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.

Prepared by:
Ronald A. Canterbury
Director and Research Scientist
The Southern West Virginia Bird Research Center
13 Crown Point
Princeton, West Virginia 24740

Citation: Canterbury, R. A. 2006. Avian Phase I Assessment of Bird Populations on the Meadwestvaco Wind Power Project in Greenbrier County, West Virginia: Spring and Fall 2005. Technical report prepared for Potesta & Associates and Beech Ridge Energy, LLC. Charleston, West Virginia. 124 pp.

ACKNOWLEDGMENTS

I thank Potesta & Associates and Beech Ridge Energy, LLC. for permission to conduct this study and for support, guidance, and review of the report. I also thank all the field crew from the Southern West Virginia Bird Research Center who participated on this study.

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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

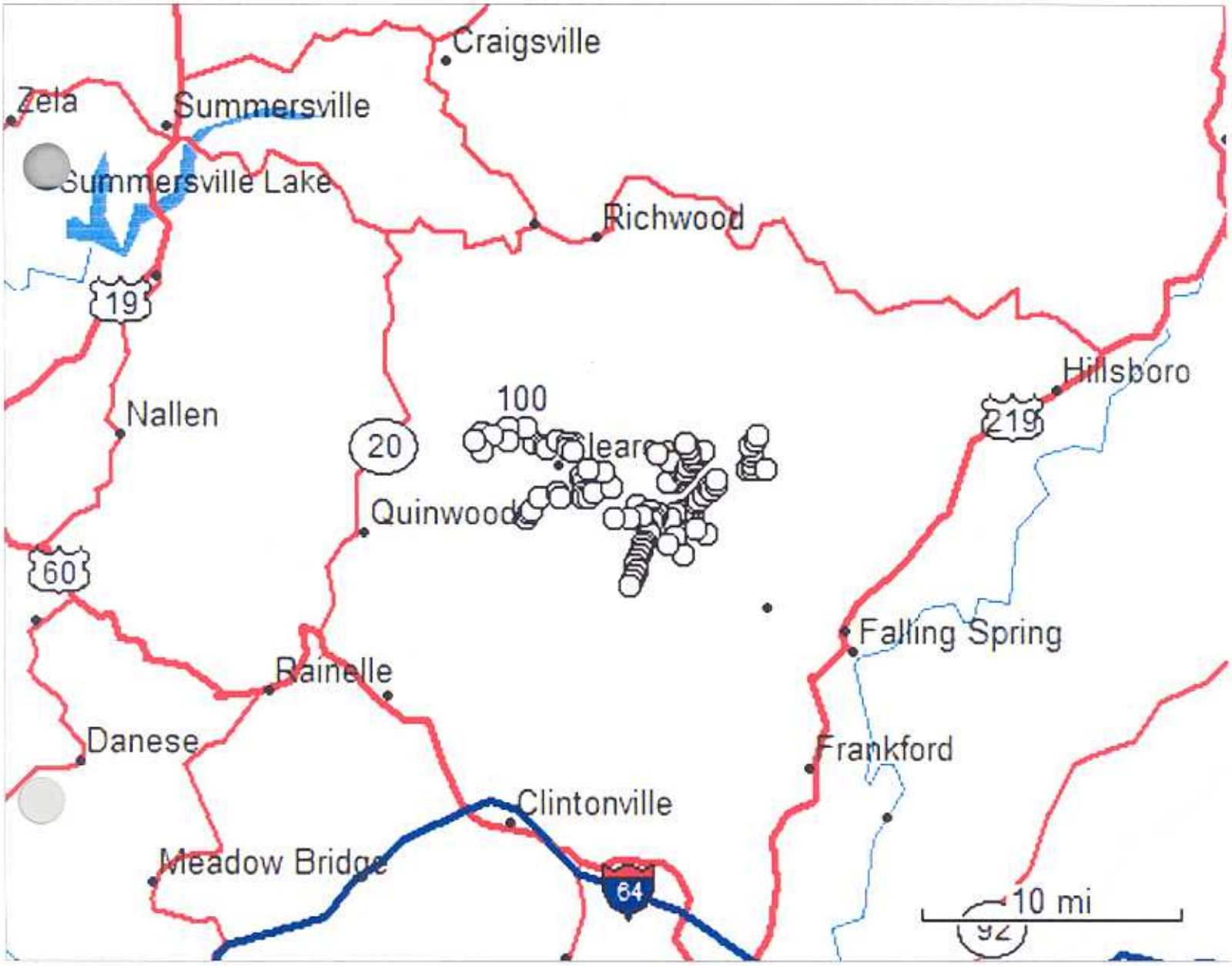

Figure 1. Location of the proposed MeadWestvaco Wind Project
(Circles represent localities of bird fixed-point surveys).

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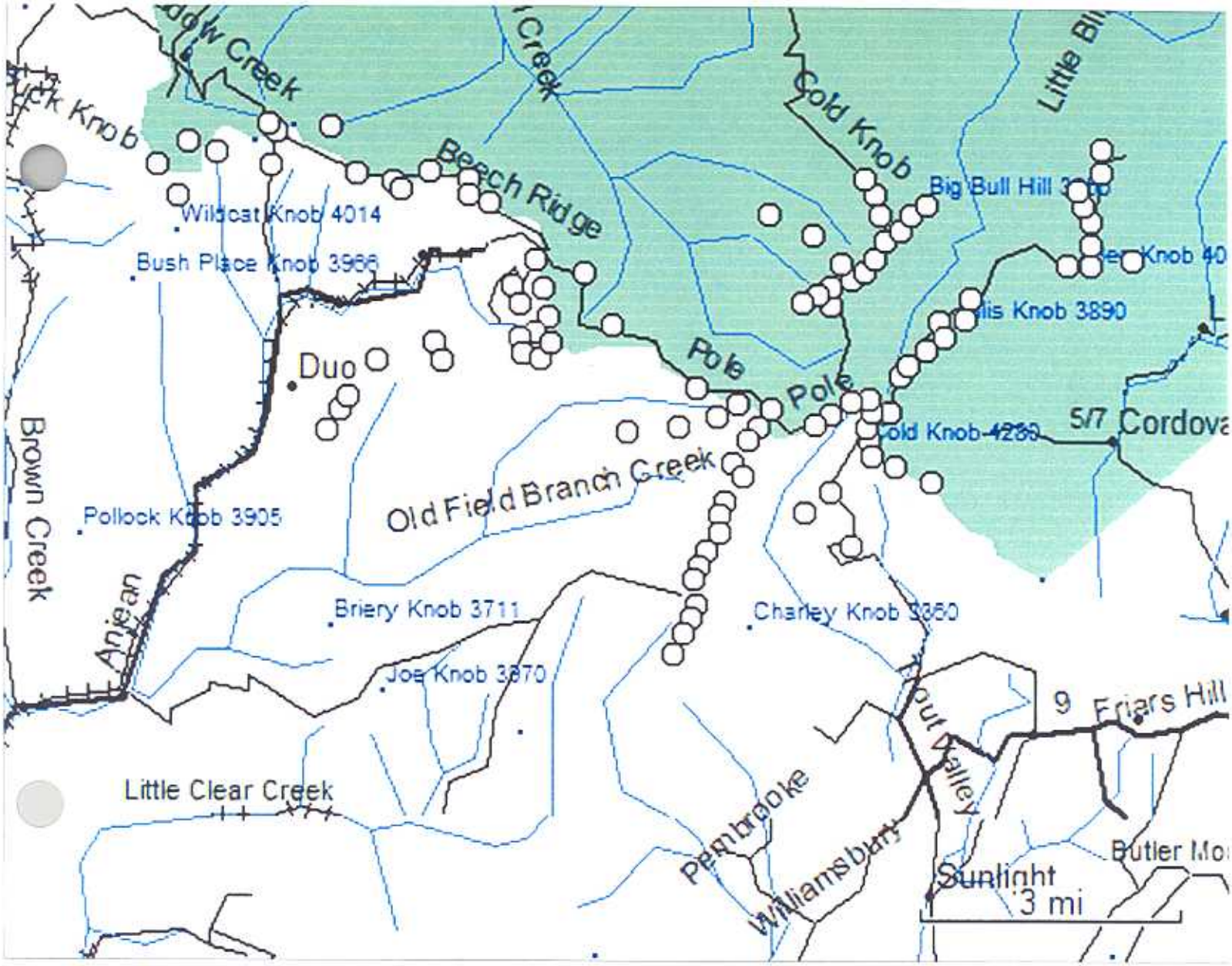

Figure 2. Location of the avian fixed-point surveys.

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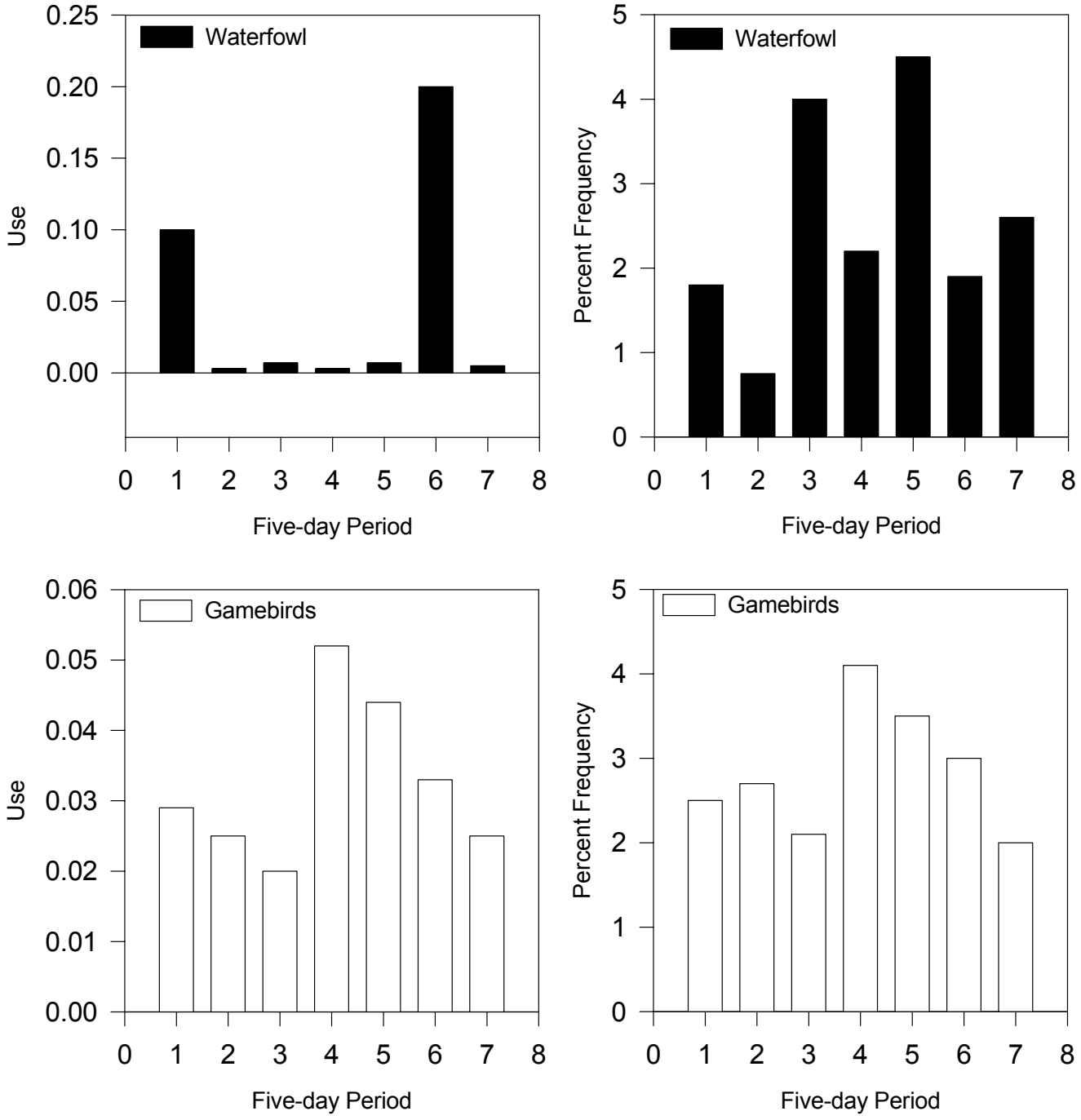


Figure 3. Mean use and frequency of occurrence for avian groups by 5-day periods from May 12 to June 15.

