat	0 (0.0)	107 (11.4)	56 (6.0)	9 (3.0)
Big Brown Bat	3 (0.8)	15 (1.6)	36 (3.9)	18 (6.0)
Northern Long-eared Bat	0 (0.0)	6 (0.6)	1 (0.1)	2 (0.7)
Seminole Bat	2 (0.6)	0 (0.0)	2 (0.2)	0 (0.0)
Unidentified bat	1 (0.3)	6 (0.6)	10 (1.1)	9 (3.0)
Total	363	941	935	299

Species	Project Number (Percentage)			
	Maple Ridge	PGC	Casselman	Total
Hoary Bat	337 (46.8)	61 (28.9)	74 (29.8)	1,203 (32.4)
Red Bat	83 (11.5)	67 (31.8)	41 (16.5)	1,134 (30.5)
Silver-haired Bat	126 (17.5)	30 (14.2)	64 (25.8)	417 (11.2)
Tri-colored Bat	0 (0.0)	33 (15.6)	27 (10.9)	444 (11.9)
Little Brown Bat	106 (14.7)	10 (4.7)	32 (12.9)	320 (8.6)
Big Brown Bat	44 (6.1)	10 (4.7)	7(2.8)	133 (3.6)
Northern Long-eared Bat	0 (0.0)	0 (0.0)	0 (0.0)	9 (0.2)
Seminole Bat	0 (0.0)	0 (0.0)	2 (0.8)	6 (0.2)
Unidentified bat	24 (3.3)	0 (0.0)	1 (0.4)	51 (1.4)
Total	720	211	248	3,717

4.0 SPECIAL STATUS SPECIES

4.1 Federally-listed Species

Information on federally-listed species for Greenbrier and Nicholas counties was obtained from the USFWS website (USFWS 2011). This includes 11 species, only three of which are bats and none are birds (Table 1.8) – the remainder of the listed species are one amphibian and seven invertebrates which are not addressed in this avian and bat risk assessment. Of the three bat species, only Indiana bat is believed to have potential to occur in the Project Area at some time during the year due to nearby hibernacula. The other two species, gray bat and Virginia big-eared bat, are believed to have little to no potential to occur in the Project area either due to lack of habitat or distance to known populations (Table 1.8). The proposed expansion of the BRWEP has no potential to impact gray bat or Virginia big-eared bat.

Table 4.1 Federally-listed endangered or threatened species listed in Greenbrier and Nicholas Counties, West Virginia [http://ecos.fws.gov/tess_public/].

Species	Status	Habitat	Potential for Occurrence
Gray bat *Myotis grisescens*	E	Regional migrant: Cave-dwelling bat. Summer colonies may occupy a home range that contains several roosting caves scattered along rivers or lakes. Wintering caves are typically deep vertical caves and maybe hundreds of kilometres from summer range. Rare and typically found in the south-western portions of West Virginia. Little to no potential to occur in the Project Area	Habitat utilized by gray bat is not present in the study area. No known caves with gray bat in the study area. No potential to occur in the Project Area.
Indiana bat *Myotis sodalis*	E	Regional migrant. Forms maternity colonies and roosts during summer under loose bark or in hollow trees in summer. Hibernates in caves or mines. Generally feeds in wooded habitats. Documented throughout WV year-round. Known winter hibernacula in Greenbrier County.	Site elevation and available data suggest unlikely occurrence of Indiana bat in the study area. Potential to occur within the study area primarily during migration to and from hibernacula.

Virginia big-eared bat *Corynorhinus townsendii virginianus*	E	Sedentary. Forms maternity colonies in mines, caves and buildings. Hibernates in caves and mines. Maternity caves are rarely found greater than 20 miles from winter caves. Forages over a variety of habitats including forested areas around occupied caves or mines. Usually inhabits caves mostly in oak-hickory forest. Recorded year-round in West Virginia. No records for Nicholas or Greenbrier Counties. Little to no potential to occur in the Project Area.	Little to no potential to occur in the Project Area due to distance to known populations. Have been recorded in the New River gorge in Fayette County approximately 30 miles from the Project Area.

E=Federally endangered

Indiana Bat

The Indiana bat is typically found in wooded or semi-wooded areas near streams, and is associated with cavernous limestone areas in the winter where suitable hibernacula occur. West Virginia contains both winter hibernacula and summer maternity roosts for Indiana bats; and there are documented hibernacula in Greenbrier County (Table 4.2; USFWS 2007). In 2007, approximately 3.1% of the estimated range-wide population of Indiana bats hibernated in West Virginia (USFWS 2008a). This increased to approximately 3.8% in 2009 (USFWS 2010c). Numbers of Indiana bats in West Virginia have steadily increased since 2001 to a recent population estimate of approximately 14,855 individuals (USFWS 2010c). There are 37 known Indiana bat hibernacula in the state, and of these, 27 have extant winter populations (at least one record since 1995) (USFWS 2007). All of the hibernacula in West Virginia are found in the eastern part of the state in the Appalachian Mountains, Central Appalachian Broadleaf Forest Ecoregion (USFWS 2007). All of West Virginia is located in the Appalachian Mountain Recovery Unit for Indiana bat (USFWS 2007).

As of the 2007 *Indiana Bat Draft Recovery Plan: First Revision* (USFWS 2007), only three maternity colonies, located in Boone and Tucker counties, were recorded for the state. Since 2007, a fourth maternity colony has been located in Ohio County. This is believed to represent a small portion of maternity colonies due to the limited nature of surveys for maternity colonies (C. Stihler, WVDNR, pers. comm.). Tucker County has three known hibernacula, while Boone and Ohio counties have no known hibernacula (USFWS 2007). Six counties (Clay, Nicholas, Pendleton, Raleigh, Randolph, and Tucker) have summer records of Indiana bats other than reproductive females or maternity colonies.

An important characteristic for the location of maternity roost sites is a mosaic of woodland and open areas, with the majority of maternity colonies having been found in agricultural areas with fragmented forests (USFWS 2007). Kurta (2004) analyzed data from 393 roost trees in eleven states and found that although at least 33 tree species were used, ash (*Fraxinus* sp.), elm (*Ulmus* sp.), hickory (*Carya* sp.), maple (*Acer* sp.), poplar (*Populus* sp.), and oak (*Quercus* sp.) were the most common types of trees used, accounting for 87% of roost trees documented. On average, Indiana bats switch roosts every two to three days although this is dependent numerous factors including reproductive condition, roost type, predation, and time of year (Kurta et al. 2002, USFWS 2007). Based on the habitat preference for the species, there is little potential Indiana bat summer habitat within the study area, primarily due to the high elevation of the study area which likely precludes persistent summer use or the presence of maternity colonies due to a shortened summer growing season suitable for rearing young.

There are no maternity colony records within Greenbrier, Nicholas or the immediate surrounding counties; however there are other summer records documented within Nicholas County (USFWS 2007). There are more data for summer and fall roost trees for male Indiana bats in West Virginia than for maternity roosts (Beverly and Gumbert 2004). Beverly and Gumbert (2004) report 26 roosts located for males in West Virginia, including seven snags, eight live trees, and five live-damaged trees. Eleven tree species were used, including shagbark hickory (Carya ovata), sugar maple, American beech, white oak, tulip tree (Liriodendron tulipfera), black cherry, red maple (Acer rubrum), northern red oak, chestnut oak (Q. montana), white ash (Fraxinus americana), and red elm (Ulmus rubra), and the size ranged from 5.0 to 27.2 inches (12.7 to 69.1 cm) DBH. During September in West Virginia (the fall swarming period), male Indiana bats roosted on average within 3.5 miles (5.6 km) of the cave and in trees near ridgetops and often switched roost trees from day to day (C. Stihler, WVDNR, pers. comm.; USFWS 2007).

There are six known Indiana bat hibernacula in Greenbrier County, West Virginia (Table 4.2; USFWS 2007). There are no hibernacula documented in Nicholas County (USFW 2007). Five of the six hibernacula in Greenbrier County are designated Priority 4 (P4)[2] caves and the remaining one is designated as P3 with an estimated population of 54 individuals since 2000. In Pocahontas County, the closest hibernacula to the project area are designated as P3, with an estimated population ranging from 196 to 285 individuals at Martha Cave and 193 individuals recorded at Snedgar Cave (Figure 1.12).

[2] Priority 1 (P1): Essential to the recovery and long-term conservation of the Indiana bat. These sites have a current and/or historically observed winter population of ≥ 10,000 individuals. Priority 1A (P1A) sites have held 5,000 or more Indiana bats during one or more winter surveys conducted during the past 10 years. P1B sites have consistently contained fewer than 5,000 bats over the past 10 years;
Priority 2 (P2): Contributes to the recovery and long-term conservation of the Indiana bat. These sites have a current and/or historical population of > 1,000 but < 10,000 individuals;
Priority 3 (P3): Contribute less the recovery and long-term conservation of the Indiana bat. These sites have a current and/or historical population of 50-1,000 bats;
Priority 4 (P4): Least important to recovery and long-term conservation of the Indiana bat. These sites have a current and/or historical population of fewer than 50 bats.

Table 4.2 Known Indiana bat hibernacula in Greenbrier County, West Virginia.

Hibernaculum name	Type	Hibernaculum ownership	Priority Number	Max. All-time Population Estimate	Max. Population Estimate since 2000	Location with relation to study area
Greenbrier Co.						
Bob Gee	Cave	Private Individual(s)	4	9	0	~12 miles Southeast
General Davis	Cave	Private Organization	4	10	6	~25 miles North
Higginbothamus	Cave	Private Individual(s)	4	?	0	~15 miles Southeast
McFerrin	Cave	Private Individual(s)	4	39	0	~12 miles Southeast
Organ	Cave	Private Individual(s)	4	14	14	~27 miles South
Piercys	Cave	Private Organization	3	54	54	~17 miles South
Pocahontas Co.						
Martha	Cave	Private Individual(s)	3	285	196	~18 miles West
Snedgar	Cave	Private Individual(s)	3	193	193	~14 miles West
Tubb	Cave	Private Individual(s)	4	20	20	>20 miles Northwest
Cass	Cave	Private Individual(s)	4	4	0	>20 miles Northwest
Dreen	Cave	State Owned	4	4	0	>20 miles Northwest
Lobelia Saltpeter	Cave	Private Individual(s)	4	4	0	>20 miles Northwest
Upper Marthas	Cave	Private Individual(s)	4	1	0	~18 miles West

Source: USFWS 2007

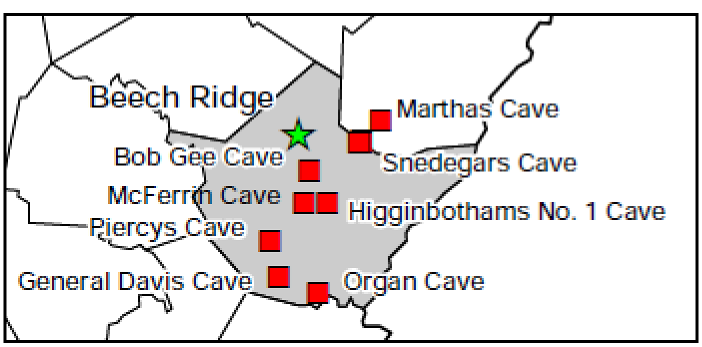

Figure 4.1 Distribution of Indiana bat hibernacula near the BRWEP, designated by the star (source: BHE 2006).

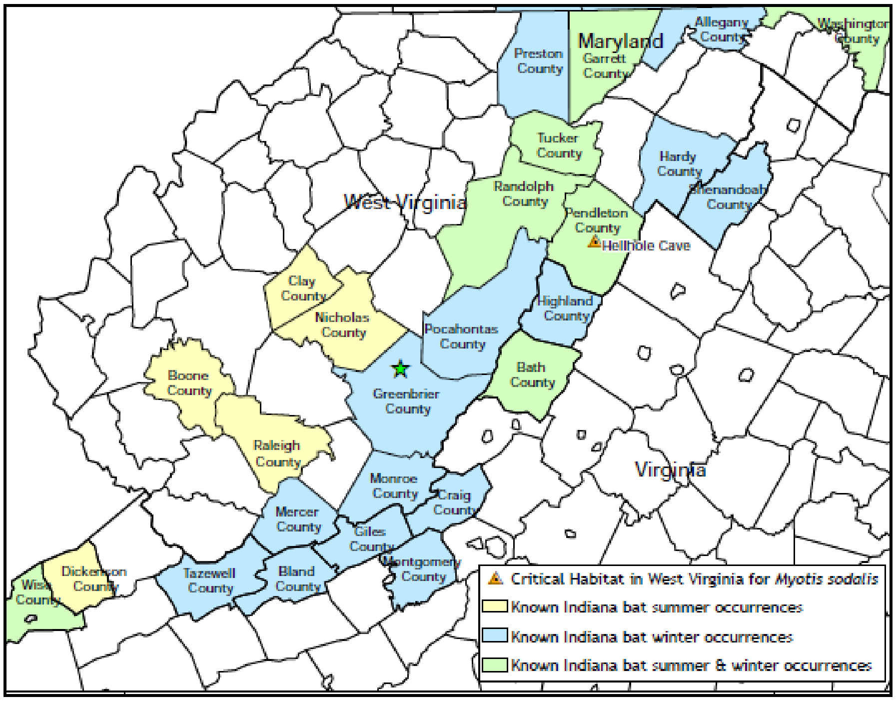

Figure 4.2 Distribution of summer and winter Indiana bat (*Myotis sodalis*) records near the proposed Beech Ridge Expansion Project, designated by the star (source: BHE *2006).*

No Indiana bats have been captured in the Project Area during mist-netting surveys (BHE 2006, Young and Gruver 2011). Acoustic surveys in 2010 recorded eight calls with characteristics similar to Indiana bat calls (Young and Gruver 2011), suggesting that Indiana bats were potentially recorded within the Project Area in very low numbers from late July to early August, which coincides with the beginning of the fall migration period for Indiana Bats. USFWS & KDFWR (2007) suggest that at least two potential Indiana bat call files per night are needed to conclude that the species is present. This occurred only once during the study (night of July 28, 2010). The Indiana bat is also susceptible to WNS and overall results to the population are unknown (USGS 2011). Overtime if the nearby populations die out due to WNS, the potential for Indiana bats to occur in the Project Area will likely decrease.

