Key Findings of 2014 Monitoring of the Kittatinny Ridge (Eastern Portion): Forest Birds and Habitat Quality

Diane W. Husic[1] (husicd@moravian.edu), Terry L. Master[2] (tmaster@esu.edu), Corey Husic,[3] Stephen Kloiber,[2] Kerry Reider,[1] and Laura Beimfohr[2]

[1]Department of Biological Sciences and Environmental Sciences and Studies Program, Moravian College, 1200 Main, Bethlehem, PA 18018
[2]Dept. of Biological Sciences, East Stroudsburg University, 200 Prospect Street, East Stroudsburg, PA 18301
[3]Harvard University, Cambridge, MA 02138

Methods:

For the 2014 monitoring project, surveys were performed at 11 locations where roads provided access to the ridge top from Hawk Mountain east to the Delaware Water Gap. This region covered a 46-mile length along the ridge-top, six counties including Monroe, Carbon and Schuylkill to the north and Northampton, Lehigh and Berks to the south and 10 north-south road crossings. At each location, five sites were chosen representing the center crest, west crest, east crest, north slope, and south slope. Interior forest points were located at least 500 m east and west of the crest point. An effort was made to incorporate as many 2nd Pennsylvania Breeding Bird Atlas (PBBA) point count locations as possible and thus, 50% of the points are located at former Atlas locations.

Forest bird populations were surveyed using the 2nd PBBA variable circular plot point count protocol (Wilson *et al.*, 2012). All birds detected, with the exception of flyovers, were recorded during five, 75-second intervals (6.25 minute duration) and were categorized as occurring within or beyond 75 m from the plot center-point. Point counts were conducted between sunrise and 10 AM from the last week of May through July 3rd when song frequency peaks during the breeding season.

Vegetation sampling was performed using a modified BBird Protocol (Martin *et al.*, 1997) at one randomly selected crest site at each of the 11 locations. This is a nested circular plot protocol where trees are sampled within a relatively large diameter circle (11.3 m) while shrubs and saplings are surveyed within a nested circle of smaller diameter (5 m). Trees ($\geq$ 10 cm in diameter) are counted, identified and measured for diameter at breast height (DBH) and height. Canopy coverage was estimated using a densitometer and foliage profile is determined by detecting presence/absence of foliage at six height intervals beginning at ground level and extending to the highest canopy level on the North and West ordinates. Saplings (< 10 cm in diameter) and shrubs (having no central stem) were counted, identified and their height and percent vegetation coverage estimated.

Physical measurements including elevation, slope and aspect are also recorded and GPS-tagged photographs of sites and vegetation were taken at each point count site. The presence of invasive plant species was recorded on PA iMap Invasives (iNaturalist). Easily identifiable insect species were also documented. GIS maps were generated using ArcMap 10.1.

Key findings:

1) During the bird surveys, a total of 4789 individuals of 78 different species were encountered.

2) Thirty-one avian families were represented in the surveys (See Table I and Figure 1).

3) As reported by Wilson and Blum (2014) from the 2013 of Priority of Forest Birds of the Kittatinny Ridge, Red-eyed Vireos and Ovenbirds were the most frequently detected species (Table II). In the 2013 survey, these two species were also the most ubiquitous. In 2014, the Red-eyed Vireo was detected at 100% of the North, South, and Crest Road sites, and at 90% of the Crest Interior sites (Table III). Ovenbirds were detected at 100% of the Crest Interior sites and 90% of the Crest Road sites. Ovenbird nesting areas were often observed where there was significant forest floor cover of Hay-scented Fern (*Dennstaedt punctilobula*).

4) Seven of ten of the most frequently detected species in the 2014 surveys were also in the top ten from the 2013 surveys. The 2013 survey was conducted mainly along the trails on the crest of the Kittatinny Ridge; whereas, some of the point count locations in 2014 were along the slopes and bottom of the Ridge, which included disturbed, non-forested habitats. The 2014 survey was conducted on the northeastern portion of the Ridge (from Hawk Mountain to Delaware Water Gap). In contrast, the 2013 survey included point counts along the entire length of the range, more southerly locations were included.

5) As first noted by Wilson and Blum, several forest interior songbird species have been under-represented in PBBA surveys that were biased towards lower elevations and roads compared to the 2013 survey. Similar results were noted in the 2014 survey.

6) One question that was examined in the 2014 surveys was whether there were slope or interior forest preferences by avian species. The mean number of species per point count at North sites and South sites relative to the Crest Road sites were significantly different (0.01 and 0.05, respectively) as determined by ANOVA and the Tukey Test. Differences between the North vs. South sites, North or South vs. Crest, or Crest Road vs. Crest were not significant.