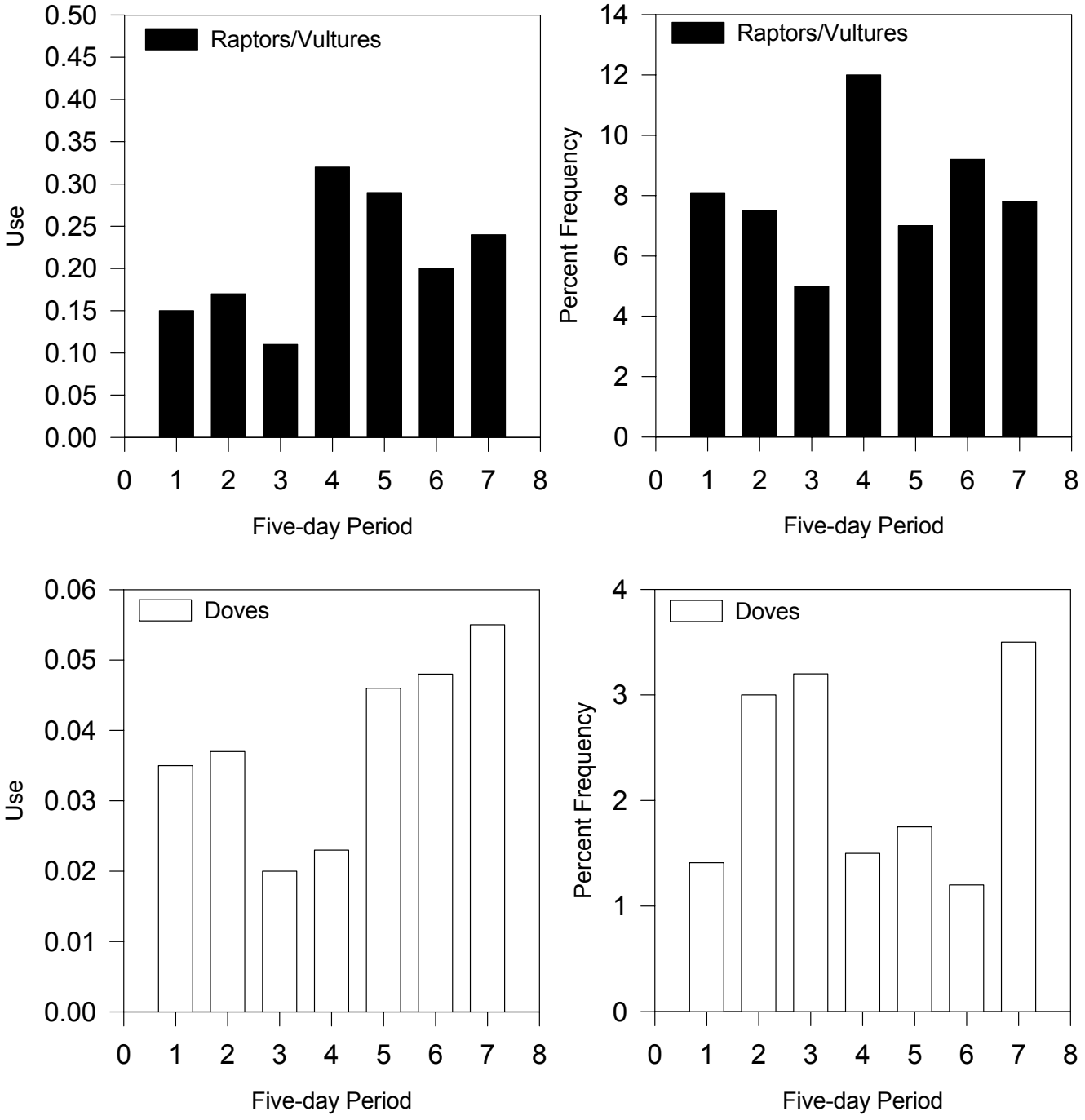


Figure 3 (continued). Mean use and frequency of occurrence for avian groups by 5-day periods from May 12 to June 15.

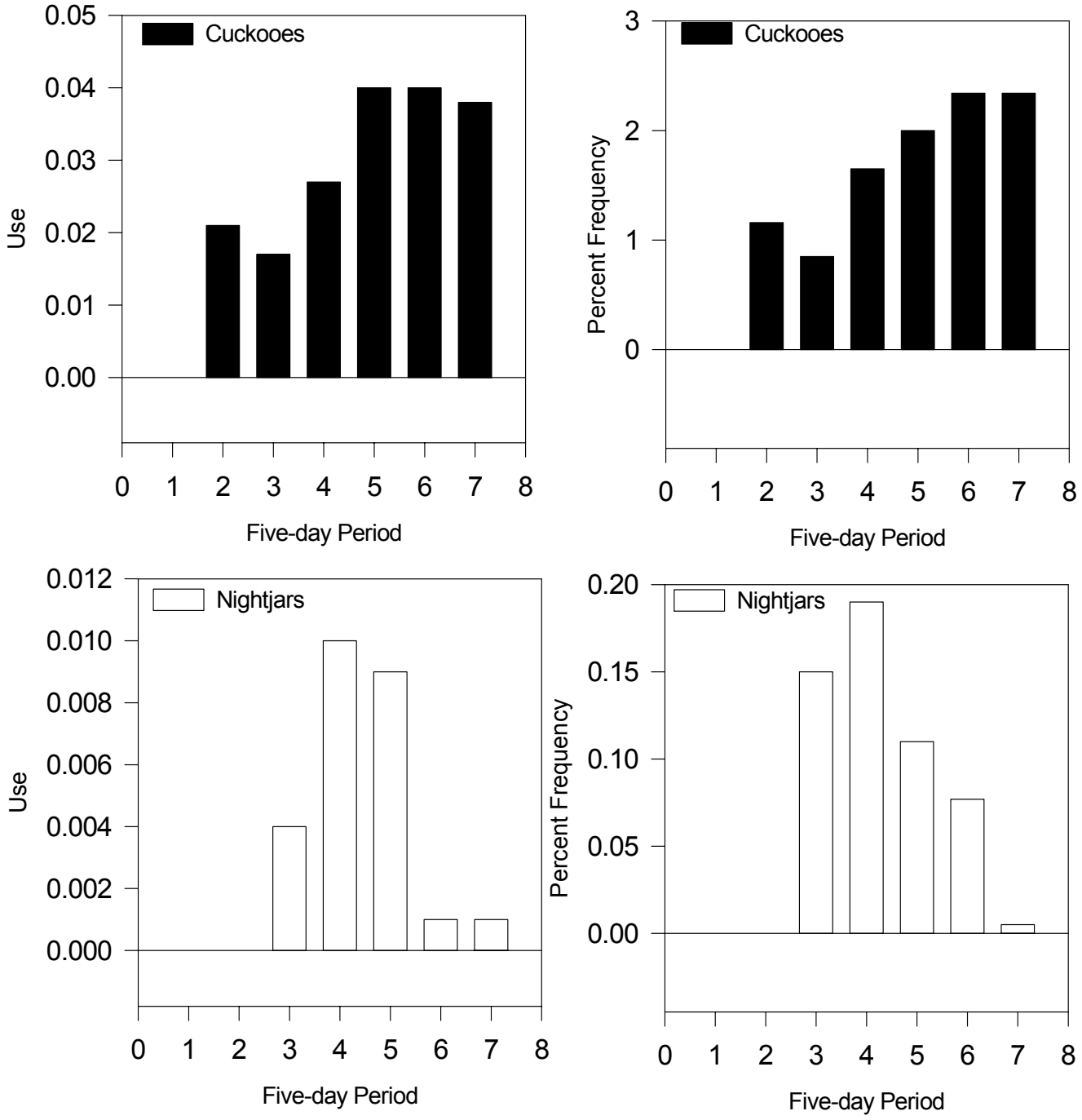


Figure 3 (continued). Mean use and frequency of occurrence for avian groups by 5-day periods from May 12 to June 15.

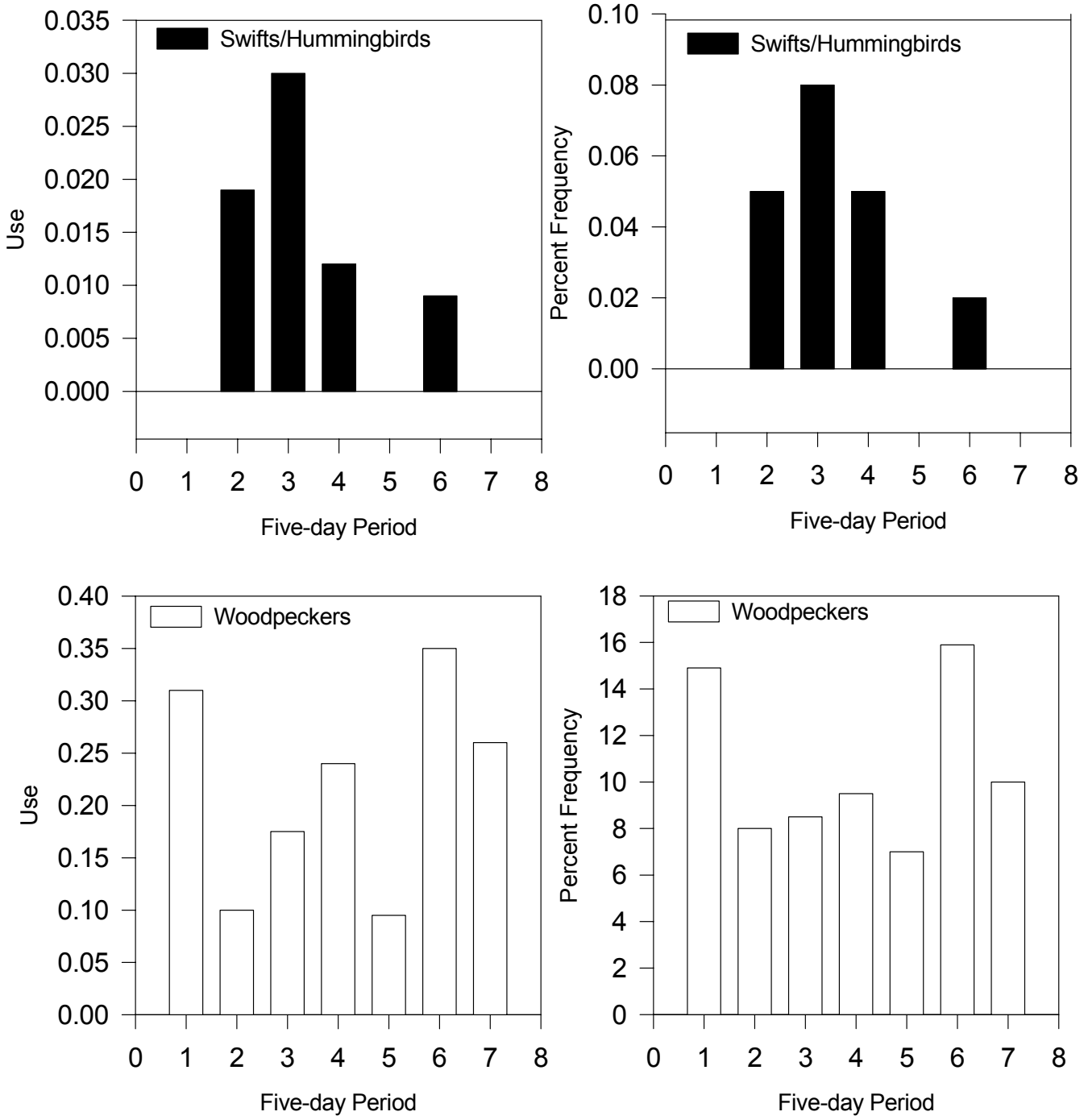


Figure 3 (continued). Mean use and frequency of occurrence for avian groups by 5-day periods from May 12 to June 15.