4.2 USFWS Birds of Conservation Concern

The USFWS lists 25 species as birds of conservation concern within the Appalachian Mountains Bird Conservation Region 28 (Appendix D; USFWS 2008). Potential impacts to these species area addressed above under Avian Resources.

4.3 State-Listed Species

West Virginia does not have a separate threatened and endangered species list; therefore species listed in Table 1.8 are also classified as state-listed.

4.4 Other Species of Concern

As of June 29, 2011 the USFWS announced a 90-day finding on a petition to list the eastern small-footed bat and the northern long-eared bat as endangered or threatened under the Endangered Species Act and initiated a 12-month status review on these species.

With the spread of white-nose syndrome (WNS) throughout the eastern U.S., several once common and abundant bat species, such as the little brown bat, are experiencing population declines (Frick et al. 2010). There is increasing potential for these species to be listed as threatened or endangered by state and federal agencies (CBD 2010). Currently, information is being collected and the conservation status of bat species susceptible to WNS such as the little brown bat, big brown bat, and tri-colored bat are being reviewed by the USFWS (CBD 2010, USFWS 2011a).

<u>Eastern Small-footed Bat</u>

The eastern small-footed myotis (*Myotis leibii*) is considered one the least common bat species in North America (Barbour and Davis 1969; Blasko 2001). Less information exists concerning this species compared to other bat species; however, they are known to range from Ontario and New England southward to Georgia and Alabama and westward into Oklahoma (Barbour and Davis 1969). In West Virginia, they are categorized by the state as an S1 species, which are species considered extremely rare and critically imperiled; there are five or fewer documented occurrences or few remaining individuals occurring within the state (West Virginia Department of Natural Resources n.d.; West Virginia Natural Heritage Program 2007); . The USFWS was petitioned to list eastern small-footed myotis as threatened or endangered in August 2010 (Center for Biological Diversity 2010).

Eastern small-footed myotis is one of the smallest *Myotis* species in North America (McDaniel et al. 1982). Their pelage is generally a dark-yellowish brown with some black undertones. Their average mass is around 0.13 oz (3.8 g) (range 0.11 to 0.20 oz [3.2 to 5.5 g]) (van Zyll de Jong 1985), and average length is around 3.2 inches (83 mm). This species has similar characteristics as other *Myotis* species; however, the eastern small-footed myotis tolerates colder temperatures than the little brown bat (Best and Jennings 1997). Eastern small-footed myotis are among the last *Myotis* species to reach their hibernacula in autumn, often as late as mid-November, and are usually the first to leave in the spring, in March or early April (Barbour and Davis 1969; Fenton 1972). Hibernation generally occurs from October to April where they usually hibernate singly but can be found in small groups or within groups of other species (Fenton 1972). During periods of mild ambient temperatures, activity and movement in and out of hibernacula has been observed in this species (Hitchcock 1965; Schwartz 1954). The maternity period lasts from May to August during which a single pup is born usually in May or June (Barbour and Davis 1969).

Eastern small-footed myotis are mostly found in mountainous regions; in or near deciduous forest, mixed deciduous-evergreen forest, or mixed forest and open farmland (NatureServe 2011); and at elevations of approximately 750 to 3,700 ft (240 to 1,125 m) (Best and Jennings 1997). In West Virginia, they have been found roosting in limestone caves during the spring and summer (Krutzsch 1966). They have been known to roost in caves, buildings, rock bluffs, talus slopes, and tunnels and beneath slabs of rock and stones (Best and Jennings 1997). Caves and abandoned mines are the only known hibernacula sites (Fenton 1972), where they occupy narrow wall crevices or under rocks on the floor (Davis 1955; Krutzsch 1966; Martin et al. 1966). Within these selected hibernacula sites, eastern small-footed myotis prefer the drafty entrances of open mines and caves where the humidity is relatively low (Barbour and Davis 1969; Fenton 1972). Caves and mines are also utilized for summer roosting, but summer roost site selection is similar to little brown bat and other *Myotis* species where buildings, bridges, hollow trees, sloughing bark, rock piles, and cliff crevices are utilized (Natureserve 2011).

Little information exists on the demographic parameters of eastern small-footed myotis. Similar to most bats, they have low reproductive rates (one young per year) and relatively long life spans. They are known to live approximately six to 12 years. Best and Jennings (1997) estimated an annual survival rate of approximately 76% for males and 42% for females. Lower female survival rates have been attributed to the greater demands of reproduction on females, higher metabolic rates, longer sustained activity during the summer months, and greater exposure to disease-carrying parasites especially in maternity colonies (Hitchcock et al. 1984; Best and Jennings 1997).

Dispersal and migratory distances of eastern-small footed myotis are believed to be influenced by the availability of hibernacula and roosting sites across the landscape (Johnson and Gates 2008). They are generally believed to be sedentary or regional migrants (Fleming and Eby 2005) and have been found in late summer during periods of active migration for bats, but the whereabouts of these individuals during other seasons is generally unknown (Barbour and Davis 1969). Although little information exists about migration patterns of eastern small-footed myotis, Johnson and Gates (2008) documented females moving <165 ft (<50 m) between successive diurnal roosts during the summer maternity period, and they typically switched roosts every day unless inclement weather prevented foraging.

<u>Northern Long-Eared Bat</u>

The northern myotis is a common bat species in the mid- to northeastern U.S., with continental range extending into southeastern and western Canada. The global status of the northern bat has been G4, which are species that are apparently secure (NatureServe 2011), and it currently has no special status in the state of West Virginia. The USFWS was petitioned to list northern myotis as threatened or endangered in August 2010 (Center for Biological Diversity 2010).

The northern myotis is a small bat weighing approximately 0.17 to 0.35 oz (5 to 10 grams) with yellow to brown coloration. Females tend to be larger and heavier than males (Caire et al.

1979). The northern myotis has large ears relative to other similar species and was previously named the northern long-eared bat.

In spring, females leave hibernacula and form maternity colonies of up to 60 individuals (Caceres and Barclay 2000). Parturition dates and subsequent weaning are likely dependent on regional conditions (Foster and Kurta 1999). Studies completed by Broders et al. (2006) over a three-year period in New Brunswick, Canada, found parturition to occur in mid- to late July. Other studies suggest that southeastern population parturition dates occur between mid-May and mid-June (Caire et al. 1979; Cope and Humphrey 1972).

Generally, female northern myotis roost communally, while males select solitary roosts (Caceres and Barclay 2000). Northern myotis have shown site fidelity related to summer roost habitat; however, studies by Foster and Kurta (1999) found that bats changed roost trees approximately every two days. Movement to hibernacula occurs as early as late July and extends as late as October. Copulation occurs outside of hibernacula during swarming behavior; however, fertilization does not occur until spring (Caceres and Barclay 2000).

Northern myotis are likely an opportunistic insectivore that primarily gleans prey from substrates (Faure et al. 1993). They are known to forage under the forest canopy at small ponds or streams, along paths and roads, or at the forest edge (Caire et al. 1979).

Northern myotis most frequently select mature-growth forests with decaying trees and/or live trees with cavities or exfoliating bark during the summer maternity season (Lacki and Schwierjohann 2001; Ford et al. 2006; Foster and Kurta 1999). Day and night roosts are utilized by northern myotis during spring, summer, and fall with old-growth forest communities selected most frequently (Foster and Kurta 1999; Owen et al. 2003; Broders and Forbes 2004). Variation in roost selection criteria has been reported between northern myotis sexes, with females forming maternity colonies in snags, while solitary males roosted in live tree cavities (Lacki and Schwierjohann 2001; Broders and Forbes 2004; Caceres and Barclay 2000). Broders and Forbes (2004) further reported that maternity colonies were more often in shade-tolerant deciduous stands in trees species that are susceptible to cavity formation. This is supported by Lacki and Schwierjohann (2001) findings that colony roosts were more likely to occur in stands with higher density of snags.

Mine and cave sites have been most often reported as hibernacula for northern myotis (Whitaker and Winter 1977; Stone 1981; Griffin 1940).

The total population size of northern myotis is not clearly known; however, estimates suggest the population may be as small as 2,500 or as large as 1,000,000 individuals (Natureserve 2011). Similar to other bat species, northern myotis has a low reproductive rate, with females birthing one offspring per year. The sex ratio for northern myotis populations appears to be dominated by males, with multiple studies reporting higher percentages of males compared to females (Griffin 1940; Pearson 1962; Hitchcock 1949; Stone 1981). The skewed ratio is believed due to greater mortality among females. The northern myotis is a fairly long-lived species (Thompson 2006), with one individual reported living up to 19 years, suggesting long life-spans (Hall et al. 1957).

Little information exists on the migration patterns and dispersal of northern myotis. The geographic summer and winter ranges appear to be identical (Barbour and Davis 1969); however, it is believed that movement between hibernacula and maternity summer roosts is likely similar to other *Myotis* species and may vary regionally. Some studies have reported movements ranging between approximately 30 and 60 miles (approximately 50 to 100 km) from hibernacula to summer habitat (Caire et al. 1979; Griffin 1945), suggesting they are regional migrants. In managed forests of West Virginia, northern myotis utilized on average a 160.6-acre (65-ha) home range, and patches smaller than this likely represent unsuitable habitat (Owen et al. 2003). Females have been reported to move up to 6,500 ft (approximately 2,000 m) and males 3,300 ft (approximately 1,000 m) between roost sites (Broders et al. 2006).

5.0 SUMMARY

The BRWEP expansion area, including a 2-mile buffer zone, is located adjacent to the existing BRWEP, within Greenbrier and Nicholas Counties, West Virginia, where land cover is predominately deciduous forest with a mosaic of mixed forest, shrub/scrub; grassland, and developed spaces. The rolling topography is not likely to concentrate migrating birds; however raptors and songbirds will be present during migration seasons. Raptor species will likely utilize the ridgeline system for updrafts. This has been evidenced by the raptor migration studies conducted during 2011 in the study area, in which 17 raptor species, including vultures and owls, were recorded. Bald and golden eagles, both protected by the Bald and Golden Eagle Act, were recorded, in low numbers, during the 2011 surveys conducted within both the expansion area and existing BRWEP. The impact of turbines on raptors along Appalachian ridge-tops is not well studied but at other wind projects in the region impacts have been low with generally less than one or two raptor fatalities per year.

High bat mortality at other wind-energy facilities is a concern and some species that appear to be at greatest risk are likely to be found in the study area, for example eastern red bats and hoary bats. There are ten species of bat that have the potential to utilize the forested habitat within the study area for roosting and/or for foraging at some time during the year; including the listed or sensitive species; Indiana bat, eastern small-footed bat, and northern long-eared bat. Both eastern small-footed bat and northern long-eared bat have been captured during mist-net surveys conducted within the Project Area and will likely be exposed to the facility; however, impacts to these two species are expected to be low based on results from other regional monitoring studies and likely population declines of these species due to WNS which is likely having the effect of reduced density of these species on the landscape. Indiana bat could not be definitely confirmed during mist-netting surveys, however, acoustic surveys suggest that this species may occur infrequently in low numbers during the late summer or fall migration and BRE is developing a HCP in consultation with the USFWS to minimize and mitigate potential impacts to this endangered species.