7) The total number of species per site did vary with location: North (67), South (56), Crest Road (41), and Crest (44). The Eastern Bluebird, Pine Warbler, and the Yellow-Throated Vireo were only found on the north slope of the Ridge. The Black-Billed Cuckoo was detected along the crest and south slope, but not the north slope of the Ridge. Cerulean Warblers were only found on south slopes. Other species seemed to show a slope or interior forest (e.g. away from roads or other forms of fragmentation) preference, but this would have to be studied more carefully in future surveys.

8) During this survey, only 5 Cerulean Warblers were detected. Wilson and Blum noted areas of relatively high counts of this species in the 2013 survey; the 2014 survey did not include those regions. A total of 57 cuckoos (Yellow- and Black-billed) were detected (1.2% of all detections). This relatively high number may be due in part to all the caterpillars that were observed along the Ridge in 2014. (Anecdotally, the numbers are high again in 2015 and the gypsy moth caterpillar infestation is severe.)

9) Due to the difficulty in accessing relatively undisturbed interior forest areas on the slopes of the mountain, it is likely that species such as the Worm-eating and Hooded Warblers are underrepresented in surveys that have been done to date. Interestingly, it was noted that Hooded Warblers were frequently found in areas where there was a high density of Japanese Barberry (*Berberis thunbergii*). Given the invasive nature of this non-native shrub, land

managers typically want to remove it. However, in areas where there is no other mid-level vegetation, removal could have impact on some bird species.

10) The Bird Community Index (BCI) is derived from ranking bird communities at sampling sites according to the proportional representation of species in 16 behavioral and physiological response groupings. The relative proportions of species with specialist or generalist characteristics in structural (nesting), functional (feeding) and compositional (life history characteristics, i.e., residents, migrants, brood parasites, etc.) categories ultimately results in a score ranking the bird community as having low, medium, high or highest ecological integrity. Generally, if the number of species with specialist characteristics in the three categories makes up a large proportion of the bird community sampled, then the BCI value will be higher than if a high proportion of the species show generalist characteristics. For the region of the Kittatinny Ridge surveyed in 2014, a ranking of medium integrity was obtained for all sites.

11) Habitat conditions varied with location with the most disturbed areas and highest amount of non-native or invasive species occurring at the lower elevations and near roads. Some forest locations showed evidence of over-browsing by deer with little mid-level canopy or understory and high density of Hay-scented Fern (*Dennstaedt punctilobula*).

12) Gypsy moth (*Lymantria dispar*) infestation was noted during the 2014 surveys and it was predicted that there would be a heavy infestation in 2015. This turned out to be an accurate prediction and extensive defoliation has occurred. In some areas close to 40% of the trees – primarily oak (*Quercus* sp.) and cherry (*Prunus* sp.) – were totally defoliated by the end of June. In areas where early successional trees like Gray Birch (*Betula populifolia*) are present (e.g. the Lehigh Gap) they have also been partially defoliated. In 2014, a significant number of Ruby Quaker caterpillars were also observed.

13) Red Maple (*Acer rubrum*) and Red Oak occurred most frequently at survey sites; these also had the highest ecological importance (Figure 2). The Ridge historically was characterized as a Chestnut-Oak forest type, so the high percentage of maple represents a significant change and a decrease in mast crop (i.e. food for wildlife). The dominant tree species was Black Gum.

14) The dominant species of shrubs and saplings (the middle understory) were Witch Hazel (*Hamamelis virginiana*), Black Birch (*Betula lenta*), Red Maple (*Acer rubrum*), and Blackberry (*Rubus allegheniensis*). In many areas, forest floor cover was mostly hay-scented fern; this is characteristic of sites that have been over-browsed by White-tailed deer (*Odocoileus virginianus*).

15) The 2014 survey did not focus on other species, but incidentally nine species of butterflies and 14 species of moth were identified. No Monarch butterflies (*Danaus plexippus*) were observed. Additionally, there were no sightings of the Timber Rattlesnake (*Croatus horridus*), Copperheads (*Agkistrodon contortrix*), or black bears (*Ursus americanus*).

16) Beside Gypsy Moths, invasive species such as Japanese Barberry (*Berberis thunbergii*), Autumn Olive (*Elaeagnus umbellate*), Japanese Stiltgrass (*Microstegium vimineum*), Wineberry, and Multiflora Rose (*Rosa multiflora*) were also found.

17) Almost 600 photos were taken during the surveys from late May through early July. A database of plant species noted in photographs from each site is being developed.