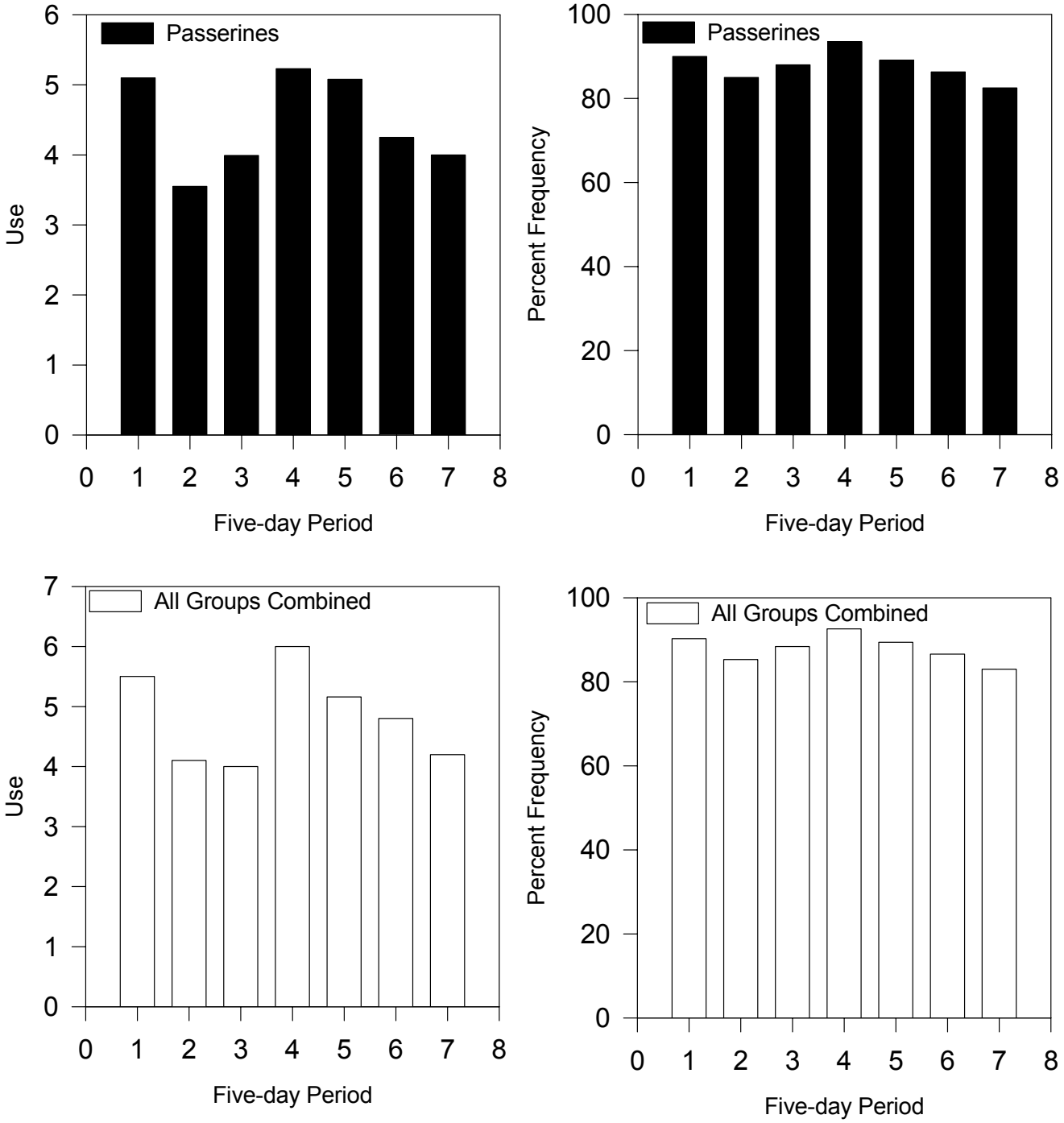


Figure 3 (continued). Mean use and frequency of occurrence for avian groups by 5-day periods from May 12 to June 15.

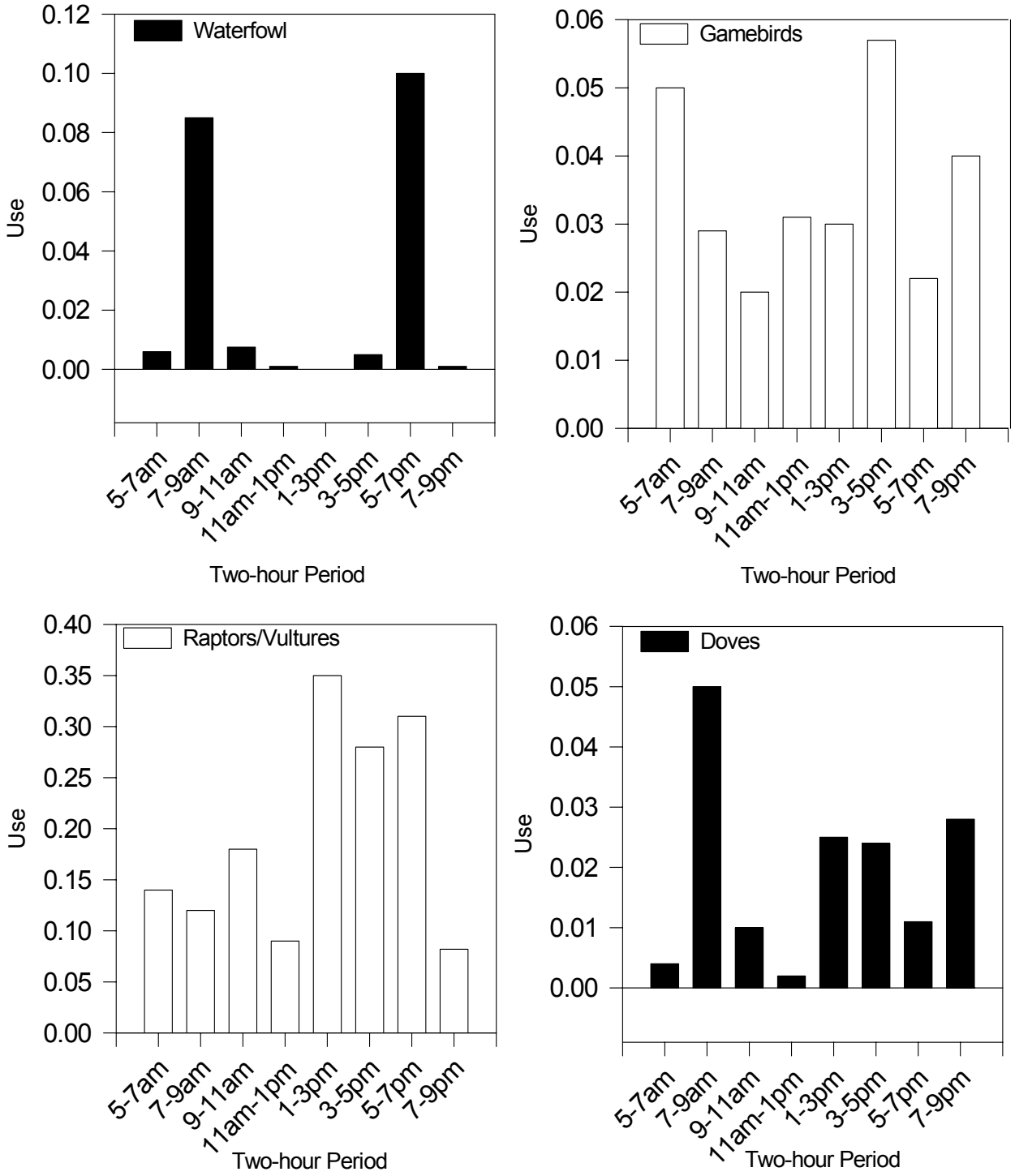


Figure 4. Mean difference in use over two-hour time periods during the spring.

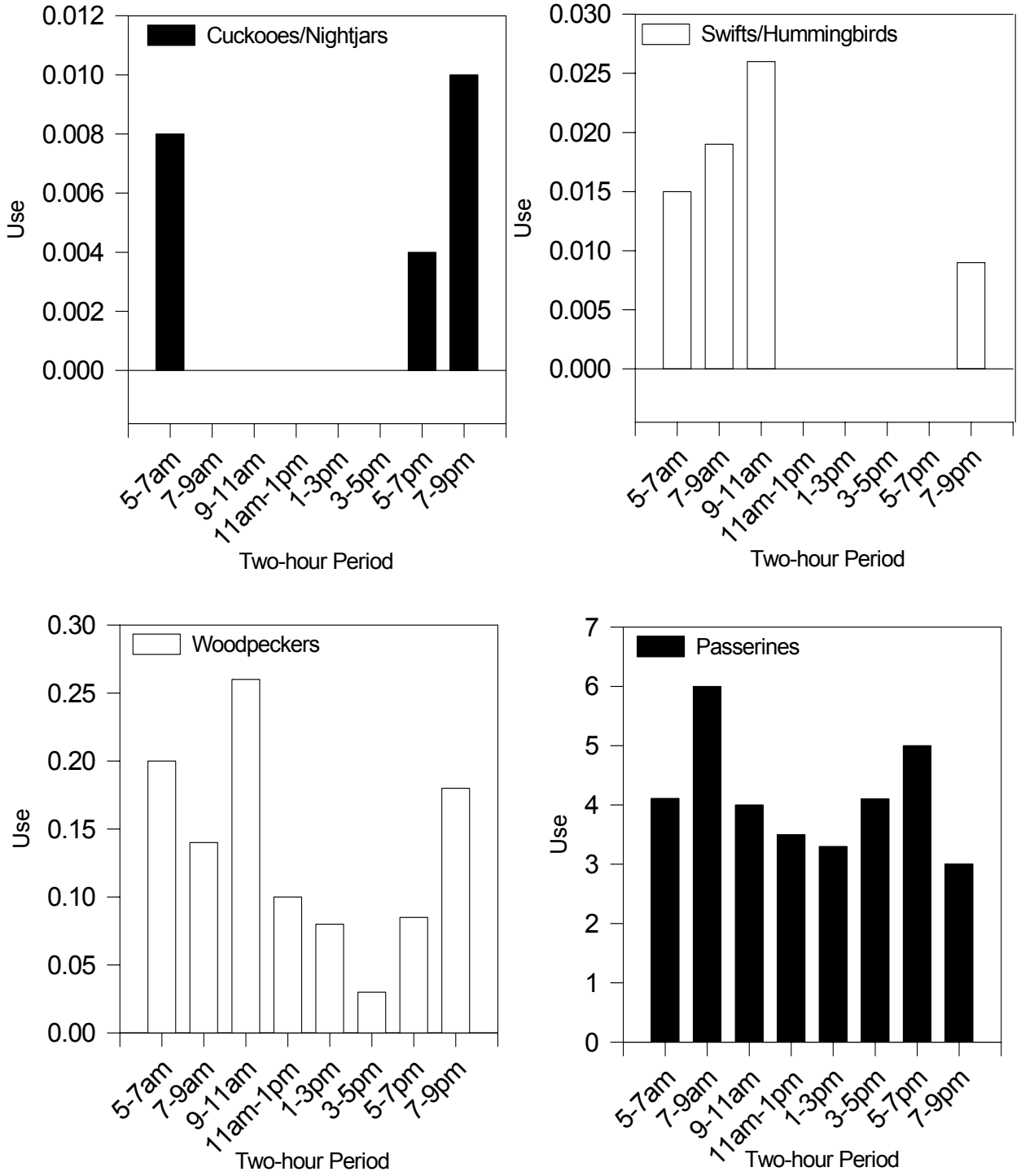


Figure 4. Mean difference in use over two-hour time periods during the spring.