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APPENDIX A

SITE VISIT: FIELD NOTES AND PHOTOS; MARCH 12, 2011

Wildlife observed during the site visit; March 12, 2011

Birds	
American crow	*Corvus brachyrhynchos*
European starling	*Sturnus vulgaris*
Barred owl	*Strix varia*
Mourning dove	*Zenaida macroura*
Cooper's hawk	*Accipiter cooperii*
Black vulture	*Coragyps atratus*
Turkey vulture	*Cathartes aura*
Red-tail hawk	*Buteo jamaicensis*
Red-shouldered hawk	*Buteo lineatus*
Mammals	
Eastern cottontail rabbit (tracks)	*Sylvilagus transitionalis*
American black bear (tracks)	*Ursus Americanus*
White-tailed deer	*Odocoileus virginianus*
Raccoon (pellets)	*Procyon lotor*
Porcupine (pellets)	*Erethizon dorsatum*

Photos A: Rolling topography with mosaic of deciduous forest and open areas.

Photos B: Large tracts of deciduous forest

Photos C: Clear-cut areas

Photos D: Drainage areas

Photos E: Rocky Outcrops

APPENDIX B

AVIAN MIGRATION OBSERVATORIES[3] DATA

[3] Within 100 miles of the Beech Ridge Wind Energy Project

Allegheny Front Migration Observatory, Grant County, West Virginia; Flyover Results 2007 and 2006 (in parentheses).

Wood Duck 1 (0)	Red-tailed Hawk 26 (6)	Tree Swallow 1373 (138)
Double-creasted Cormorant 6 (2)	Golden Eagle 3 (2)	Cliff Swallow 17 (0)
Great Blue Heron 4 (1)	American Kestrel 13 (21)	Barn Swallow 635 (58)
Black Vulture 13 (4)	Merlin 11 (19)	Red-breasted Nuthatch 338 (8)
Turkey Vulture 10 (11)	Peregrine Falcon 2 (1)	Eastern Bluebird 4 (0)
Osprey 23 (17)	Common Nighthawk 38 (16)	American Robin 176 (252)
Bald Eagle 15 (5)	Chimney Swift 17 (14)	Cedar Waxwing 1613 (1242)
Northern Harrier 20 (4)	Red-headed Woodpecker 1 (1)	Scarlet Tanager 27 (16)
Sharp-shinned Hawk 100 (47)	Yellow-bellied Sapsucker 2 (1)	Rose-breasted Grosbeak 86 (261)
Cooper's Hawk 18 (6)	Northern Flicker 95 (264)	Purple Finch 128 (8)
Red-shouldered Hawk 3 (3)	Eastern Phoebe 2 (5)	Pine Siskin 8 (0)
Broad-winged Hawk 1195 (864)	American Crow 185 (2)	Dragonflies 125 (60)

Allegheny Front Migration Observatory, Grant County, West Virginia; Banding Results 1958-2007.

ALLEGHENY FRONT MIGRATION OBSERVATORY CUMULATIVE TOTALS
1958-2007

TOTAL SPECIES 120 (plus 2 hybrids) **TOTAL INDIVIDUALS 220,397**

1	American Green-winged Teal	835	Brown Creeper	27172	Blackpoll Warbler
96	Sharp-shinned Hawk	36	Carolina Wren	27	Cerulean Warbler
3	Cooper's Hawk	9	Bewick's Wren	1349	Black-and-white Warbler
5	American Kestrel	75	House Wren	1622	American Redstart
8	Merlin	571	Winter Wren	218	Worm-eating Warbler
35	American Woodcock	6430	Golden-crowned Kinglet	4201	Ovenbird
16	Black-billed Cuckoo	3920	Ruby-crowned Kinglet	123	Northern Waterthrush
12	Yellow-billed Cuckoo	108	Blue-gray Gnatcatcher	24	Louisiana Waterthrush
9	Eastern Screech-Owl	428	Veery	19	Kentucky Warbler
83	Northern Saw-whet Owl	675	Gray-cheeked Thrush	367	Connecticut Warbler
19	Whip-poor-will	13641	Swainson's Thrush	29	Mourning Warbler
32	Ruby-throated Hummingbird	1255	Hermit Thrush	5592	Common Yellowthroat
6	Red-headed Woodpecker	1315	Wood Thrush	418	Hooded Warbler
5	Red-bellied Woodpecker	887	American Robin	1171	Wilson's Warbler
181	Yellow-bellied Sapsucker	1	Varied Thrush	588	Canada Warbler
219	Downy Woodpecker	767	Gray Catbird	3	Yellow-breasted Chat
25	Hairy Woodpecker	145	Brown Thrasher	648	Scarlet Tanager
60	Northern Flicker	17	European Starling	963	Eastern Towhee
2	Olive-sided Flycatcher	1	American Pipit	87	Chipping Sparrow
163	Eastern Wood Pewee	388	Cedar Waxwing	320	Field Sparrow
154	Yellow-bellied Flycatcher	43	Blue-winged Warbler	46	Vesper Sparrow
32	Acadian Flycatcher	54	Golden-winged Warbler	190	Savannah Sparrow
51	Traill's Flycatcher	4	Brewster's Warbler	2	Henslow's Sparrow
145	Least Flycatcher	1	Lawrence's Warbler	98	Fox Sparrow
2	Empidonax (sp?)	23371	Tennessee Warbler	574	Song Sparrow
47	Eastern Phoebe	42	Orange-crowned Warbler	369	Lincoln's Sparrow
2	Great Crested Flycatcher	2553	Nashville Warbler	529	Swamp Sparrow
1	Eastern Kingbird	235	Northern Parula	1616	White-throated Sparrow
19	White-eyed Vireo	18	Yellow Warbler	217	White-crowned Sparrow
554	Blue-headed Vireo	1935	Chestnut-sided Warbler	6701	Dark-eyed Junco
56	Yellow-throated Vireo	9466	Magnolia Warbler	11	Northern Cardinal
7	Warbling Vireo	16066	Cape May Warbler	1667	Rose-breasted Grosbeak
745	Philadelphia Vireo	29253	Black-throated Blue Warbler	140	Indigo Bunting
2445	Red-eyed Vireo	1018	Yellow-rumped Warbler (Myrtl	7	Rusty Blackbird
4171	Blue Jay	16861	Black-throated Green Warbler	1	Common Grackle
1	American Crow	9322	Blackburnian Warbler	9	Brown-headed Cowbird
1039	Black-capped Chickadee	2	Yellow-throated Warbler	30	Baltimore Oriole
7	Carolina Chickadee	34	Pine Warbler	319	Purple Finch
222	Tufted Titmouse	41	Prairie Warbler	1	Red Crossbill
881	Red-breasted Nuthatch	292	Palm Warbler	61	Pine Siskin
153	White-breasted Nuthatch	7707	Bay-breasted Warbler	1332	American Goldfinch

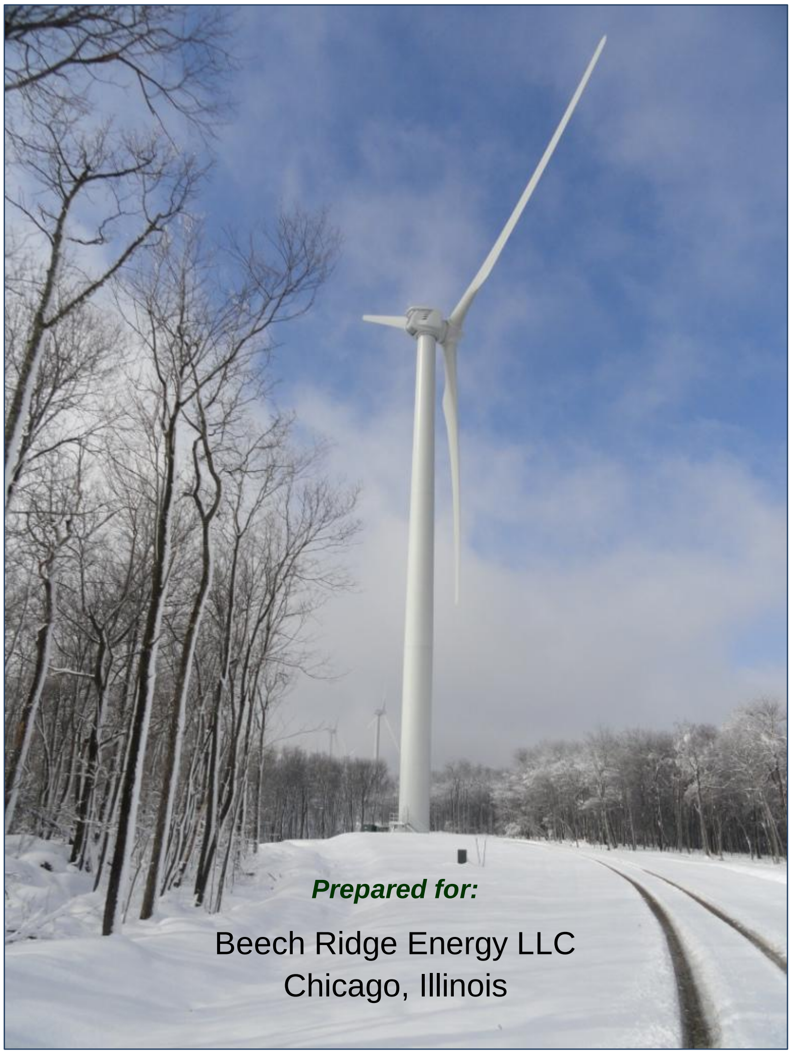
Hanging Rock Raptor Observatory Flyover Results 1974 to 2009; Monroe County, West Virginia.

Survey Year	Osprey	Bald Eagle	Golden Eagle	Northern harrier	Sharp-shinned hawk	Cooper's hawk	Red-shouldered hawk	Broad-winged hawk	Red-tailed hawk	American Kestrel	Merlin	Peregrine
2009	39	71	28	9	304	71	14	1,875	243	44	3	15
2008	25	36	5	15	195	30	4	2,215	50	54	0	4
2007	36	43	17	14	316	91	8	1,735	364	39	3	2
2006	40	56	7	10	312	59	6	2,737	93	67	4	2
2005	77	33	14	8	265	70	8	1,442	166	60	1	1
2004	61	46	8	16	252	73	5	2,678	132	40	3	3
2003	58	20	3	13	422	120	8	2,248	154	75	6	12
2002	37	20	4	8	197	56	7	3,697	166	40	1	4
2001	70	31	12	12	158	91	18	1,551	115	64	11	7
2000	59	37	27	17	414	127	12	4,261	214	93	6	10
1999	38	20	15	11	288	70	4	2,701	202	80	3	6
1998	41	8	2	13	307	60	5	2,882	43	63	8	0
1997	35	18	11	19	339	119	7	2,763	244	73	5	0
1996	86	25	8	4	258	105	0	3,256	76	32	5	5
1995	29	14	8	10	274	41	4	4,428	58	32	0	0
1994	24	8	5	6	261	39	4	1,974	43	58	0	0
1993	25	9	0	7	391	70	8	5,008	46	54	3	2
1992	27	6	9	8	252	76	2	1,865	50	51	2	0
1991	45	7	2	9	548	85	5	3,735	248	94	1	3
1990	43	2	1	8	312	77	4	3,030	36	75	2	0
1989	21	2	1	4	78	28	2	1,220	12	33	0	2
1988	29	2	6	8	153	27	4	3,153	102	37	0	1
1987	28	2	1	10	417	230	2	4,730	22	65	0	0
1986	31	0	0	6	218	62	2	5,993	2	50	1	0
1985	6	1	2	1	39	13	0	985	22	8	0	0
1984	9	0	0	6	86	3	2	1,222	4	23	0	0
1983	10	0	2	5	72	8	4	2,444	3	19	0	0
1982	18	2	0	0	100	16	2	3,518	22	38	0	0
1981	29	1	0	3	167	11	0	7,106	7	40	0	0
1980	16	1	0	5	88	10	0	5,666	9	9	0	0
1979	10	0	0	2	65	11	0	4,181	11	23	0	0
1978	14	0	0	5	87	10	0	4,761	2	35	0	0
1977	13	0	0	7	257	40	3	5,186	10	17	0	0
1976	24	0	0	5	100	19	4	6,220	15	37	0	0
1974	17	1	0	3	8	17	6	10,501	11	8	0	0
Total Ind. 1974 to 2009	**1,170**	**522**	**198**	**287**	**8,000**	**2,035**	**164**	**122,967**	**2,997**	**1,630**	**68**	**79**

Winter Raptor Surveys for the Beech Ridge Wind Energy Project

Greenbrier and Nicholas Counties, West Virginia

December 2011- March, 2012



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January 15, 2013

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

EXECUTIVE SUMMARY

Beech Ridge Energy LLC, a wholly-owned subsidiary of Invenergy LLC, has developed and proposes to expand the Beech Ridge Wind Energy Project (BRWEP) in Greenbrier and Nicholas Counties, West Virginia. Winter raptor surveys, with a focus on eagles, following the one-year post-construction study of raptor activity at the BRWEP, are part of Invenergy's commitment to an Avian Protection Plan. The principal objective of this study was to provide a site-specific winter passage rate (defined as the number of raptor or vulture observations recorded per observer-hour) by eagles and all raptors that would be useful in evaluating potential impacts from the existing BWREP and the proposed expansion.