Recommendations:

1) The 2013 and 2014 surveys provide an assessment of the diversity and populations of birds along the Kittatinny Ridge, illustrating its importance for forest interior songbirds that have been previously underrepresented in other surveys. However, given the number of threats that the Ridge faces, including habitat loss due to residential and commercial development, invasions by forest-threatening insects and alien plant species, and climate change, periodic surveys should be conducted (every 3-5 years). The protocol requires individuals who are able to identify 80 – 100 bird species by sound and able to hike on rough terrain.

2) Because slopes are underrepresented in all surveys conducted to date, it is important to find accessible sites for future studies to better understand habitat requirements of species such as the Worm-eating Warbler, to determine if there are north-south slope preferences by individual species, and to determine if there is any northward (or southward) range expansion of species since the Kittatinny Ridge is a boundary for numerous species as evidenced from reviewing the range maps in the 2nd PBBA and is predicted to be a major climate migrant corridor.

3) Only preliminary vegetation surveys were conducted along the easternmost portion of the Ridge and at only ten sites. To gain a better picture of habitat quality and to understand what might change over time, such surveys should be done along the length of the Ridge. This protocol could be done by citizen scientists/volunteers if they knew how to identify trees and shrubs. It should be noted that the timing of these surveys is important since some plants (e.g. spring ephemerals) go through their entire life cycle very early, some don't emerge until later in the season, and fungi are dependent on rainfall and time of season, so can easily be missed. The habitat monitoring should be used to create a geodatabase that includes maps, images and can be overlaid with satellite imagery.

4) Many other important species are important indicators of the importance of the Kittatinny Ridge and how it might be changing. Surveys of reptiles and amphibians (herps) and key mammals (bats, Allegheny Woodrat, etc.) should be done.

5) Future surveys should monitor whether there is significant tree die-off from the gypsy moth infestation. In contrast, the cold weathers of 2014 and 2015 have reportedly killed off a large percentage of the Hemlock Woolly Adelgid (*Adelges tsugae*), so future monitoring should pay attention to the relative condition of Eastern Hemlock (*Tsuga Canadensis*) along the length of the ridge.

6) The spring of 2015 (April and May) was extremely dry with moderate drought conditions designated in central and eastern countries that included the Kittatinny Ridge. A number of fires broke out between Little Gap and Bake Oven Knob. These areas should be monitored in coming years to evaluate the extent and quality of revegetation and invasions by non-native plant species.

Table I. Avian Families Represented in 2014 Kittatinny Ridge Point Count Surveys

Family	Total number detected	% Total birds counted
Herons, Egrets, Bitterns	1	0.02
New World Vultures	6	0.13
Swans, Geese	2	0.04
Bird Hawks	2	0.04
Eagles, Buzzard Hawks	13	0.27
Grouse, etc.	1	0.02
Turkeys	23	0.48
Pigeons, Doves	56	1.17
Cuckoos	63	1.32
Swifts	4	0.08
Hummingbirds	1	0.02
Woodpeckers	132	2.76
Flycatchers	188	3.92
Vireo	1015	21.19
Crows, Jays, etc.	305	6.37
Swallows	70	1.46
Chickadees, Titmouse	130	2.71
Nuthatches	20	0.42
Wrens	52	1.09
Gnatcatchers	37	0.77
Thrushes	289	6.03
Catbird, Mockingbirds, Thrashers	165	3.44
Starlings	16	0.33
Cedar Waxwing	36	0.75
Warblers	1183	24.7
Tanagers	195	4.07
New World Sparrows	300	6.26
Cardinales, Grosbeaks, Buntings	314	6.56
Blackbirds, Orioles, Cowbird	147	3.07
Finches	22	0.46
Old World Sparrow	2	0.04

Figure 1. Avian Families Represented in 2014 Kittatinny Ridge Point Count Surveys