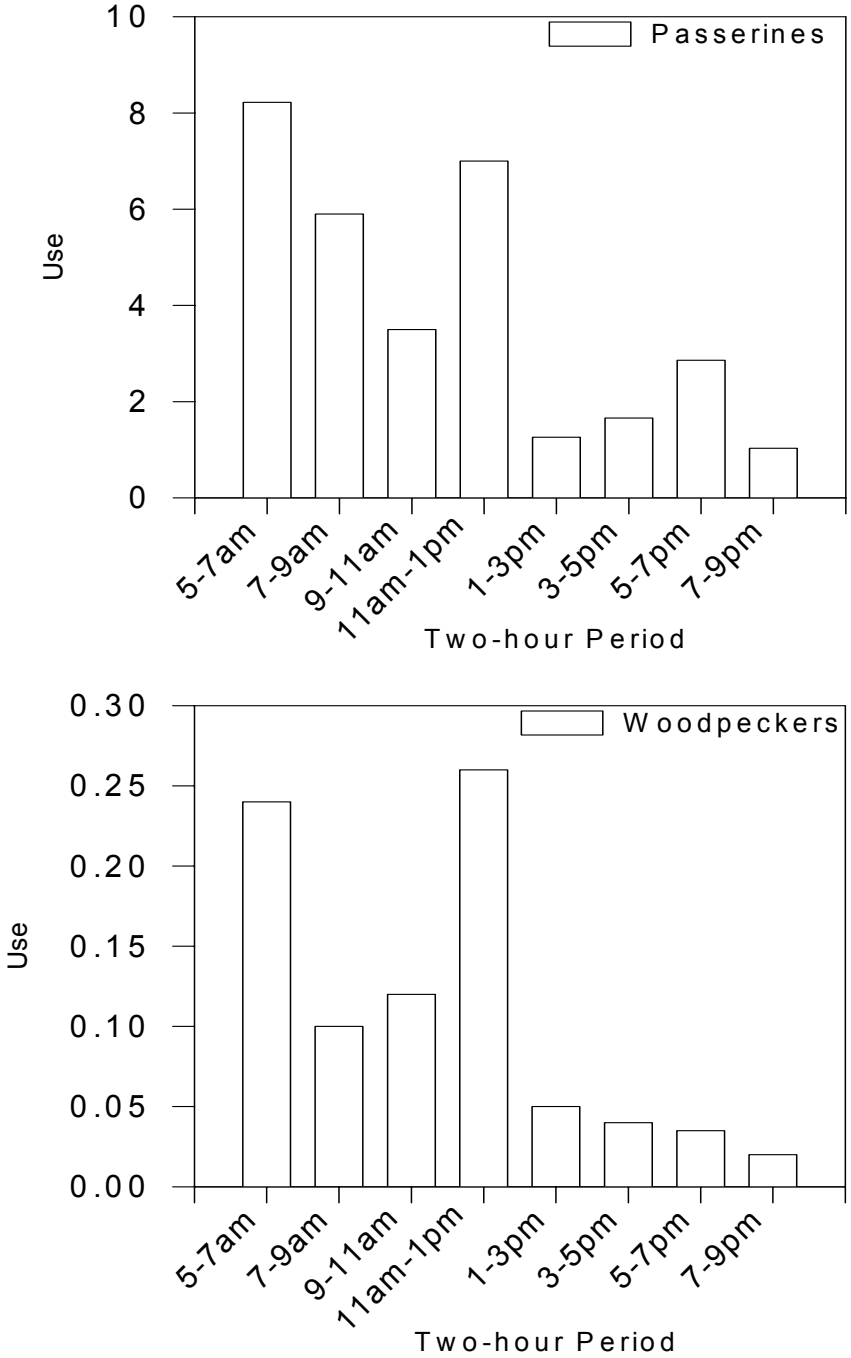
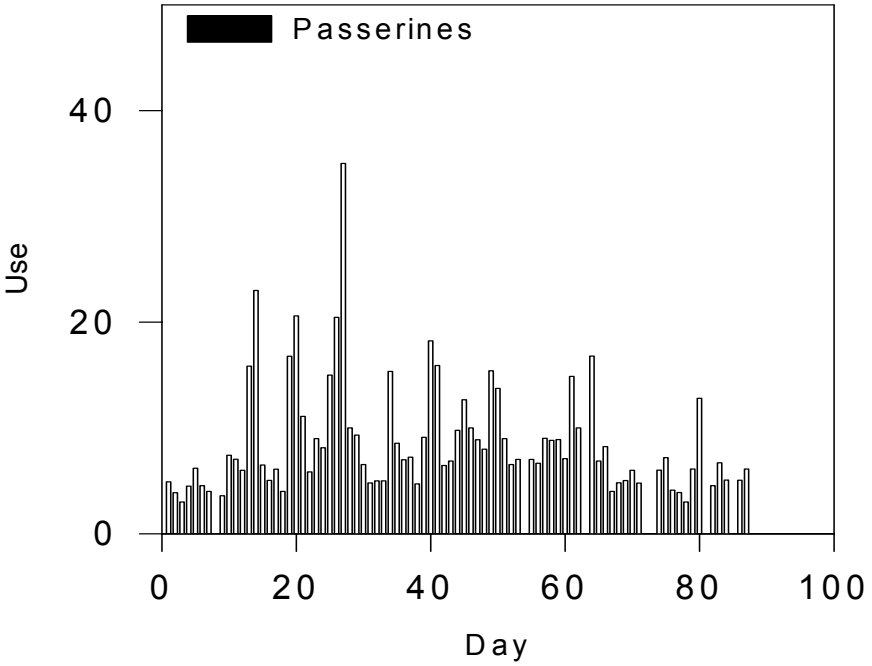


Figure 5. Mean difference in use over two-hour time periods for passerines and woodpeckers in the fall 2005.



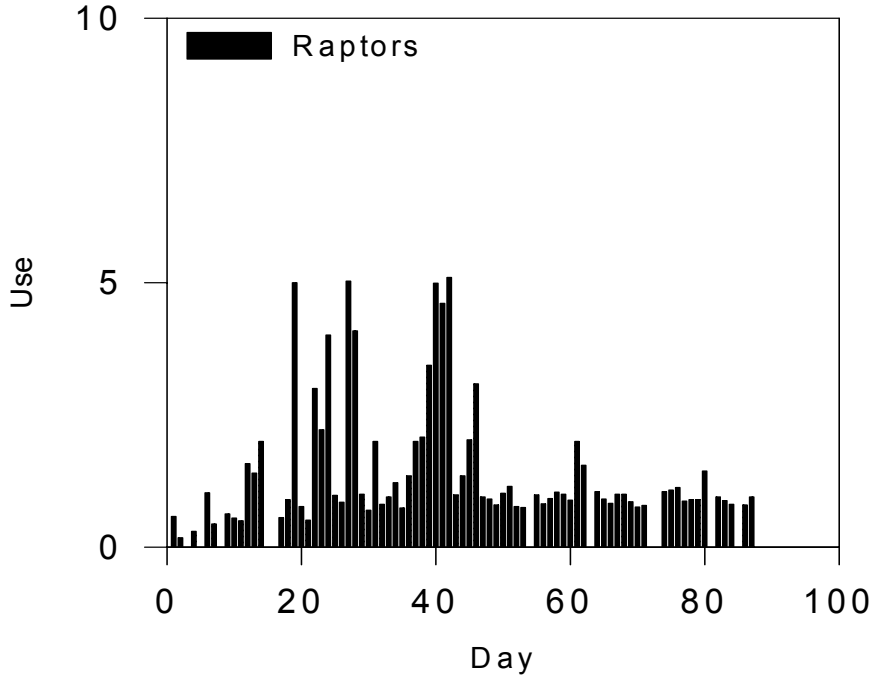


Figure 6. Number of observations per 10-min. survey plotted by day from August 23 - November 15, 2005.

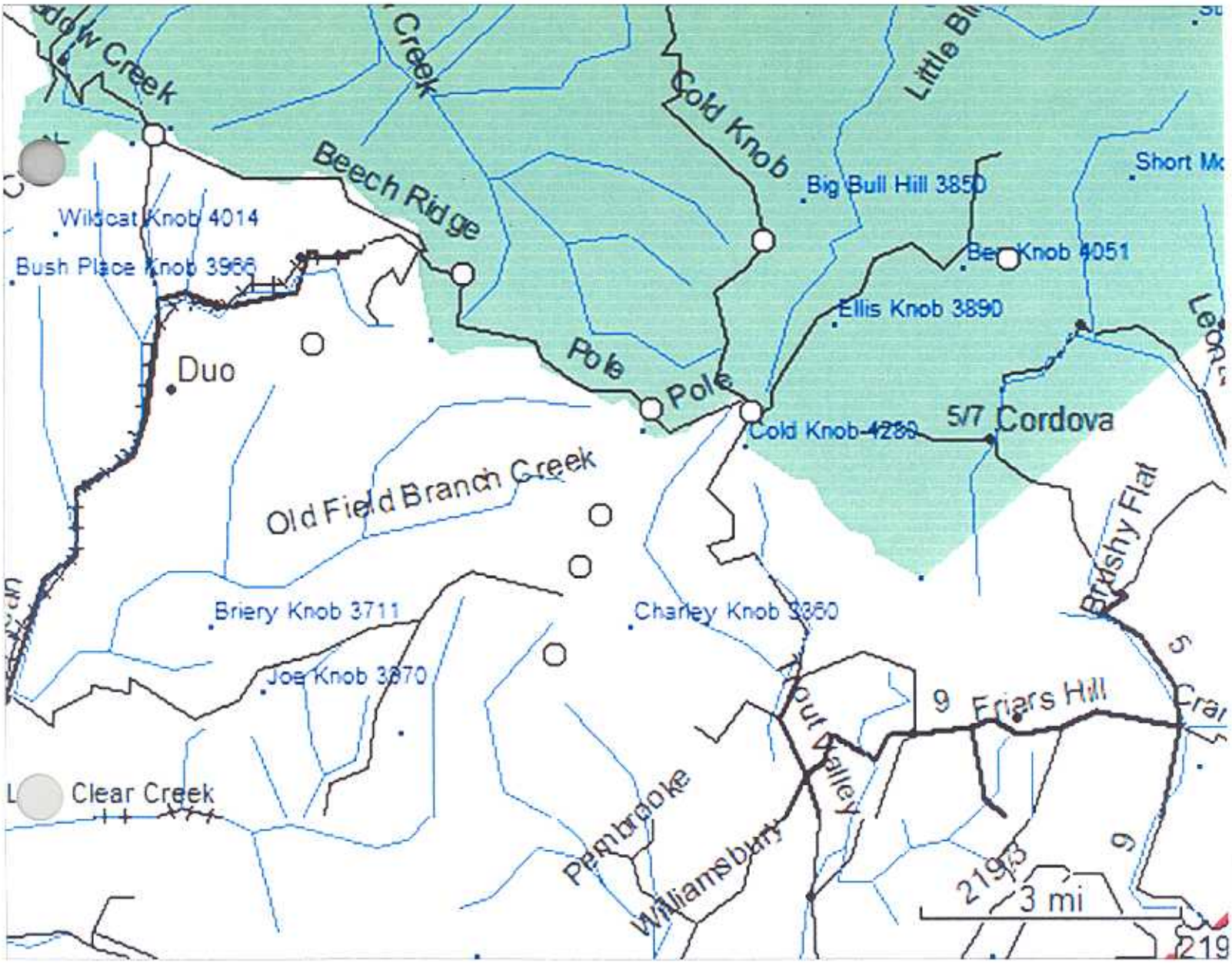


Figure 7. Localities of where Red-shouldered Hawks responded to broadcast calls.

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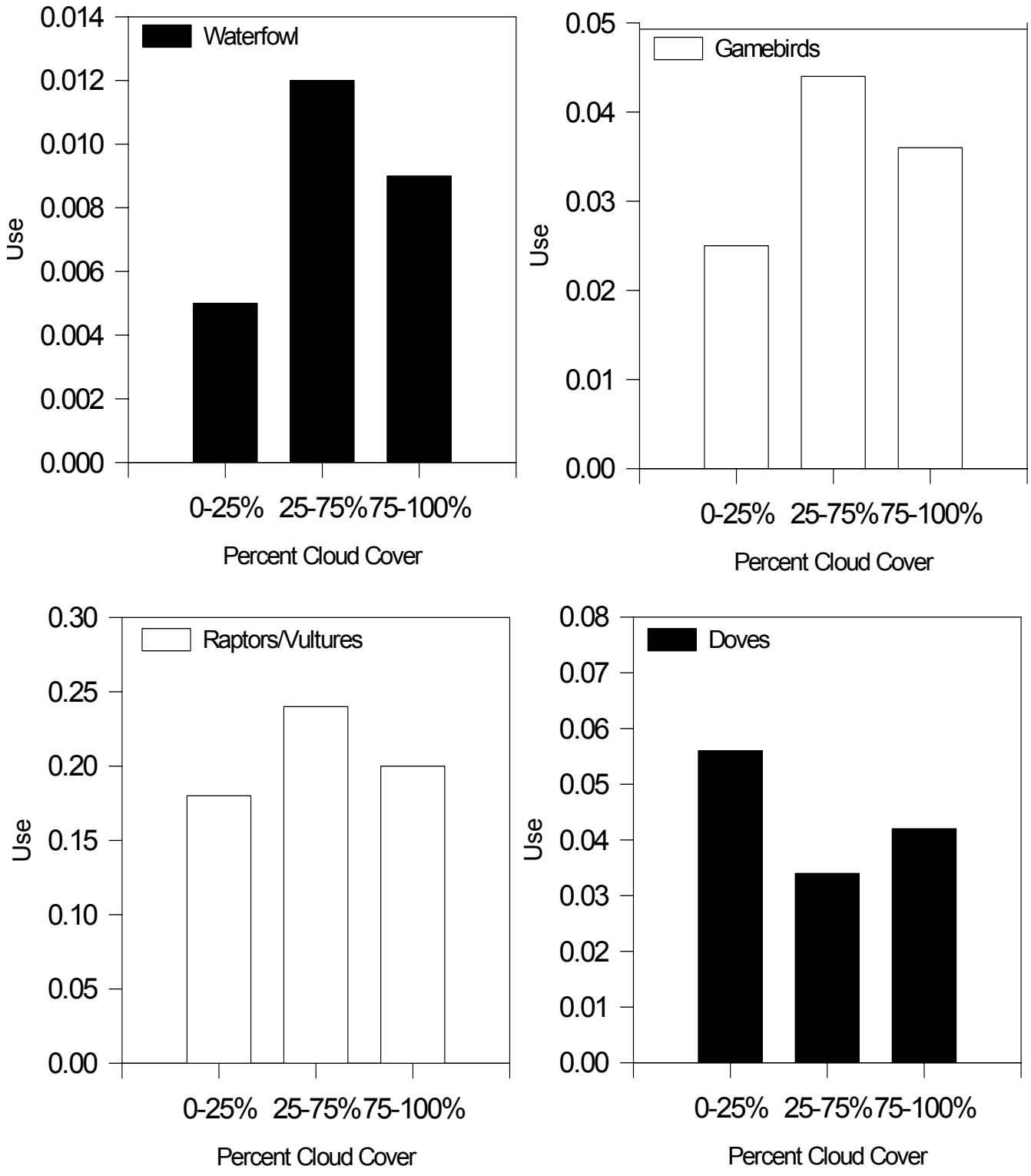


Figure 8. Mean difference in use during surveys with low, medium, and high cloud cover during the spring.