One-hundred and twenty-eight one-hour raptor surveys were conducted at eight survey stations between December 14, 2011, and March 27, 2012. All surveys were conducted between the hours of 0900 and 1600 during weather conditions conducive to observing raptor activity. Four raptor species and one vulture species were recorded. Mean species richness was 0.62 species per survey. The mean raptor passage rate was 0.51 raptor per observer-hour, while mean vulture passage rate was 0.61 vulture per observer hour. Raptor passage rates in the proposed expansion area were between 0.48 and 1.33 raptors per observer-hour compared to the BRWEP which were between 0.09 and 0.40 raptor per observer-hour.

The mean eagle passage rate was 0.14 eagles per observer-hour. Eagle activity in the study area was from golden eagles and distributed across the study area, with the highest passage rates at survey stations BRE1, BRE2, BR1, and BR5 (0.17 to 0.34 eagle per observer-hour); though no areas of concentrated activity were observed. Of the ten golden eagles observed flying within 800 meters of the observer, three were flying within the rotor swept height. Golden eagle activity was only observed between 1000 and 1500 hours, with the highest passage rates after 1200 hours.

Results of the winter raptor surveys suggest that there are no unique or extraordinary winter concentrations of raptors or eagles within the BRWEP study area. Winter raptor study data for other locations or developments in the region are lacking or not publicly available; therefore, it is unknown how raptor and eagle winter passage rates at the BRWEP compare to raptor and eagle use in the surrounding region.

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1.0 INTRODUCTION

Beech Ridge Energy LLC (BRE), a wholly owned subsidiary of Invenergy LLC, has developed the Beech Ridge Wind Energy Project (BRWEP) in Greenbrier and Nicholas Counties, West Virginia. The BRWEP was granted a Siting Certificate by the West Virginia Public Service Commission (PSC) on August 26, 2006, and on reconsideration, on January 11, 2007. The approval included 124 wind turbine generators (WTG) of 1.5 megawatts each for a total of 186 megawatts of generating capacity. Construction on the BRWEP began in April 2009.

BRE has planned for an expansion/modification of the original project proposed to consist of an additional 33 WTGs immediately west of the original footprint of the project as approved by the PSC (Figure 1). This expansion/modification of the project will require review and approval by the PSC.

The existing WV PSC permit issued for the project includes a requirement for a winter raptor study at the BRWEP, which is interpreted to include the proposed expansion area. The Technical Advisory Committee for BRWEP determined that winter raptor studies would complement raptor migration surveys conducted during the migration seasons at the BRWEP (Young 2011). This report has been prepared to comply with the PSC requirement and the Avian Protection Plan commitments (BRE 2013) by providing information regarding wintering eagles and raptors in the BRWEP and expansion area. The report is intended to fulfill the winter raptor studies requirement and supplement the results from the original site surveys in 2005.

1.1 Study Objectives

The principal objective of the study to fulfill the PSC requirement were to provide site-specific information on winter eagle and raptor activity that would: (1) be useful in evaluating potential impacts from the BRWEP and proposed expansion; (2) provide information for planning of the expansion project to minimize potential impacts to birds to the extent practical; and (3) supplement and update the previous studies on avian activity and migration in the study area.

1.2 Study Area

The BRWEP area is located in Greenbrier and Nicholas counties, West Virginia, approximately nine miles (mi; 14 kilometers [km]) northeast of Ranielle, West Virginia (Figure 1). The BRWEP is located primarily along Beech Ridge and is bounded on the west by Clear Creek Mountain, on the south by Old Field Mountain, on the east by Cold Knob, and on the north by Big Mountain along County Road 10/1. The expansion area is located primarily along the intersection of Clear Creek Mountain, Huggins Ridge, Pollock Mountain and adjacent spur ridges located off of Beech Ridge. The proposed expansion area for the BRWEP is located immediately west of the existing BRWEP footprint (Figure 1).

The BRWEP is located on a 63,000-acre tract owned by MeadWestvaco. BRE has leased approximately 3,688 acres (with 1,780 acres to be leased for the 33-turbine phase), plus additional road rights-of-way from this landowner. Only a portion of the 5,468-acre Project area actually hosts wind farm facilities. The area of life-of-project impacts (the land to be occupied by facilities) for the 100 turbines, access roads, transmission line, substation, permanent meteorological towers, and O&M facility is approximately 71 acres. About 373 acres were temporarily disturbed for construction of the 67-turbine phase and transmission line and about 148 acres of land would be temporarily disturbed during construction of expansion area (33 additional turbines). Once construction is completed, about 450 acres that were temporarily disturbed will undergo reclamation. Upon the successful reclamation of the disturbed areas, it is expected that these areas will undergo natural succession. This process is expected to start as grass and then progress into scrub/shrub habitat.

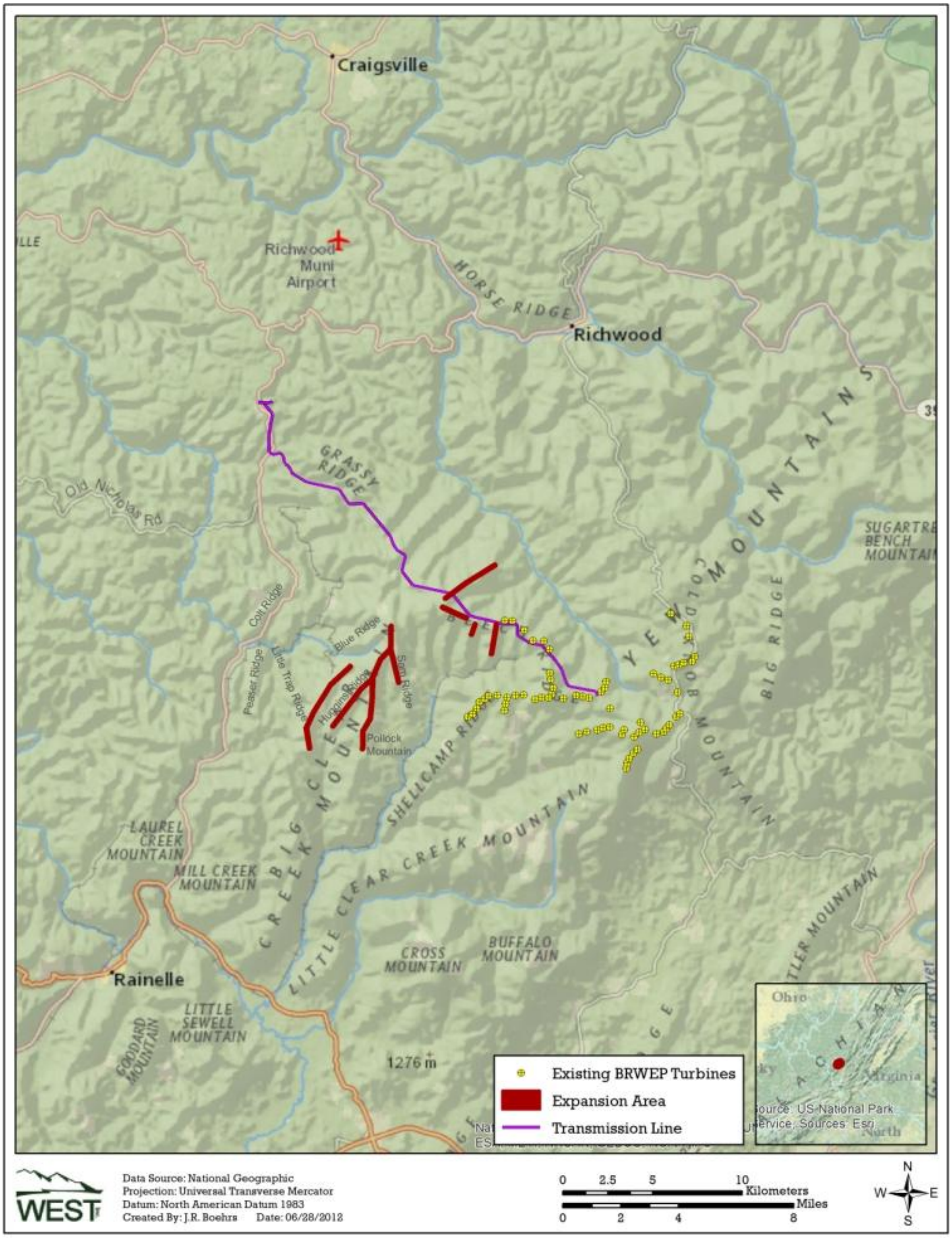

Figure 1. Location of the proposed Beech Ridge Wind Energy Project and expansion area.

2.0 METHODS

The 2011-2012 winter raptor surveys were intended to provide site-specific data on raptors and vultures, particularly eagles, wintering at the BRWEP or passing through the BRWEP expansion area in the winter. Data of interest includes metrics such as species diversity and richness, and raptor abundance such as passage rate, percent of overall passage, and frequency of occurrence for diurnal raptors and vultures. In addition, data were collected during the surveys on flight height to calculate the percentage of raptors observed flying within the potential turbine rotor-swept height. The surveys were conducted according to standard methods used by the Hawk Migration Association of North America (HMANA) and Hawk Watch International (HWI), and surveys were designed to provide visual coverage of large areas by using point-count stations located at prominent vantage points.

2.1 Survey Stations

Eight survey stations were selected within the study area: five stations labeled BR 1-5 within the BRWEP and three stations labeled BRE 1-3 within the expansion area to survey for wintering raptors (Figure 1). The stations were established on top of ridges in open, non-forest habitats to provide good visual coverage in roughly 360 degrees around the point over long distances.

2.2 Survey Methods

Surveys were conducted according to methods used by the HMANA and HWI, with observers continuously scanning overhead for raptors or vultures. Binoculars were frequently used throughout each survey period to aid in locating raptors. The date, start and end time of the survey period, and weather information such as temperature, wind speed, wind direction, barometric pressure, percent cloud cover, precipitation, and maximum visibility estimates were recorded for each survey. Weather information was recorded using a Kestrel® 2500 pocket wind meter. Time of observation, species or best possible identification, number of individuals, age and sex (if possible), and best estimation of distance from observer, flight height, and flight direction were recorded for each raptor or vulture observation. Surveys were conducted only on days when weather conditions were conducive to raptor activity (i.e., relatively warm, clear, high pressure conditions).

2.3 Observation Schedule

Sampling intensity was designed to provide data to characterize species composition, relative abundance, and passage rates of raptors wintering within the study area. Surveys were conducted at each station approximately once per week during the study period from December 14, 2011, to March 27, 2012. Individual survey periods were one hour in duration and were conducted between approximately 0900 and 1600 each survey day to cover the peak daily period of diurnal raptor migration activity.

2.4 Statistical Analysis

Following field surveys, observers inspected data forms for completeness, accuracy, and legibility. A Microsoft® ACCESS database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined protocol to facilitate subsequent Quality Assurance/Quality Control (QA/QC) and data analysis. A sample of records from the electronic database was compared to the raw data forms and any errors detected were corrected. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. All data forms, field notebooks compiled, and electronic data files were retained for reference.

2.4.1 Raptor Diversity and Species Richness

Raptor diversity was represented by the total number of species observed. Species richness was calculated as the mean number of raptor species observed per survey. The unit of species richness for raptor migration surveys was just species observed per survey since the survey plot was defined by an unlimited viewshed at each station.

2.4.2 Passage Rate, Percent of Overall Passage, and Frequency of Occurrence

Observations of raptors or vultures detected within an unlimited viewshed were used in the analysis. Passage rate was the number of raptor or vulture observations recorded per observer-hour[1] and was calculated by dividing the total number of raptors or vultures observed during a survey by the number of hours in the survey. Passage rate per visit was calculated as the total number of raptors or vulture observations averaged over all plots. A visit was defined as a complete round of surveys at all plots. This metric allows standardized comparison between sample locations, time (hours, days, weeks, seasons), or with other studies where similar data exist. Overall passage rates for the season or entire study period were calculated by averaging across all visits. To illustrate passage rate by time of day, passage rate was averaged across all stations for 1-hour time blocks (e.g., 1000-1100 hours, 1100-1200 hours, etc.).

Percent of overall passage was calculated as the proportion of the total passage rate recorded that was attributable to a particular species or raptor type. Frequency of occurrence was calculated as the percent of surveys in which a particular species or raptor type was observed. Frequency of occurrence and percent of passage rate provide relative estimates of species exposure to the wind energy facility. For example, a species may have high passage rates for the site based on just a few observations of large groups; however, the frequency of occurrence would indicate that the species occurred during very few surveys and, therefore, may be less likely affected by the facility.