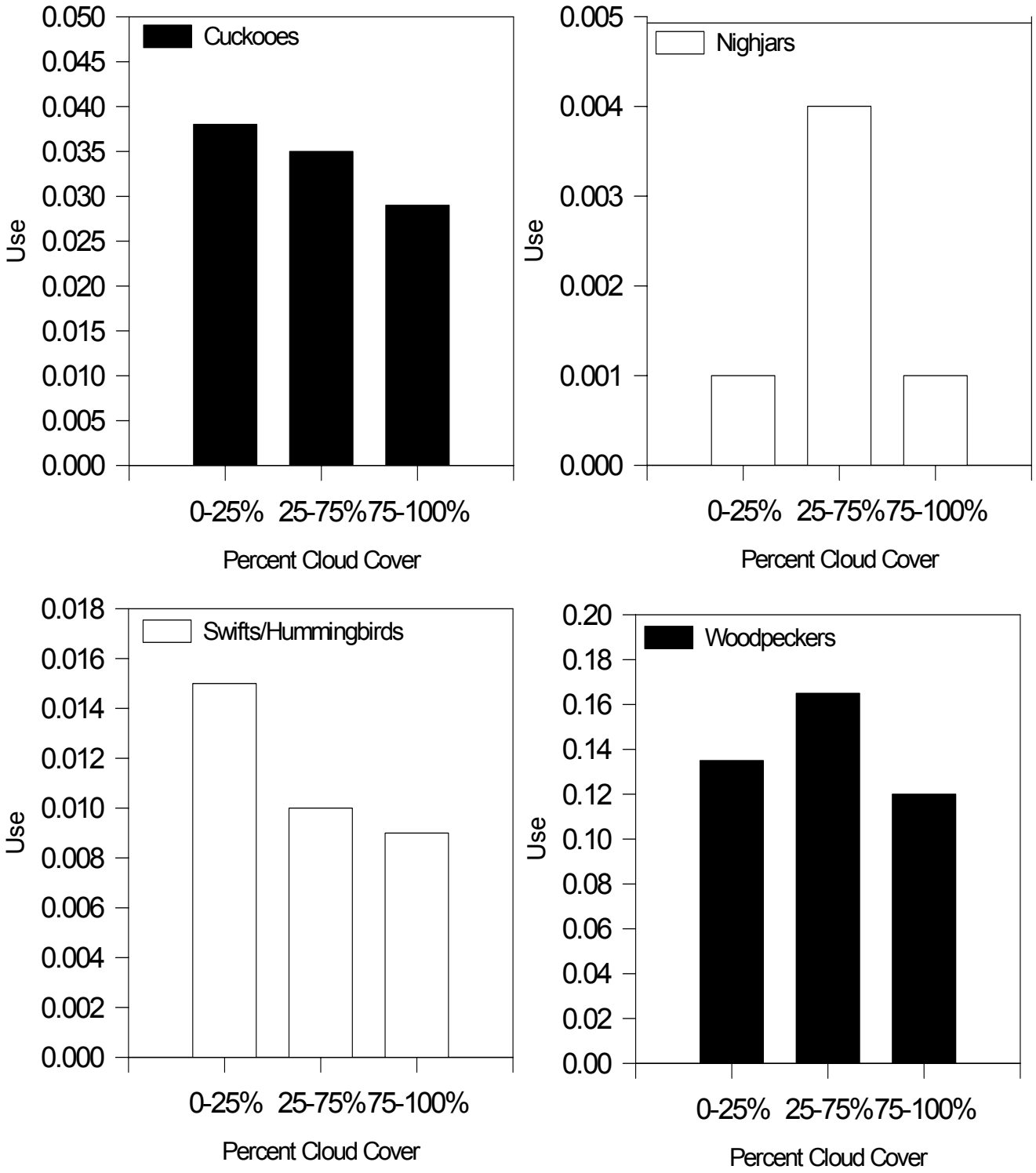
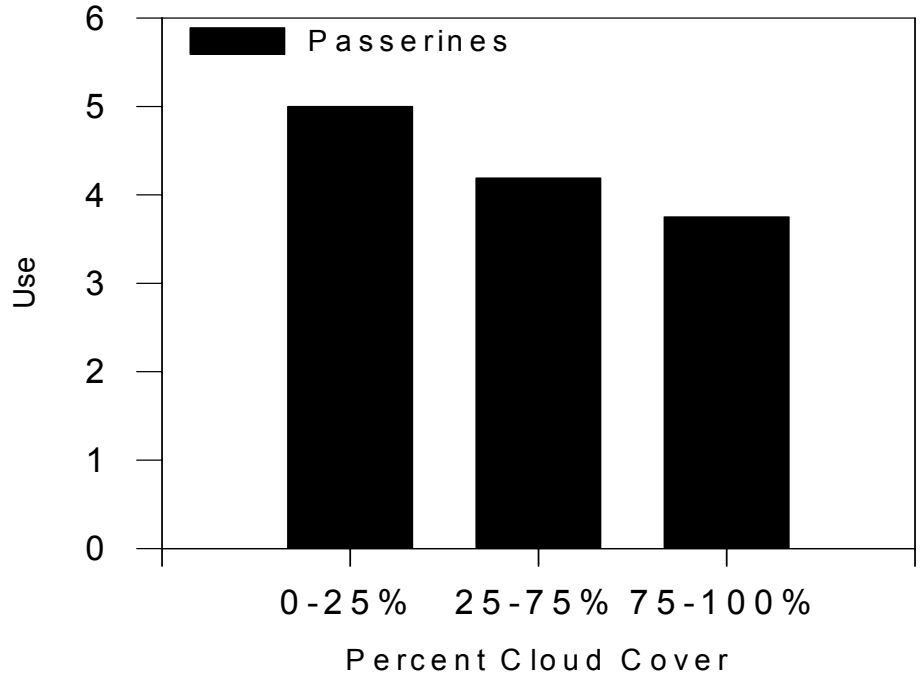


Figure 8 (continued). Mean difference in use during surveys with low, medium, and high cloud cover during the spring.



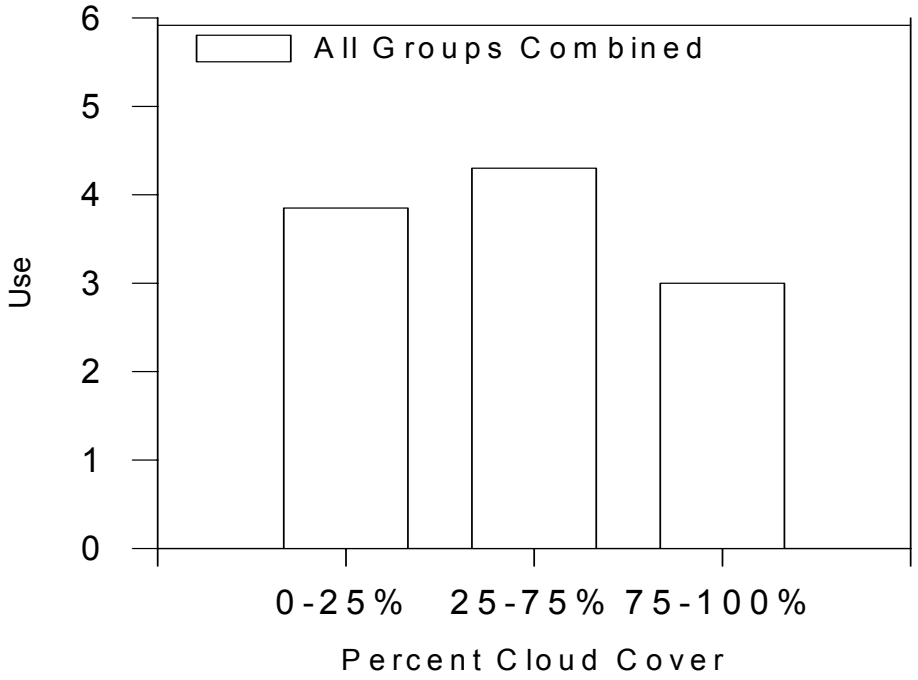
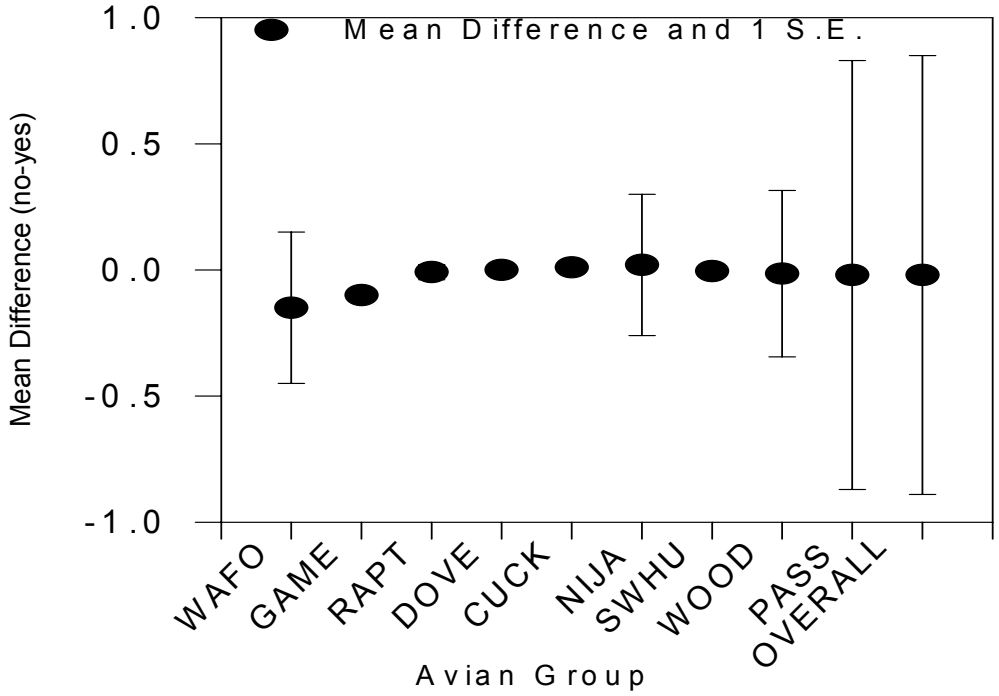


Figure 8 (continued). Mean difference in use during surveys with low, medium, and high cloud cover during the spring.



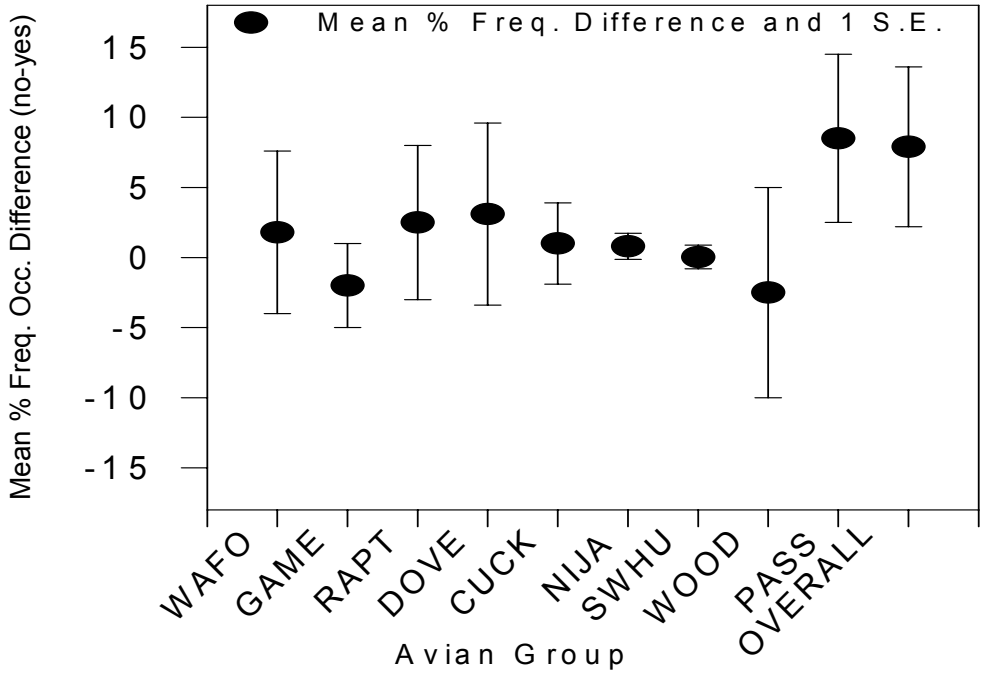


Figure 9. Mean difference in spring use and freguency of occurrence between surveys with and without precipitation (bars are 1 standard error)

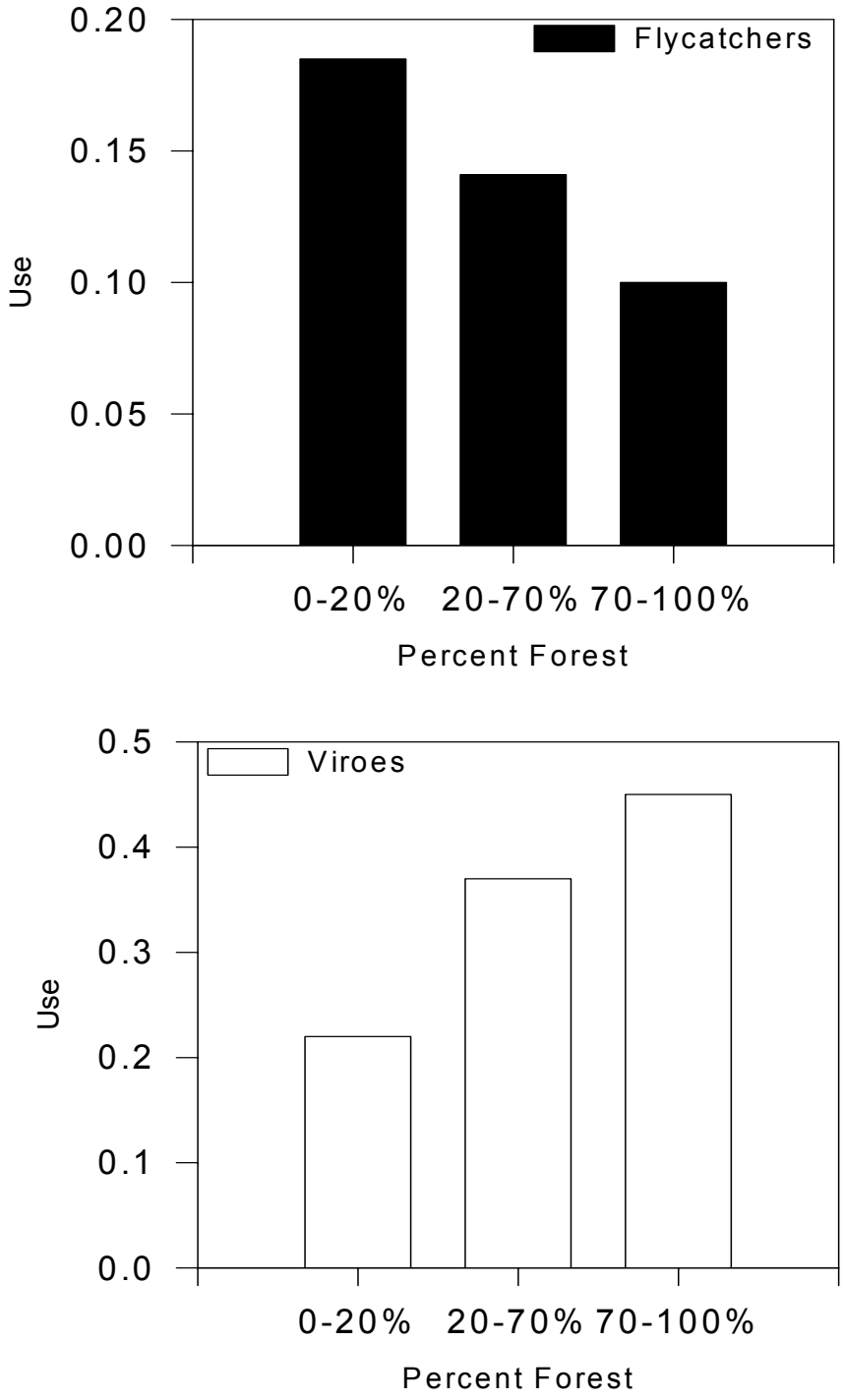
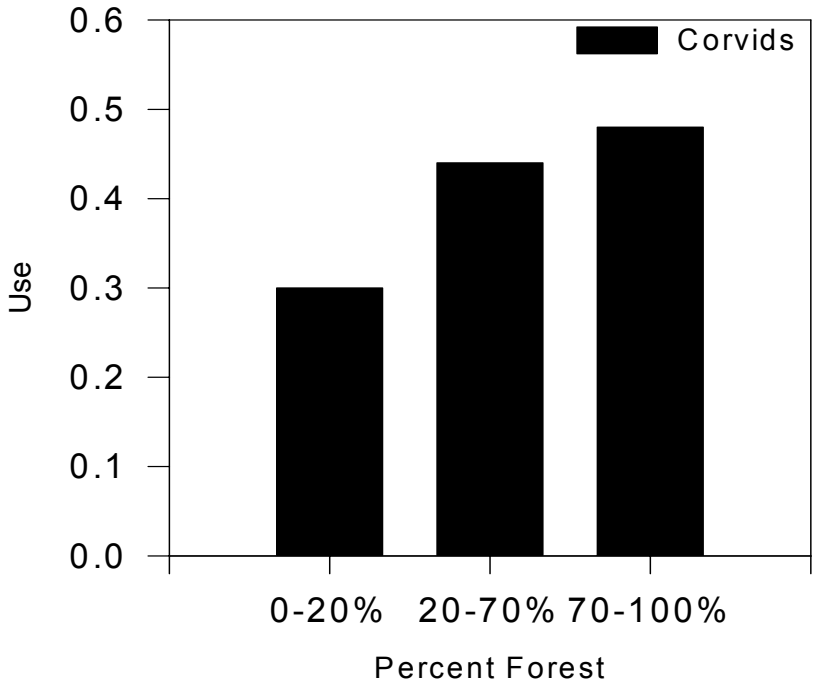


Figure 10. Passerine use by forest cover during the spring.



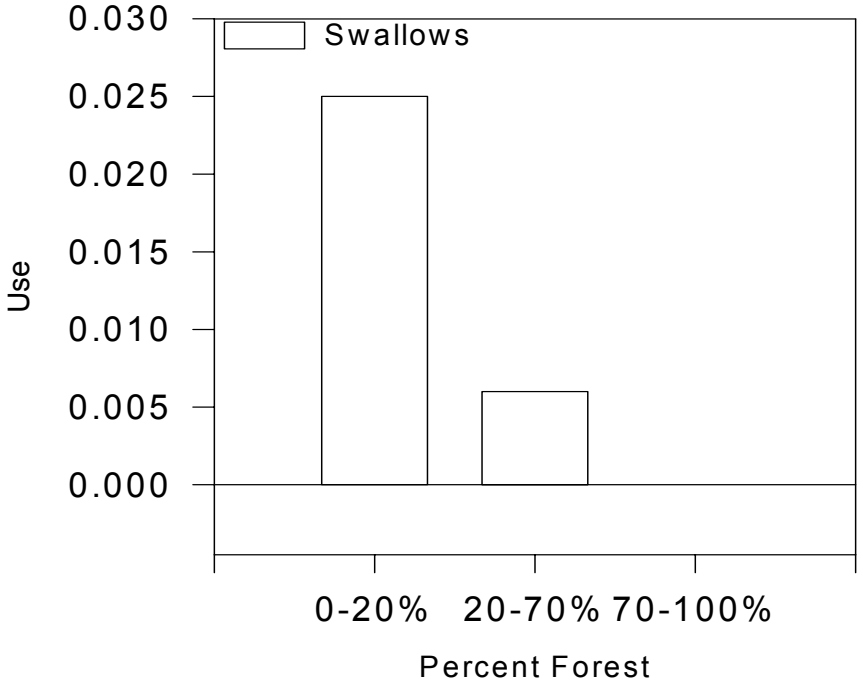


Figure 10 (continued). Passerine use by forest cover during the spring.

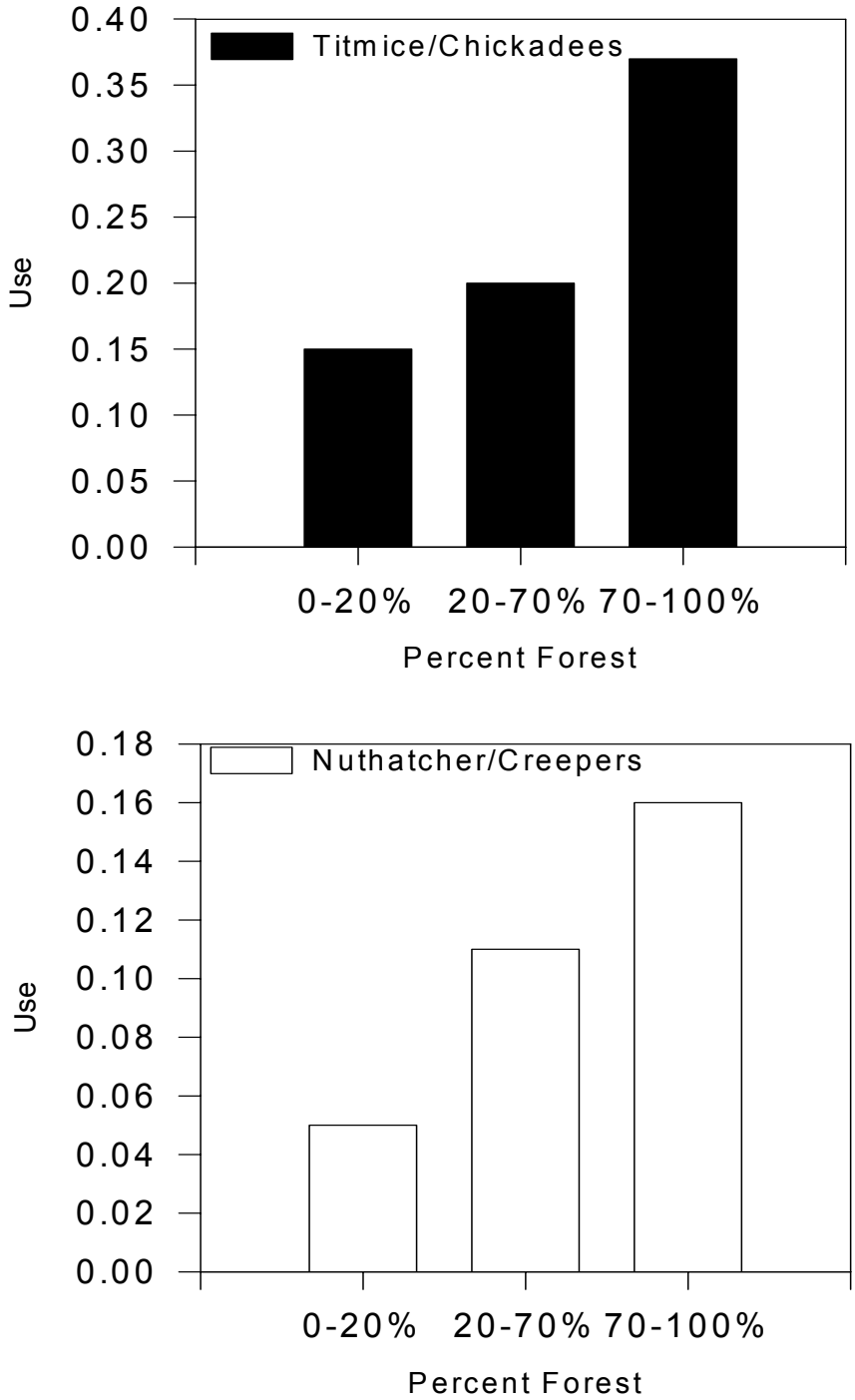
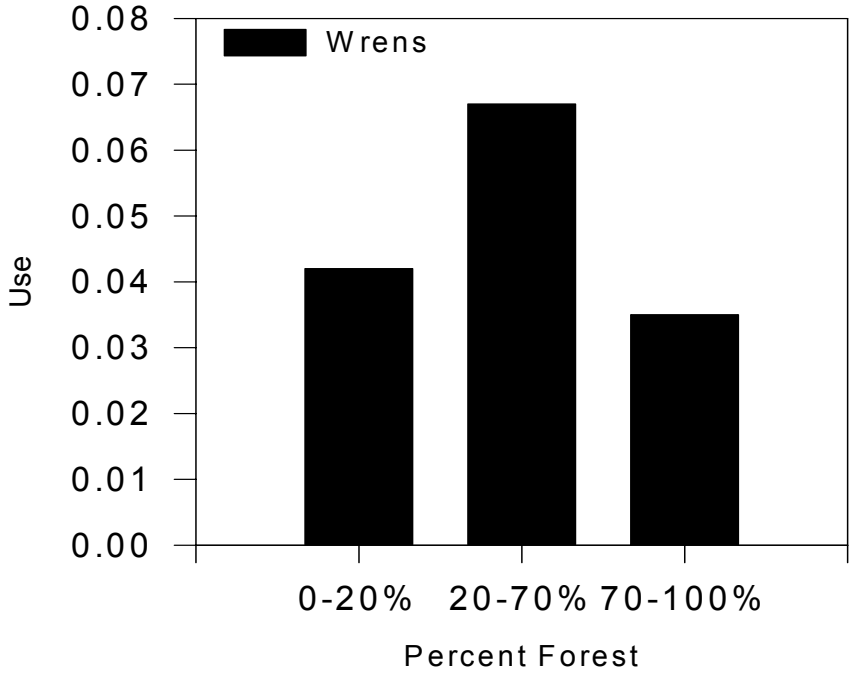


Figure 10 (continued). Passerine use by forest cover during the spring.