2.4.3 Bird Flight Height

For observations of raptors within 800 meters (m) of the survey station[2], the approximate flight height was recorded at the point where the bird was first observed. This flight height was used to calculate the percentage of raptors flying within the approximate rotor-swept height (44 to 150 m [82.0 to 492.1 ft] above ground level) for the BRWEP turbines.

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[1] The number of birds per observer-hour is the standard metric used during raptor migration surveys at established HMANA and HWI sites. Because raptors are counted in an unlimited viewshed around the survey station, survey plot boundaries are not used to further standardize or define use estimates.

[2] Due to the difficulty with estimating flight height when there are few reference points, flight height was not estimated for observations of birds greater than 800 m from the survey station.

3.0 RESULTS

Winter raptor surveys were conducted at each of the eight stations between December 14, 2011, and March 27, 2012. Sixteen visits were conducted, totaling 128 surveys and 127.7 hours of survey.

3.1 Raptor Diversity and Species Richness

In total, 188 raptors and vultures of five species were observed in the BRWEP and expansion area during the winter raptor surveys (Table 1). Species richness during winter raptor surveys was 0.62 species per survey (Table 2). Species richness was highest at Stations BRE1 and BRE 3 (1.00 and 0.94 species per survey, respectively), and the lowest species richness was observed at Station BR4 (0.38 species per survey).

Table 1. Summary of observations by species and bird type during the winter raptor surveys.

Species	Scientific Name	Number of Groups	Number Observed
Diurnal Raptors		**75**	**93**
Buteos		*53*	*68*
broad-winged hawk	*Buteo platypterus*	1	1
red-shouldered hawk	*Buteo lineatus*	25	37
red-tailed hawk	*Buteo jamaicensis*	27	30
Eagles		*22*	*25*
golden eagle	*Aquila chrysaetos*	22	25
Vultures		**45**	**95**
turkey vulture	*Cathartes aura*	45	95
Overall		**120**	**188**

Table 2. Mean passage rate and species richness recorded at each station during the winter raptor surveys.

Station	Mean Passage Rate[1]	Species Richness[2]
BR1	0.55	0.44
BR2	0.57	0.62
BR3	1.12	0.56
BR4	1.05	0.38
BR5	1.25	0.56
BRE1	1.48	1.00
BRE2	0.86	0.50
BRE3	2.06	0.94
All Stations	**1.12**	**0.62**

[1] number of birds per observer-hour
[2] number of species per survey

3.2 Passage Rate, Percent of Passage Rate, and Frequency of Occurrence

Combined raptor and vulture passage rate was 1.12 birds per observer-hour (Table 2). The passage rate was highest at Station BRE3 (2.06 birds per observer-hour) and lowest at Station BR1 (0.55 birds per observer-hour; Table 2).

3.2.1 Raptors

The mean diurnal raptor passage rate during winter raptor surveys was 0.51 raptor per observer-hour (Table 3). The mean buteo passage rate was 0.36 buteo per observer-hour and the eagle passage rate was 0.14 eagle per observer hour (Table 3). Buteos were observed during 25% of surveys, while eagles were observed during 15.6% of surveys. Red-shouldered hawk (*Buteo lineatus*) was the most commonly observed raptor species, followed by red-tailed hawk (*B. jamaicensis*) and golden eagle (*Aquila chrysaetos*) (Table 1). Diurnal raptors comprised 45.3% of the overall passage rate recorded during the study (Table 3). Buteos compose 32.6% of the overall passage rate, and golden eagles, the only eagle species observed, composed 12.7% of the overall passage rate (Table 3).

Diurnal raptor passage rate was higher at Station BRE1 (1.33 raptors per observer-hour) than at the other stations (Table 3). The relatively high activity at Station BRE1 was primarily attributable to buteo activity (Table 3, Figure 2a). Passage rates at other stations ranged from 0.09 (Station BR4) to 0.76 raptor per observer-hour (Station BRE3; Table 3). Eagle passages rates were relatively low (i.e., 0.20 eagle per observer-hour or less) at all stations except Station BRE3, where the eagle passage rate was 0.34 eagle per observer-hour (Table 3, Figure 2b).

3.2.2 Vultures

Turkey vulture (*Cathartes aura*), the only vulture species observed, passage rate was 0.61 vulture per observer-hour (Table 3). Turkey vulture composed 54.7% of overall passage rate and was observed in 18.8% of surveys (Table 3). Passage rates for turkey vulture ranged from 0.15 (Station BRE1) to 1.29 (Station BRE3) vultures per observer-hour (Table 3, Figure 2c). Mapped flight paths were concentrated at BRE3 as well (Figure 3c).

Table 3. Passage rates, percent of passage rate, and frequency of occurrence for each bird type and raptor subtype by station during the winter raptor surveys.

Type / Subtype	Passage Rate[1]	Percent of Passage Rate[2]	Frequency of Occurrence[3]
	Station BR1		
Diurnal Raptors	**0.27**	**49.0**	**31.2**
Buteos	*0.09*	*17.0*	*12.5*
Eagles	*0.18*	*32.0*	*18.8*
Vultures	**0.28**	**51.0**	**12.5**
	Station BR2		
Diurnal Raptors	**0.40**	**69.5**	**37.5**
Buteos	*0.30*	*52.5*	*31.2*
Eagles	*0.10*	*17.0*	*12.5*
Vultures	**0.17**	**30.5**	**18.8**
	Station BR3		
Diurnal Raptors	**0.35**	**30.8**	**25**
Buteos	*0.28*	*25.2*	*18.8*
Eagles	*0.06*	*5.6*	*6.2*
Vultures	**0.78**	**69.2**	**25.0**
	Station BR4		
Diurnal Raptors	**0.09**	**8.7**	**12.5**
Buteos	*0.04*	*3.4*	*6.2*
Eagles	*0.06*	*5.3*	*6.2*
Vultures	**0.96**	**91.3**	**25.0**
	Station BR5		
Diurnal Raptors	**0.37**	**29.6**	**31.2**
Buteos	*0.20*	*15.8*	*18.8*
Eagles	*0.17*	*13.7*	*25.0*
Vultures	**0.88**	**70.4**	**12.5**
	Station BRE1		
Diurnal Raptors	**1.33**	**90.0**	**56.2**
Buteos	*1.13*	*76.4*	*56.2*
Eagles	*0.20*	*13.6*	*25.0*
Vultures	**0.15**	**10.0**	**6.2**
	Station BRE2		
Diurnal Raptors	**0.48**	**56.5**	**31.2**
Buteos	*0.45*	*52.1*	*25.0*
Eagles	*0.04*	*4.5*	*6.2*
Vultures	**0.37**	**43.5**	**18.8**
	Station BRE3		
Diurnal Raptors	**0.76**	**37.0**	**43.8**
Buteos	*0.43*	*20.7*	*31.2*
Eagles	*0.34*	*16.3*	*25.0*
Vultures	**1.29**	**63.0**	**31.2**
	All Stations		
Diurnal Raptors	**0.51**	**45.3**	**33.6**
Buteos	*0.36*	*32.6*	*25.0*
Eagles	*0.14*	*12.7*	*15.6*
Vultures	**0.61**	**54.7**	**18.8**

[1] number of birds per observer-hour
[2] proportion of the overall passage rate attributable to a species or type
[3] percent of surveys in which a species or type was observed

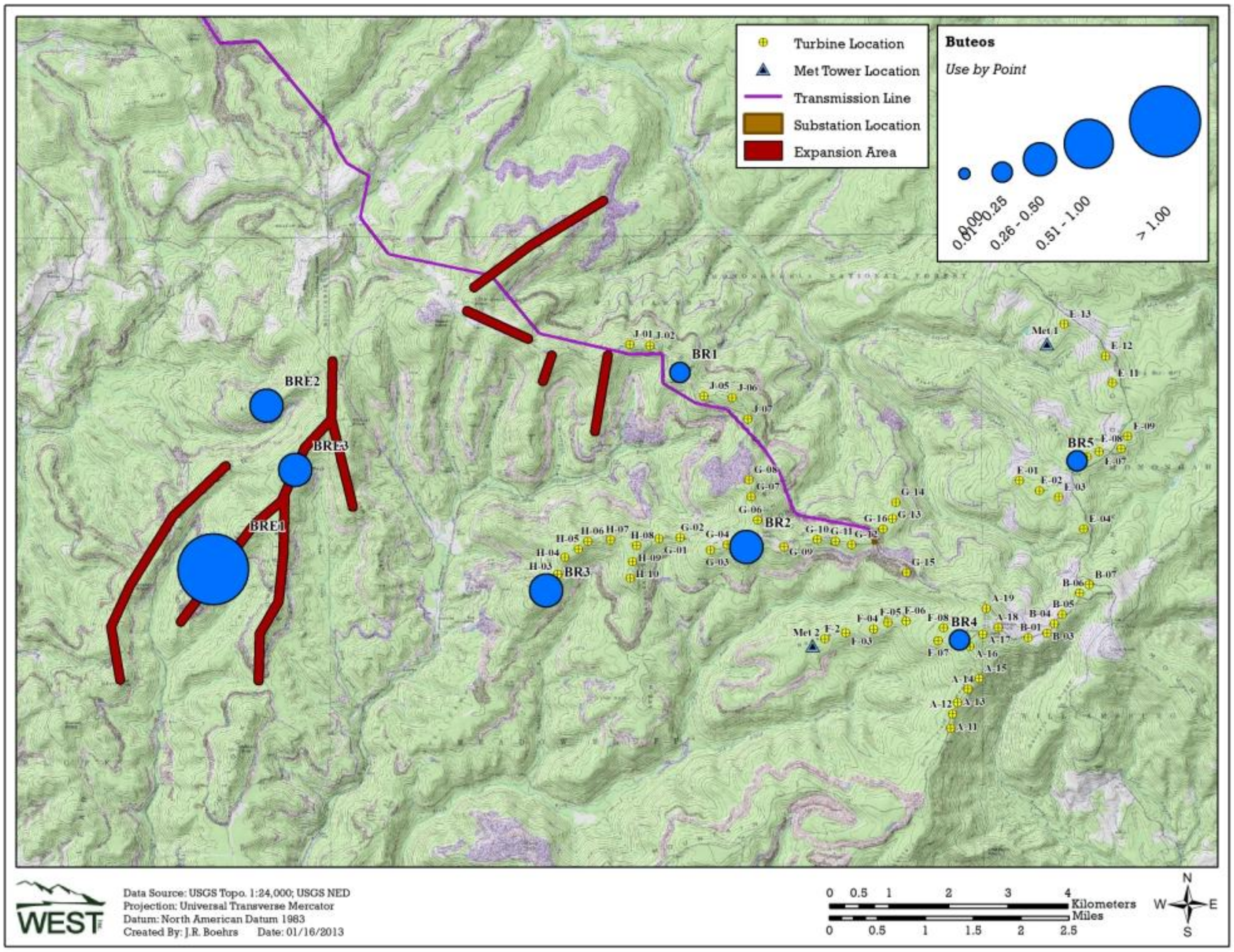

Figure 2a. Buteo passage rates by survey station during the winter raptor surveys.

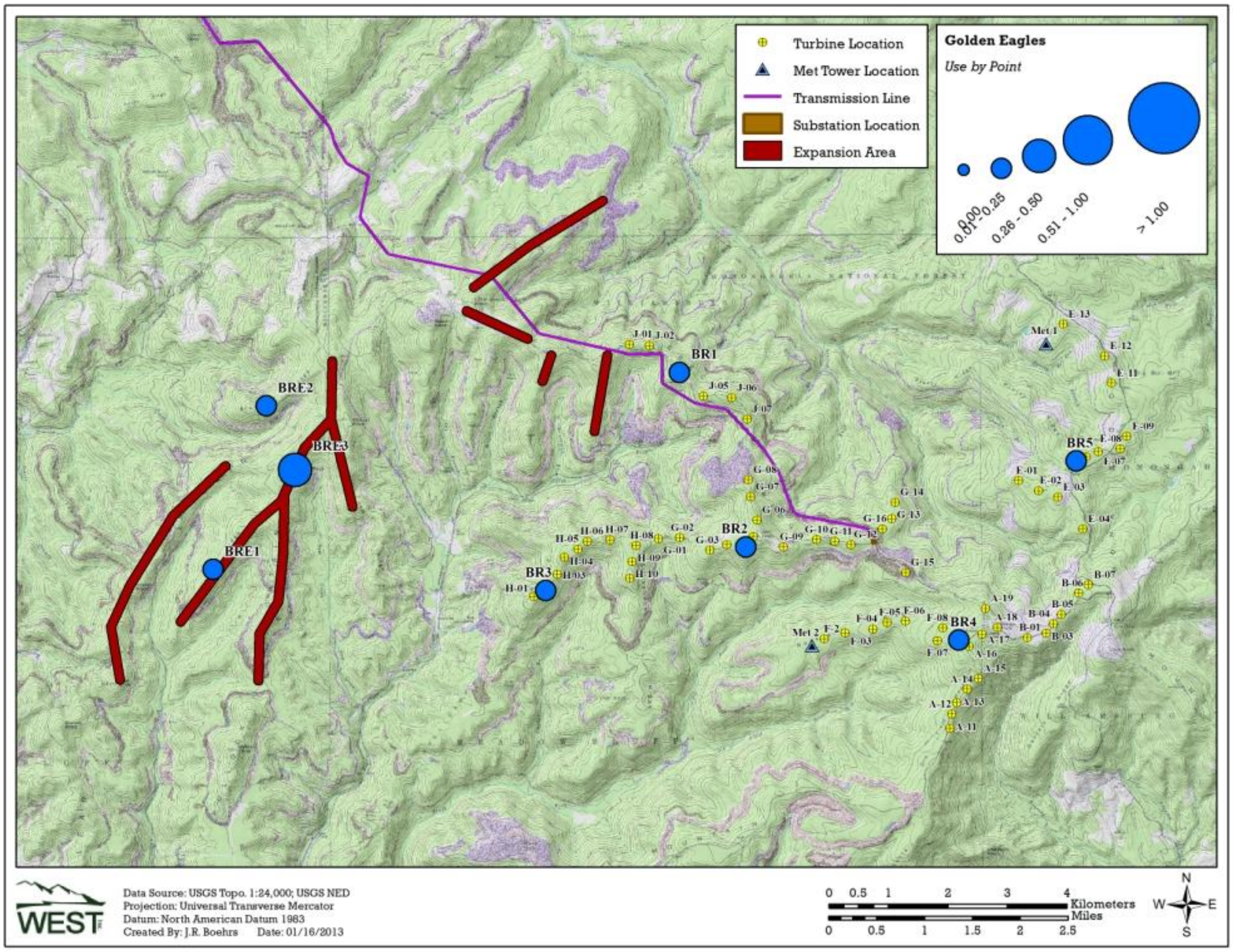

Figure 2b. Eagle passage rates by survey station during the winter raptor surveys.