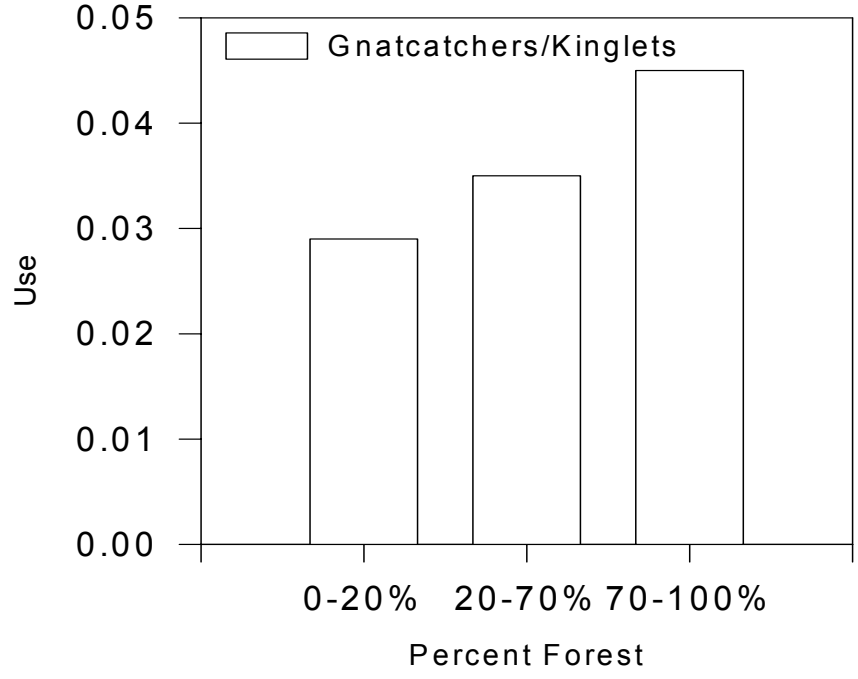
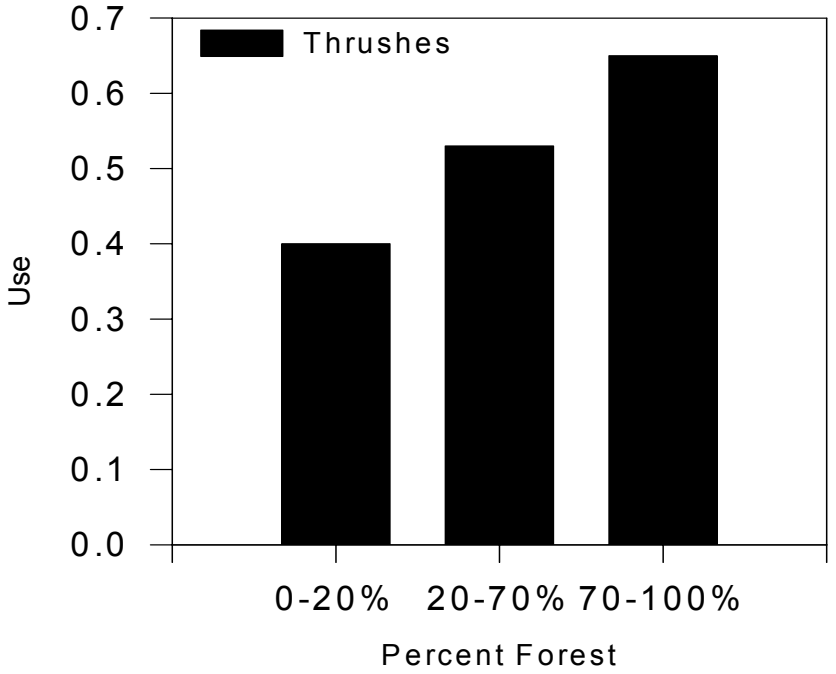


Figure 10 (continued). Passerine use by forest cover during the spring.



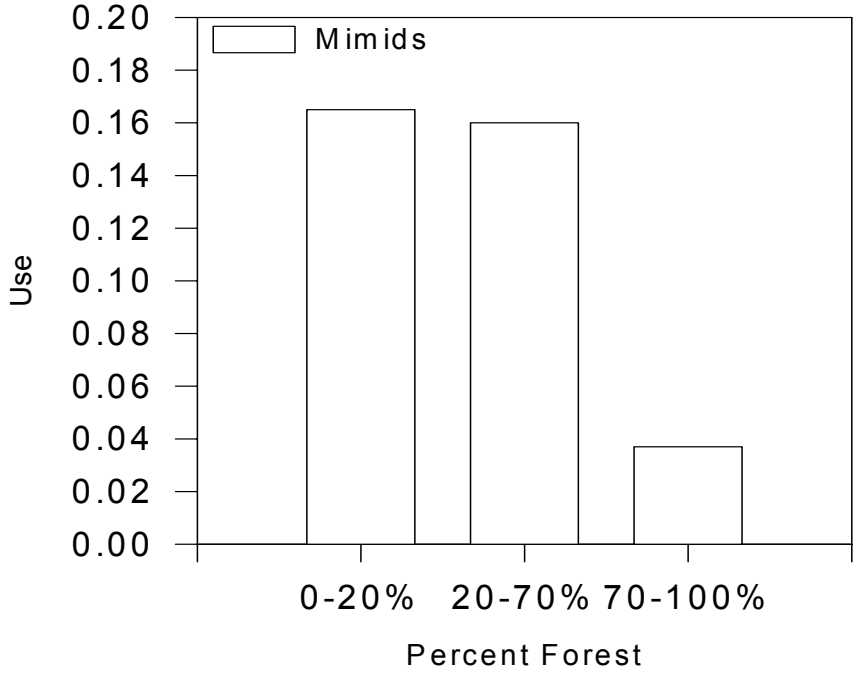
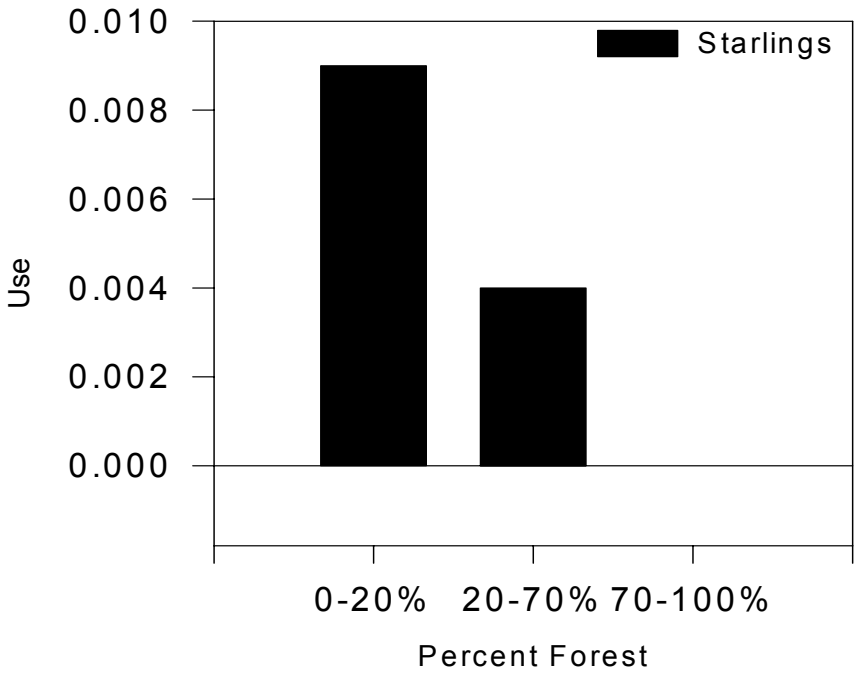


Figure 10 (continued). Passerine use by forest cover during the spring.



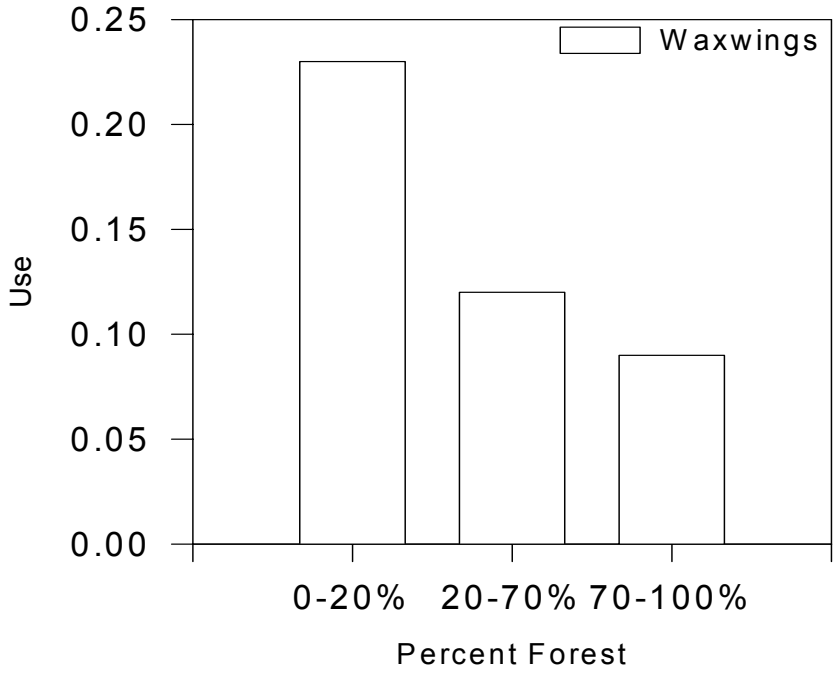
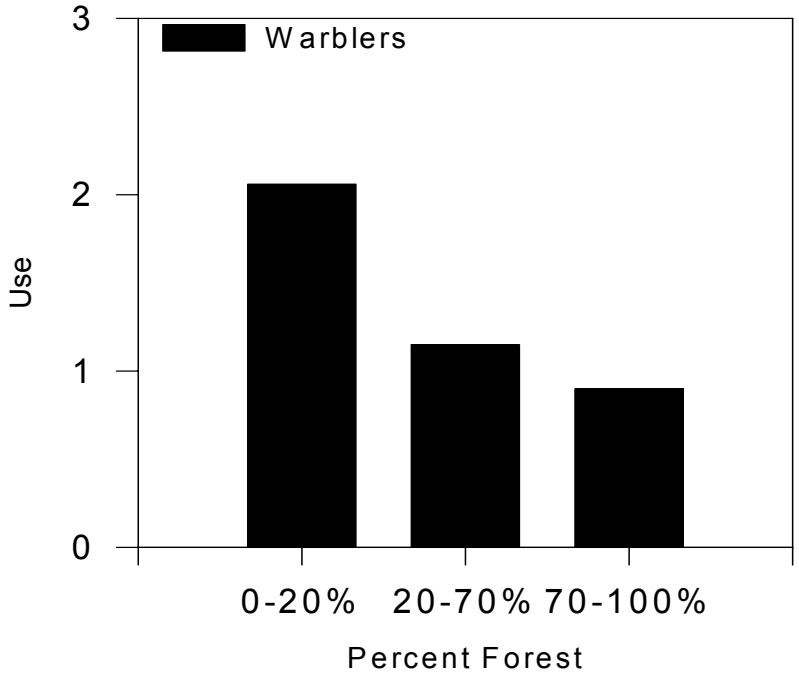


Figure 10 (continued). Passerine use by forest cover during the spring.



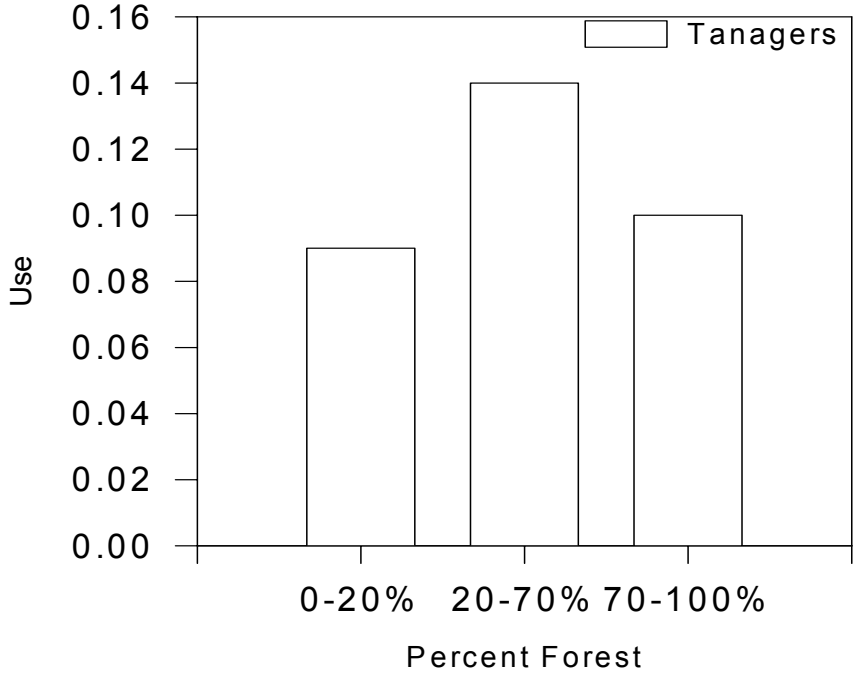
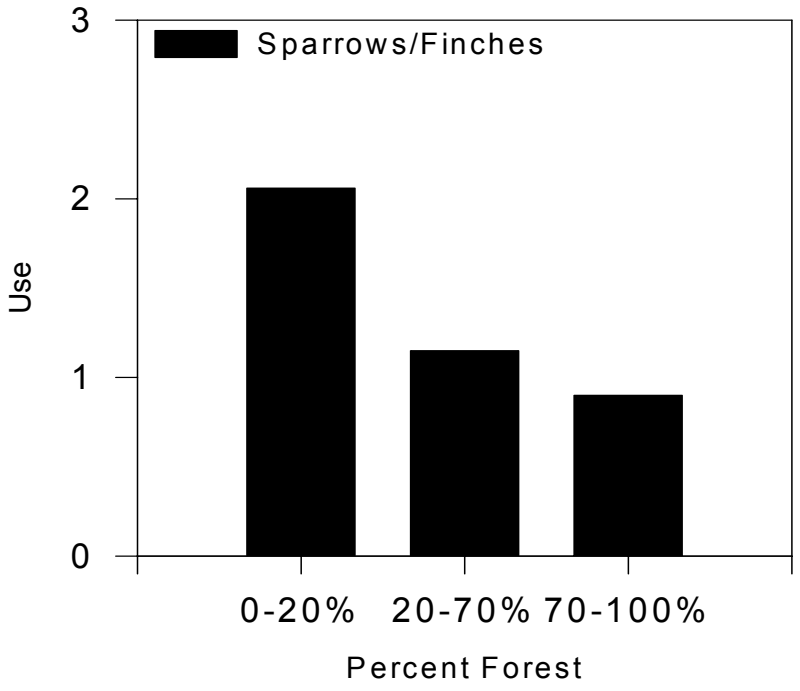


Figure 10 (continued). Passerine use by forest cover during the spring.



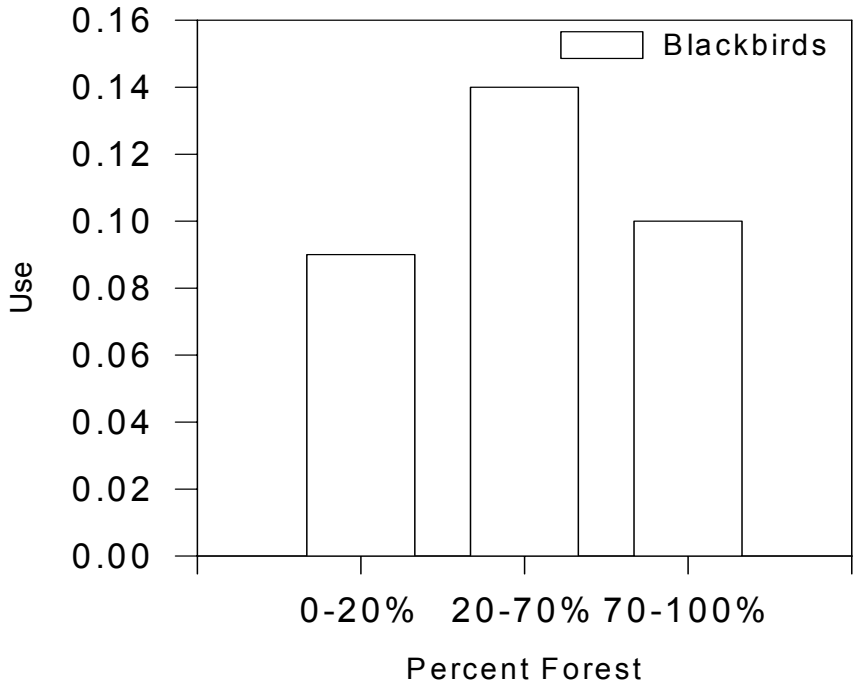
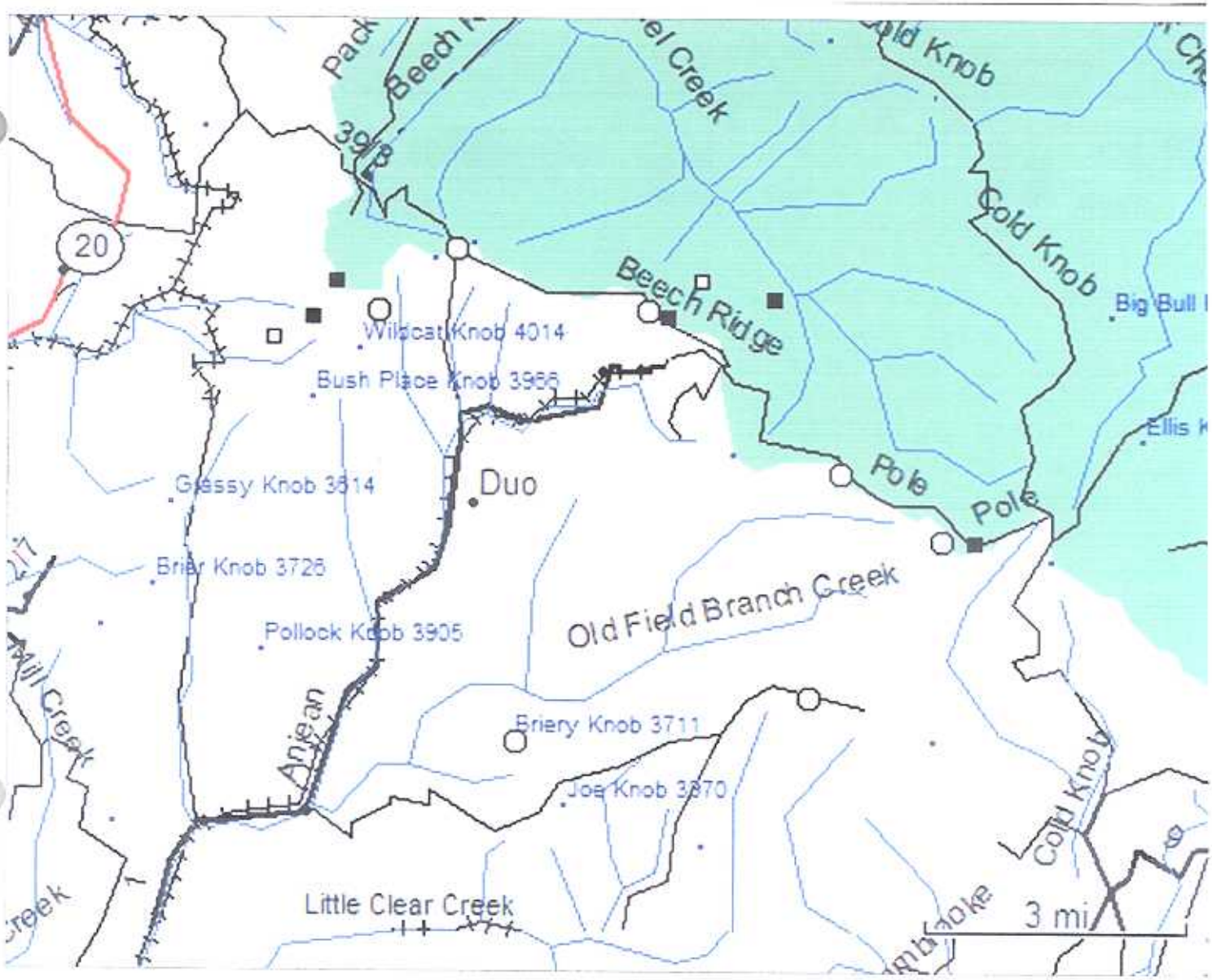


Figure 10 (continued). Passerine use by forest cover during the spring.


Beech Ridge
Cold Knob
Cold Knob
Big Bull
Ellis
Pole
Pole
Wildcat Knob 4014
Bush Place Knob 3966
Grassy Knob 3814
Duo
Briar Knob 3726
Pollock Knob 3905
Old Field Branch Creek
Briery Knob 3711
Joe Knob 3870
Anjean
Mill Creek
Little Clear Creek
Cold Knob
3 mi
20

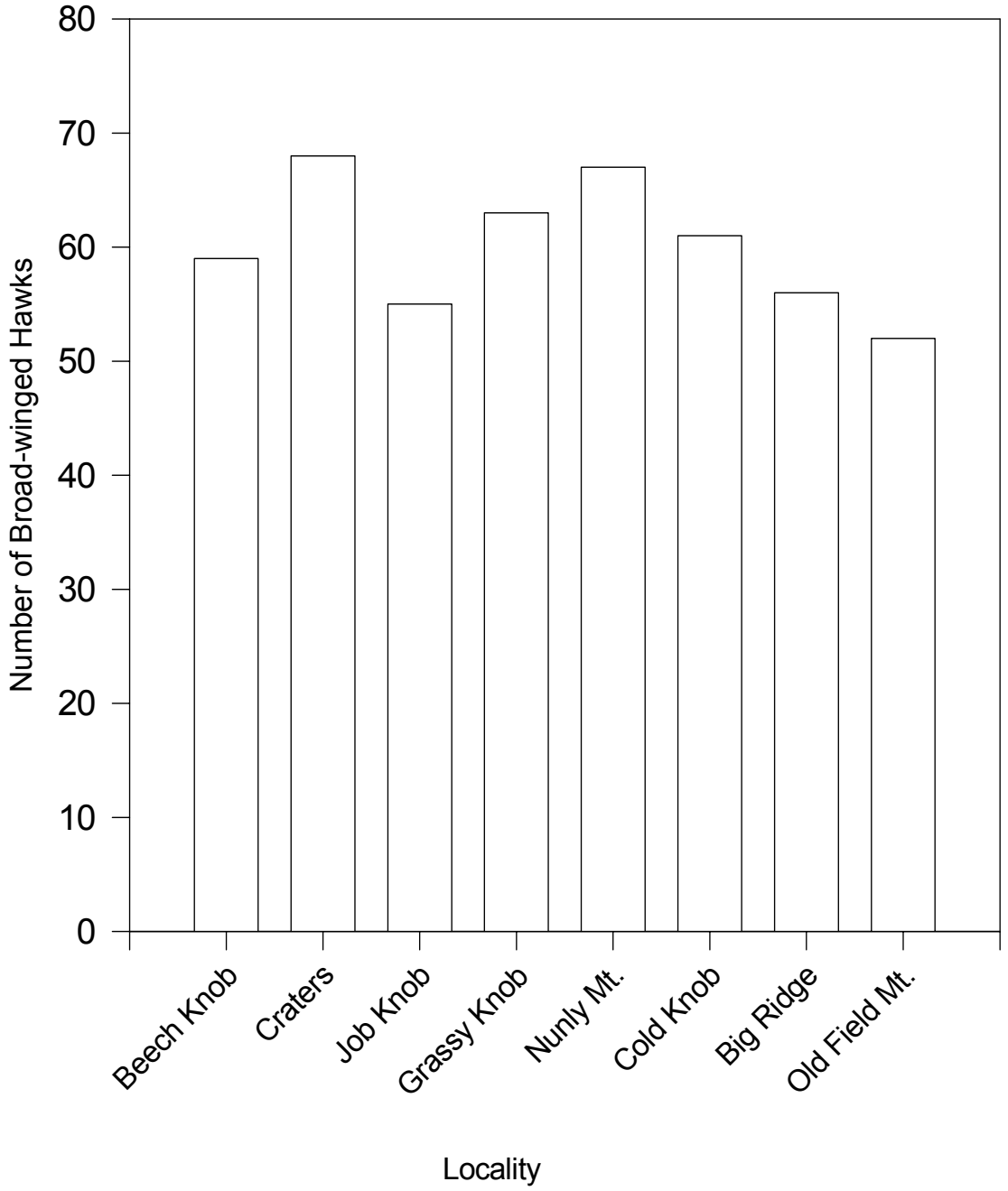


Figure 12. Number of Broad-winged Hawks recorded during 12.5 hours of observation at each locality during a fall raptor study.