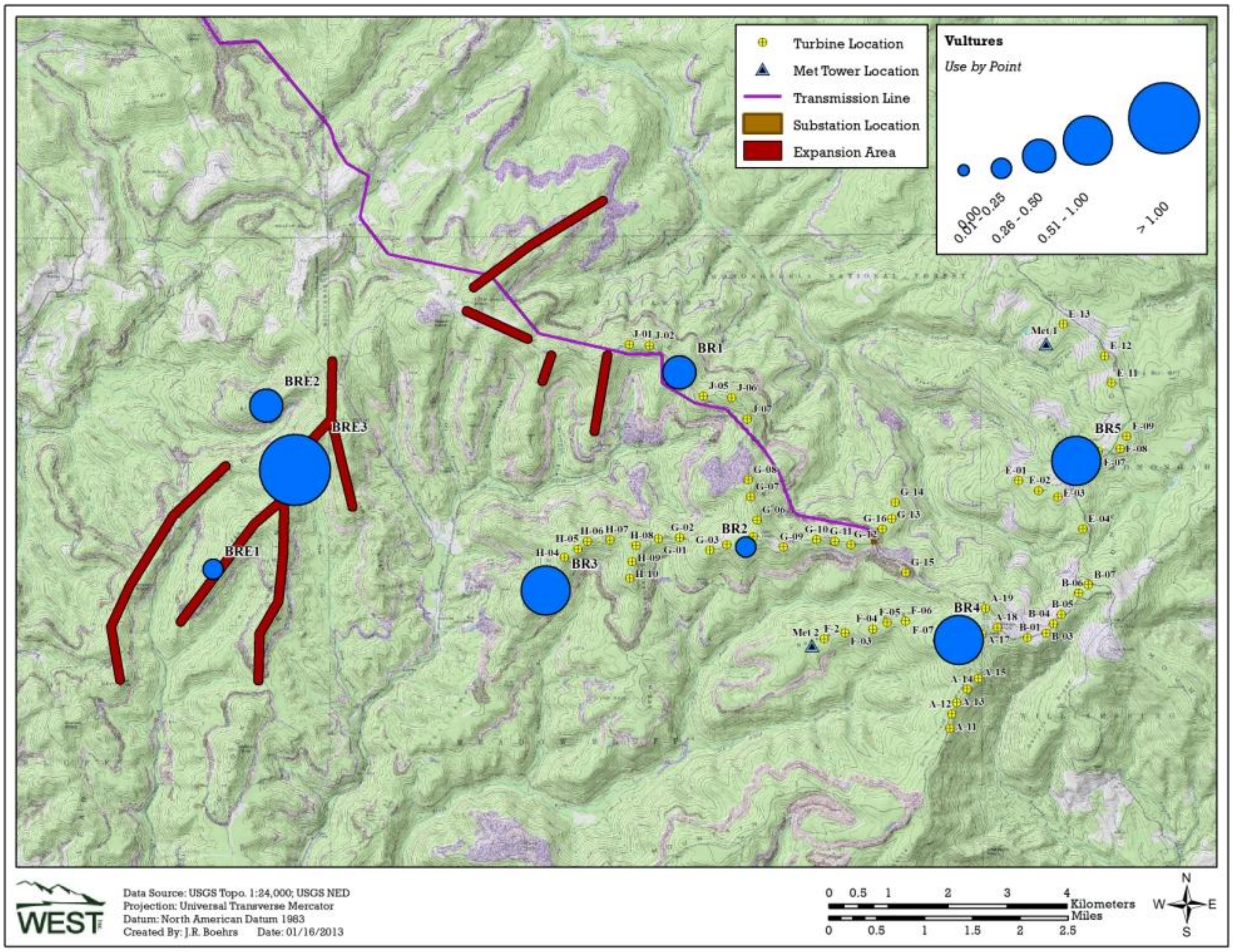

Figure 2c. Vulture passage rates by survey station during the winter raptor surveys.

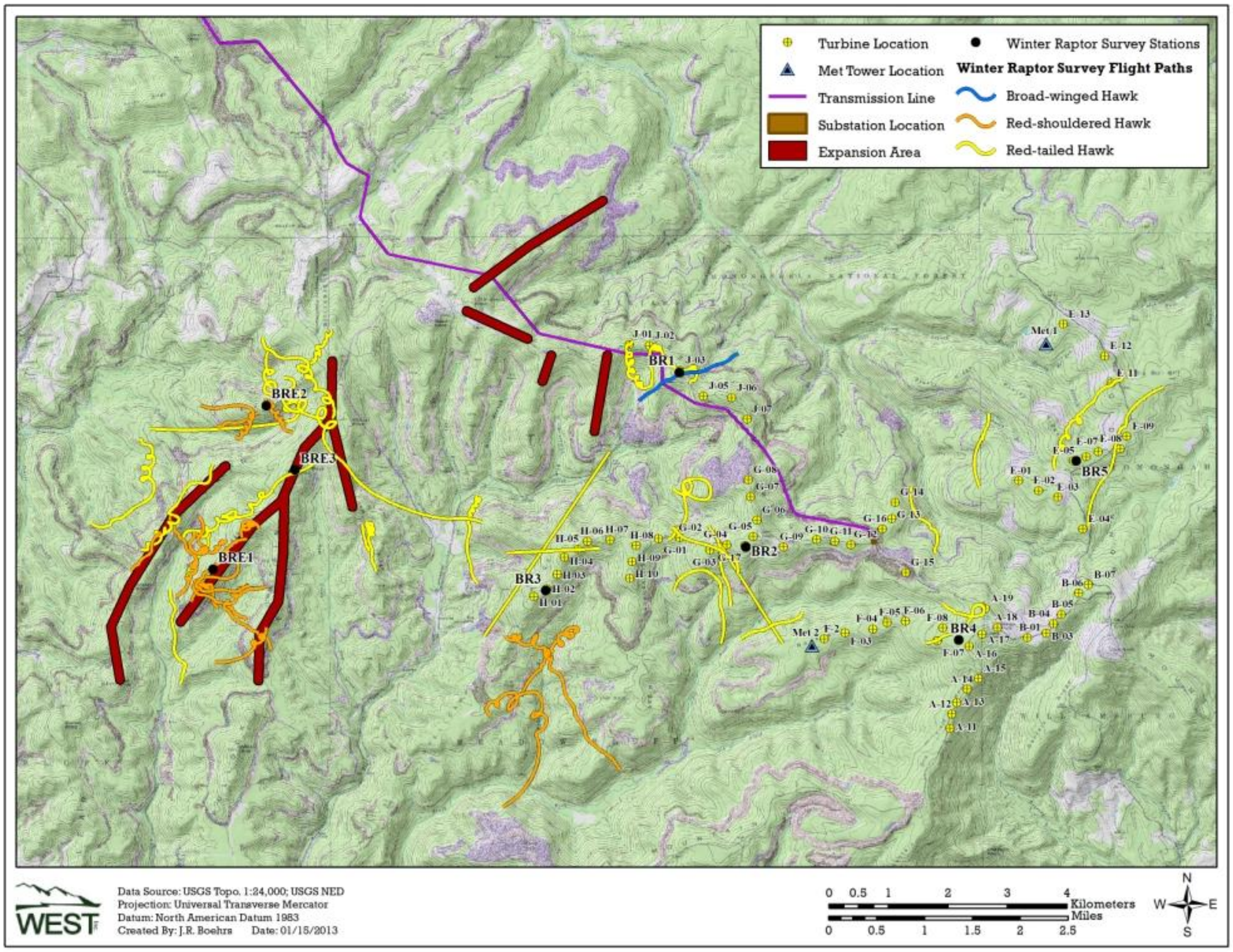

Figure 3a. Buteo flight paths[1] recorded during winter raptor surveys within the Beech Ridge Wind Energy Project and expansion area.

[1] Note: Flight paths mapped are of groups observed; some observations were beyond the scope of the map.

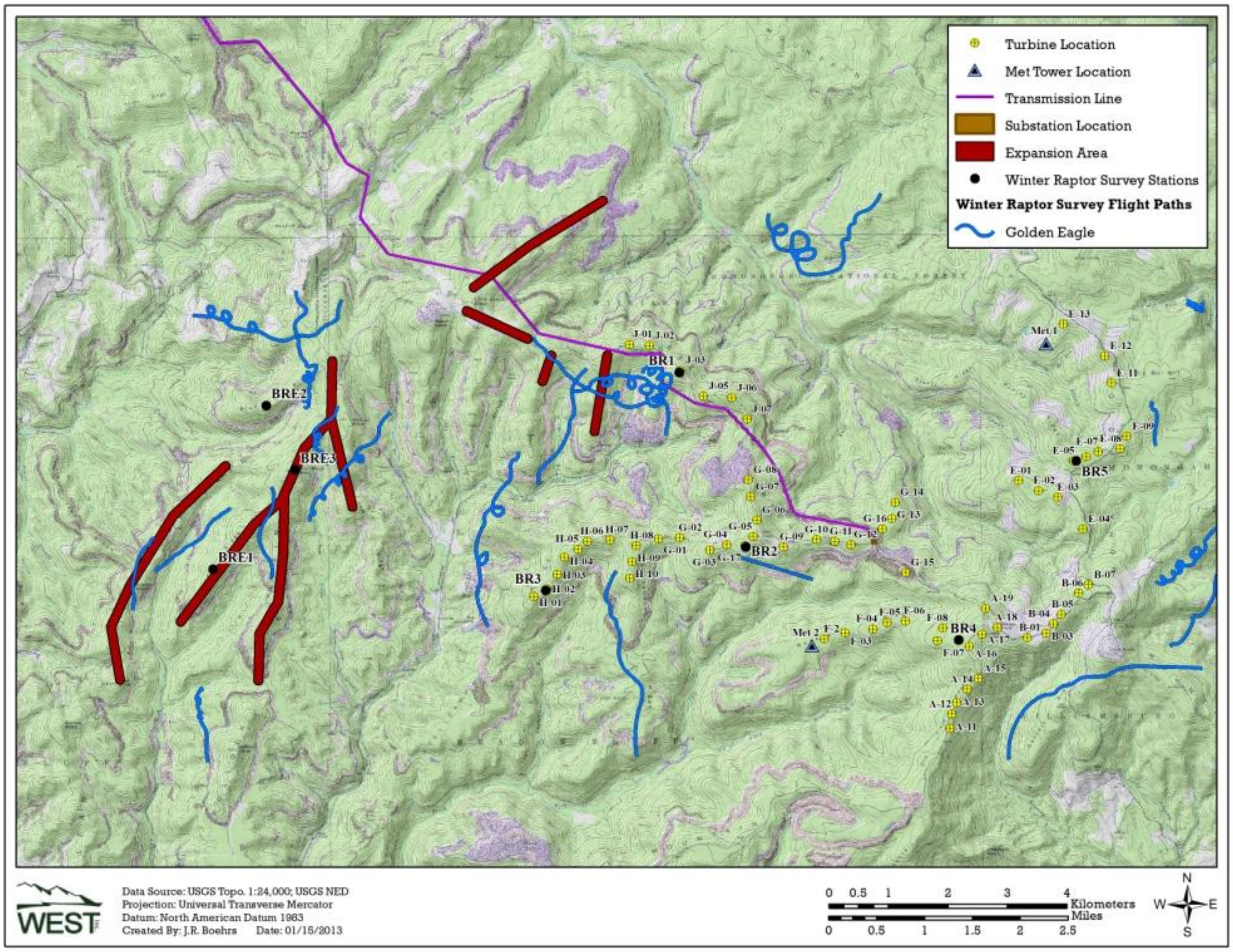

Figure 3b. Golden eagle flight paths[1] recorded during winter raptor surveys within the Beech Ridge Wind Energy Project and expansion area.

[1] Note: Flight paths mapped are of groups observed; two observations were beyond the scope of the map.

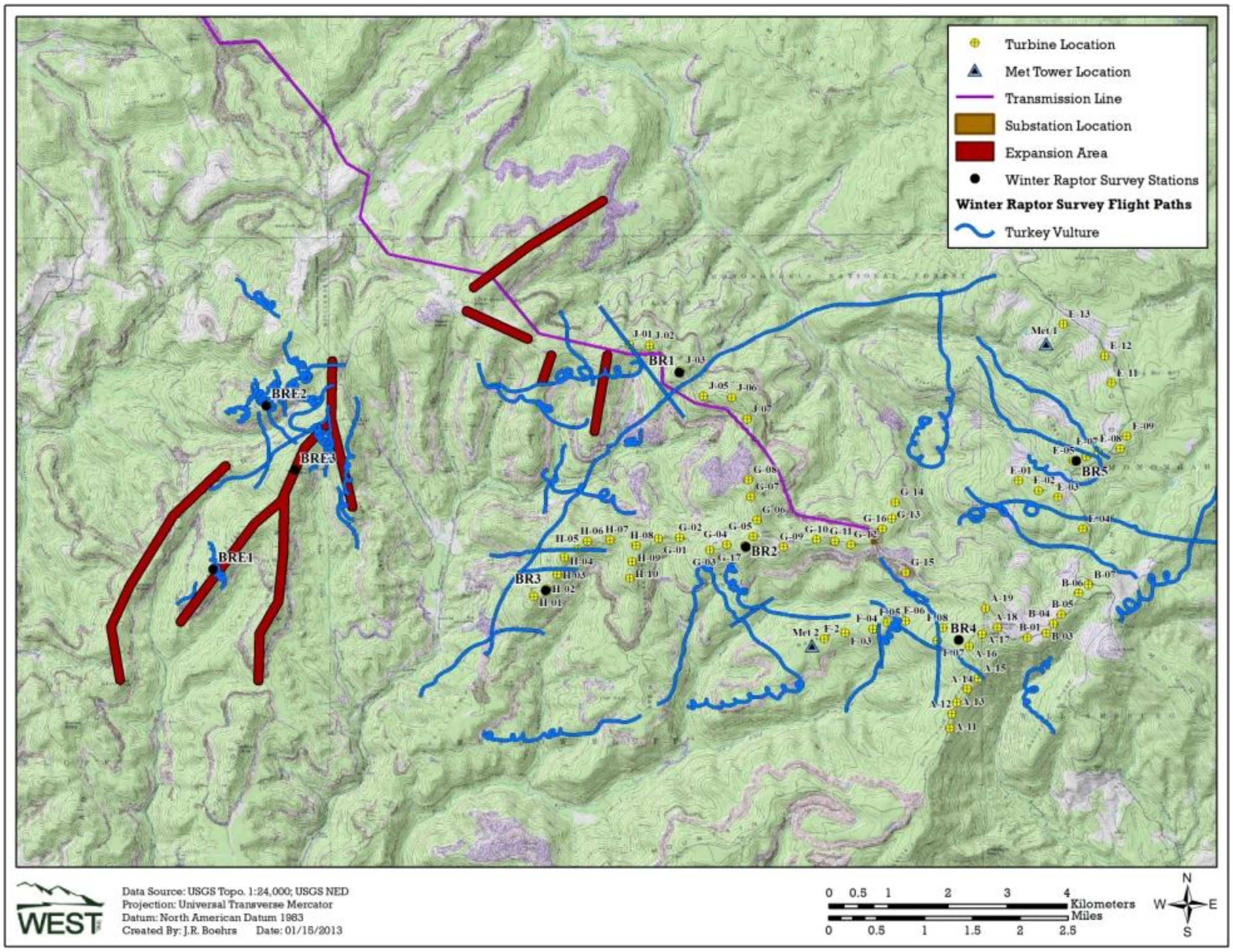

Figure 3c. Turkey vulture flight paths[1] recorded during winter raptor surveys within the Beech Ridge Wind Energy Project and expansion area.

[1] Note: Flight paths mapped are of groups observed; some observations were beyond the scope of the map.

3.3 Temporal Patterns of Activity

During the winter raptor survey, daily buteo observations ranged from zero to 17 and peaked on March 17 (Figures 4a). Buteos were observed on 22 survey days during the study period (Figure 4a). Daily eagle observations ranged from zero to six and eagles were observed on 11 survey days during the study period (Figure 4b). No eagles were observed in the study area after the month of February (Figure 4b). The highest number of vulture observations occurred on March 18 (28 observations), and 87 or 95 vultures (91.6%) were recorded between March 7 and March 27 (Figure 4c).

No birds were observed during the first (08:00 to 09:00) or last (15:00 to 16:00) survey hours (Table 4, Figure 5). Diurnal buteo passage rates peaked between 10:00 and 11:00 (0.98 buteo per observer-hour; Table 4, Figure 5a). Eagle passage rates were highest between 12:00 and 13:00 (0.21 eagle per observer-hour) and 14:00 and 15:00 hours (0.28 eagle per observer-hour; Table 4, Figure 5b). Vulture passage rates were highest between 14:00 and 15:00 hours (1.95 vultures per observer-hour; Table 4, Figure 5c).

Table 4. Passage rate by survey hour during winter raptor surveys.

Time (hrs)	All Raptors	Buteos	Eagles	Vultures
08:00	0	0	0	0
09:00	0.14	0.14	0	0
10:00	1.12	0.98	0.13	0.26
11:00	0.64	0.49	0.15	0.87
12:00	0.70	0.49	0.21	0.66
13:00	0.62	0.49	0.14	0.66
14:00	0.28	0	0.28	1.95
15:00	0	0	0	0

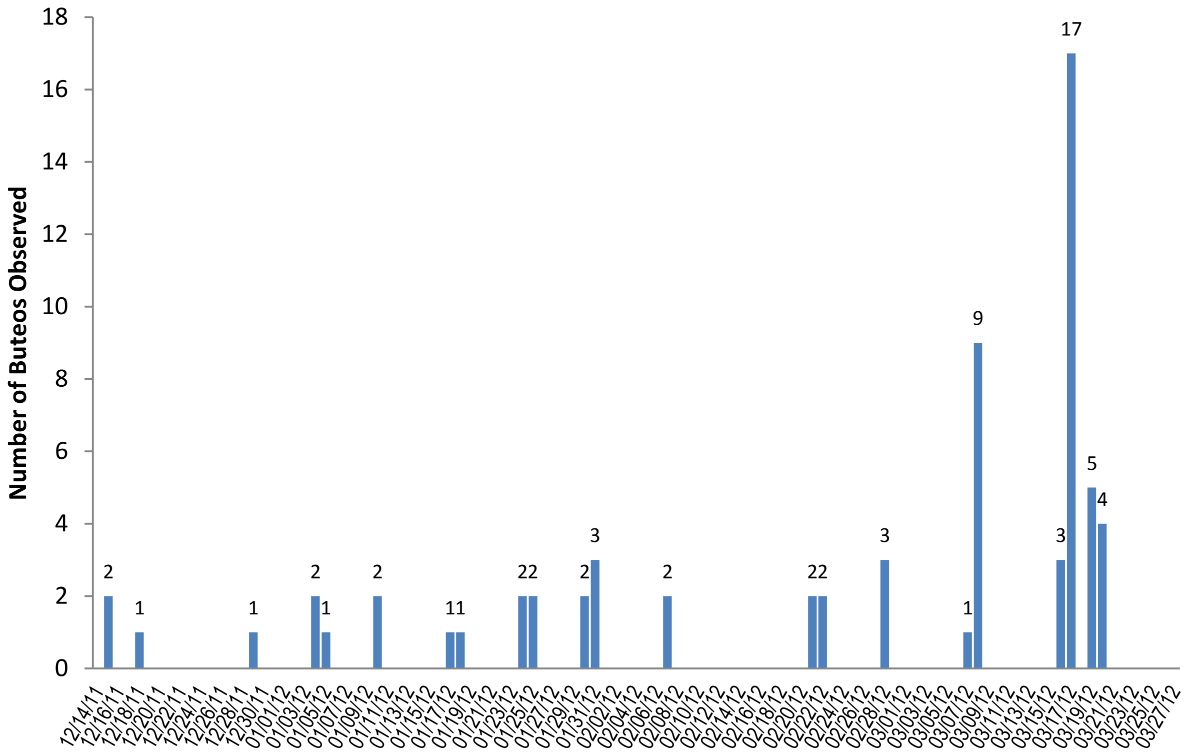

Figure 4a. Total buteo observations by survey day during winter raptor surveys.

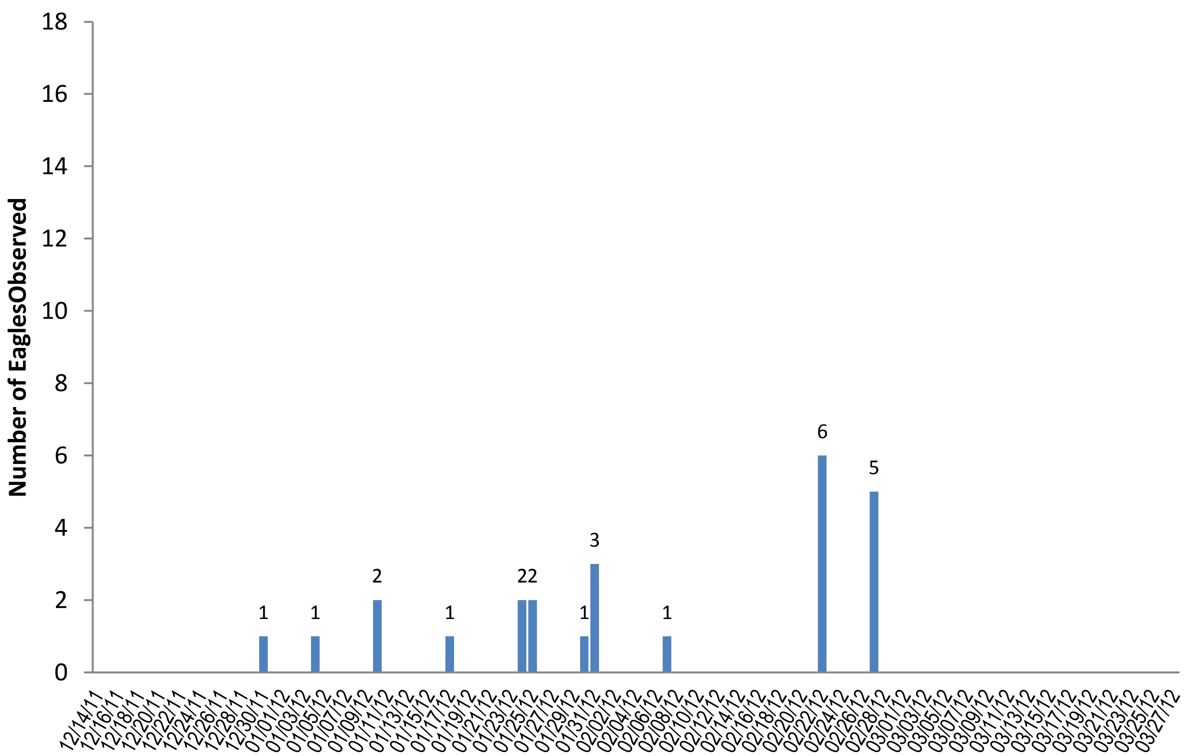

Figure 4b. Total eagle observations by survey day during winter raptor surveys.

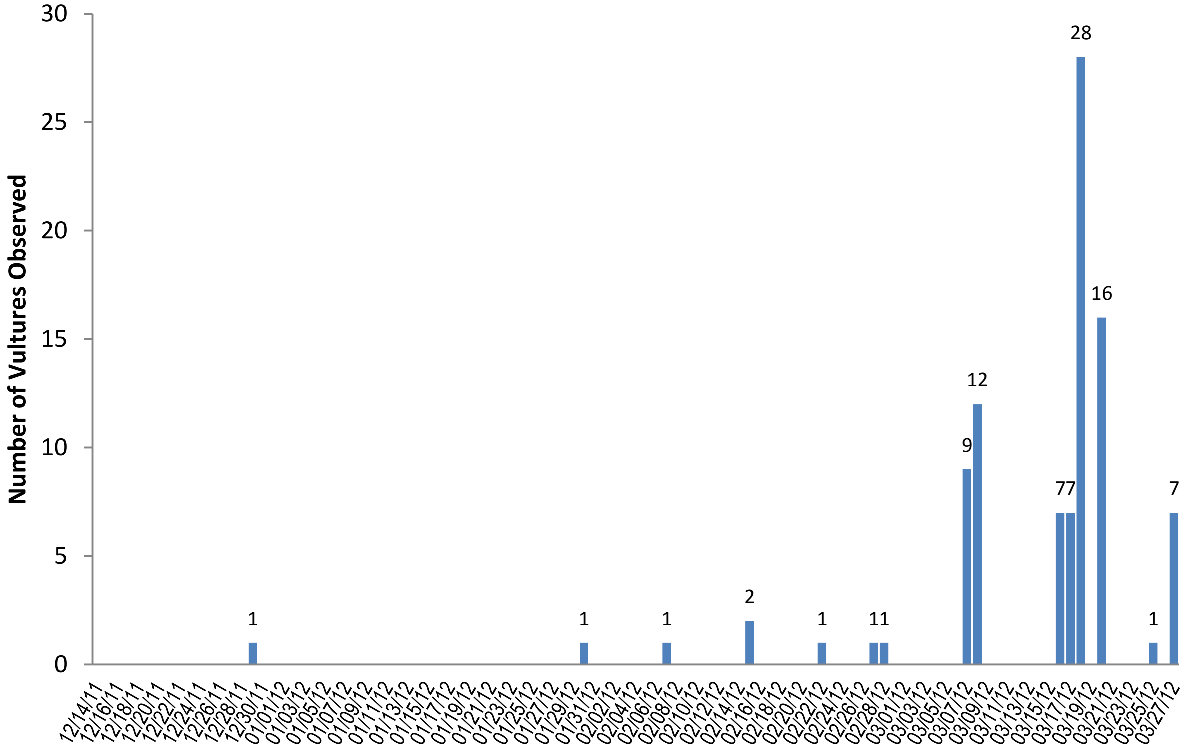

Figure 4c. Total vulture observations by survey day during winter raptor surveys.

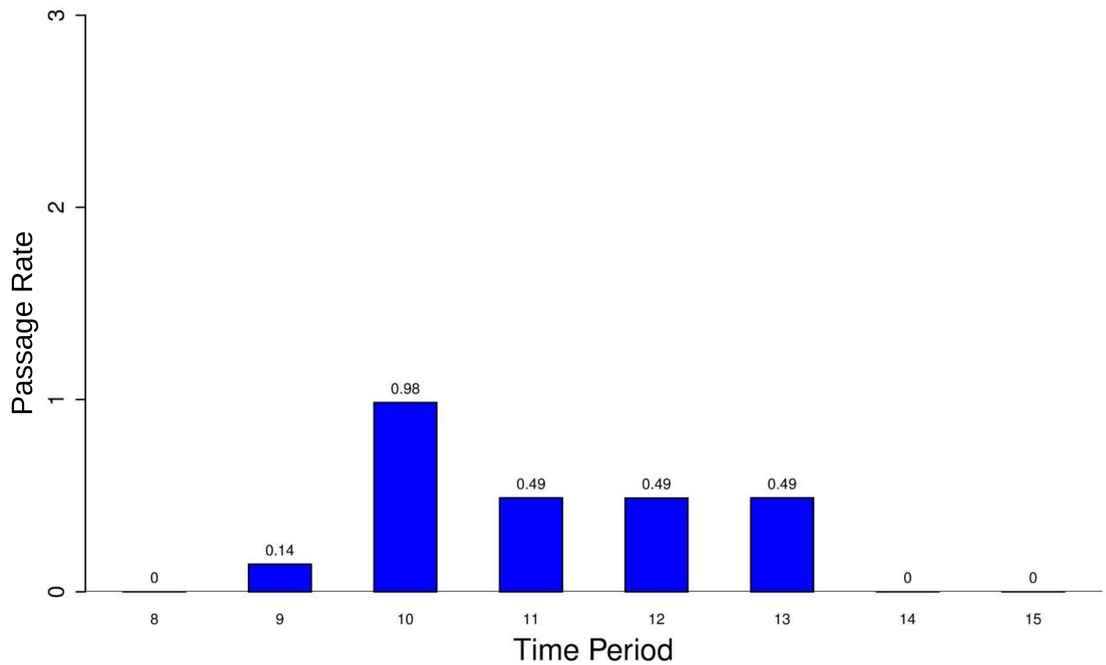

Figure 5a. Buteo passage rates by daily time period (hour) during the winter raptor surveys.

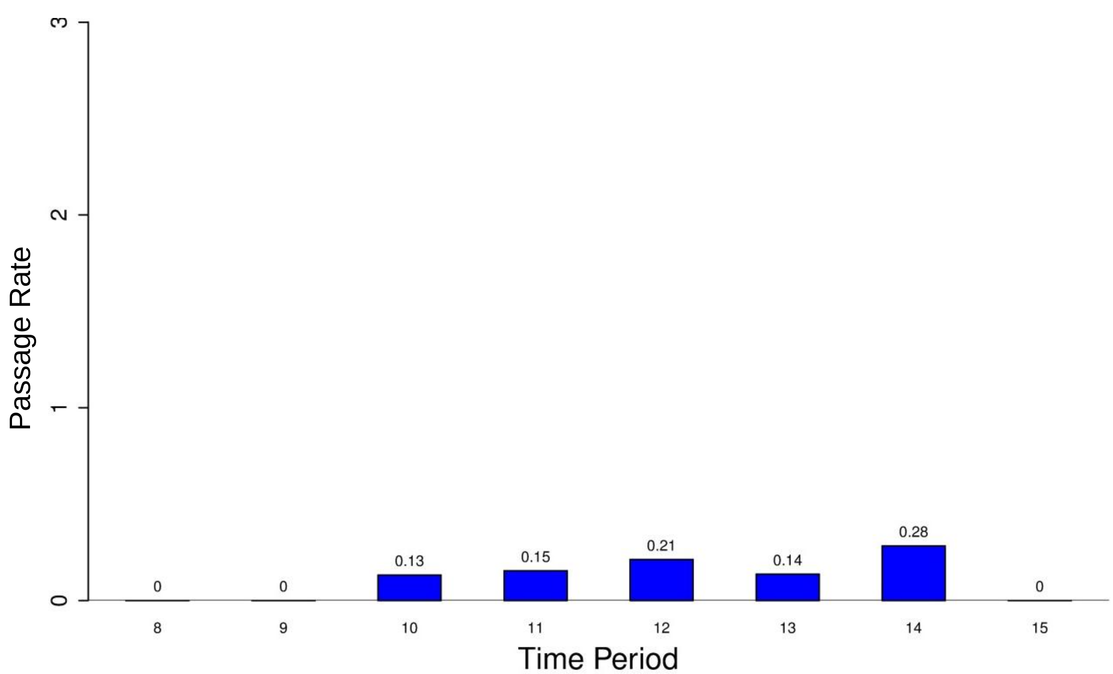

Figure 5b. Eagle passage rates by daily time period (hour) during the winter raptor surveys.

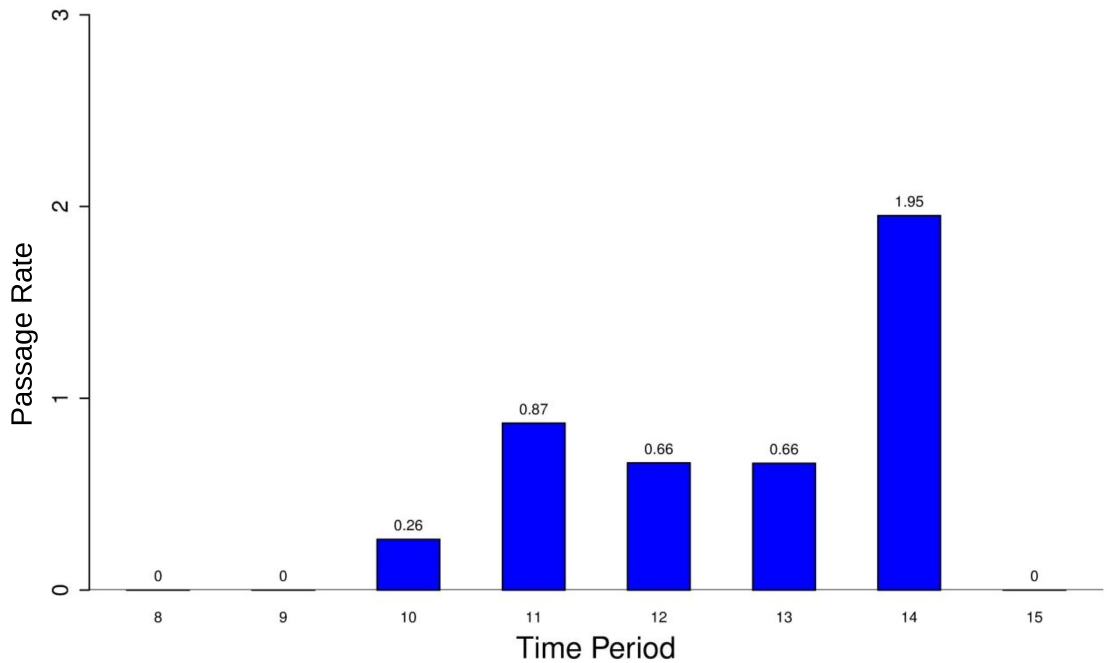

Figure 5c. Vulture passage rates by daily time period (hour) during the winter raptor surveys.

3.4 Flight Height Characteristics

Approximately 9% of flying raptors within 800 m of the survey stations were within the RSH (Table 5). About 3% of flying buteos and 30.0% of flying eagles within 800 m of the survey stations were within the RSH. About 15% of flying turkey vultures within 800 m of the survey station were observed within the RSH (Table 5).

Table 5. Flight height characteristics of birds observed within 800-m of survey stations during winter raptor surveys.

Bird Type	Number of Groups	Number of Observations	Mean Flight Height (m)	Median Flight Height (m)	Percent in Flight	Percent Within RSH[1]
Diurnal Raptors	**33**	**45**	**29.1**	**20.0**	**48.4**	**8.9**
Buteos	*25*	*35*	*23.5*	*17.0*	*51.5*	2.9
Eagles	*8*	*10*	*46.5*	*24.0*	*40.0*	30.0
Vultures	**23**	**41**	**26.0**	**18.0**	**43.2**	**14.6**

[1] RSH = approximate rotor-swept heights for potential collision with a turbine blade or 44 to 150 m (144 to 492 feet) above ground level.

4.0 DISCUSSION

Winter raptor surveys were designed to provide insight into raptor passage rates and spatial distribution in the BRWEP and proposed expansion area during the winter. In General, the data collected during the winter raptor surveys do not suggest that there are large wintering populations or concentrations within the study area that encompassed both the BRWEP and the proposed expansion area. Raptor diversity and species richness were relatively low, with three species composing 99% of raptors observations: red-shouldered hawk (40%), red-tailed hawk (32%), and golden eagles (27%). Overall the raptor passage rate during the winter surveys was also low, averaging less than one raptor observed per hour (0.51 raptor per observer-hour). Winter raptor study data for other locations or developments in the region are lacking or not publicly available; therefore, it is unknown how raptor and eagle winter passage rates at the BRWEP compare to raptor and eagle use in the surrounding region.

Data collected during the survey on golden eagles suggests that, while they do occur in the study area during the winter, the standardized passage rates are relatively low and there were no unique feature of the study area that appeared to concentrate eagle activity. Golden eagle activity was distributed throughout the study area with relatively even passage rates across the survey stations (see Figures 2b and 3b). Ten eagle observations were of flying birds within 800 m of the survey stations and of these three were flying within the RSH of turbines at the facility. Golden eagle activity was concentrated in the middle of the day between 1000 and 1500 hours, with the highest relative passage rate after midday (1200).

5.0 REFERENCES

Beech Ridge Energy, LLC (BRE). 2013. Final Avian Protection Plan for Beech Ridge Energy LLC's Beech Ridge Wind Project Greenbrier and Nicholas Counties, West Virginia. January 2013

HawkWatch International (HWI) website. http://www.hawkwatch.org/home/

Young, D.P. 2011. Spring and Fall Eagle and Osprey Surveys for the Beech Ridge Wind Energy Project, Greenbrier and Nicholas Counties, West Virgini, March-May and September-October, 2011. Technical Report prepared for: Beech Ridge Energy LLC, Chicago, Illinois. Prepared by: Western EcoSystems Technology, Inc., Waterbury, Vermont and Cheyenne, Wyoming. Januarey 23, 2011.