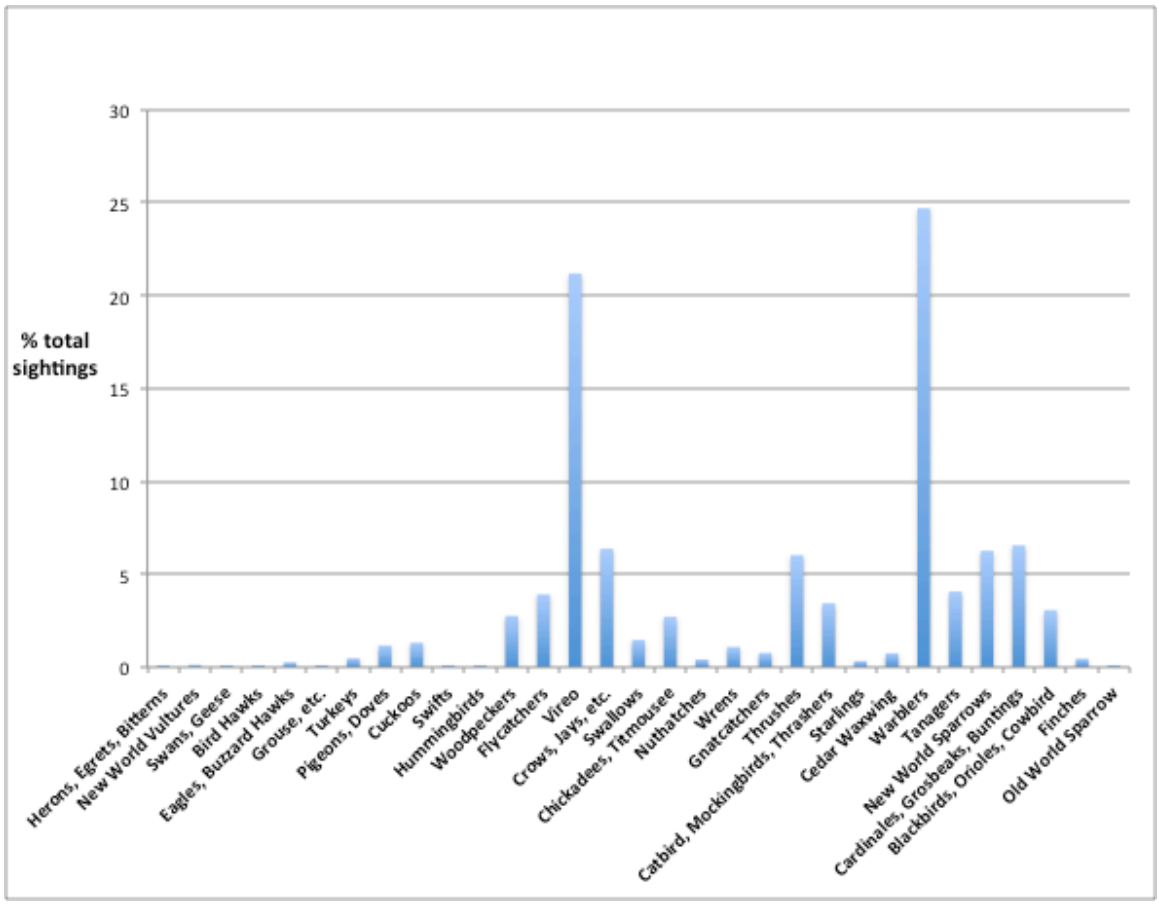

Table II. Most abundant bird species detected in 2014 surveys along the Kittatinny Ridge:

Species	Total number detected	Percentage of all detections
Red-eyed Vireo	995	20.7
Ovenbird	694	14.5
American Crow	205	4.3
Indigo Bunting	201	4.2
Scarlet Tanager	195	4.1
Gray Catbird	161	3.4
Wood Thrush	158	3.3
Black-and-white Warbler	150	3.1
Eastern Wood-Pewee	116	2.4
Chipping Sparrow	105	2.2

Table III. Ten Most Frequently Occurring Species Across all Point Count Sites in Each Area (10/10 = 100%).

Species	North	South	Crest Road	Crest Interior*
Red-eyed Vireo	100	100	100	90
Blue Jay	90		70	55
American Crow	80	90	60	55
American Robin	80	80		
Gray Catbird	80	80		
Ovenbird	80	70	90	100
Brown-headed Cowbird	70			
Indigo Bunting	70	70	50	60
Black-and-White Warbler			60	65
Canada Goose			60	
Cedar Waxwing	60	50	60	
Common Grackle	60			
Chipping Sparrow	60		50	
Song Sparrow	60			
Tufted Titmouse	60	70		
Mourning Dove		50		
American Goldfinch	50			
Eastern Wood Pewee				55
Great-crested Flycatcher	50	50		
Northern Cardinal	50	70		
Red-bellied Woodpecker	50	80		
White-breasted Nuthatch		50		
Blue-Gray Gnatcatcher		60		
Chipping Sparrow		60		
Scarlet Tanager	50	60	100	85
Wood Thrush	50	60	50	
Yellow-billed Cuckoo		60		

* Frequency calculated out of 20 survey points (20/20 = 100%)

Figure 2. Ecological Importance Value of Trees Encountered in Surveys Along the Kittatinny Ridge. Ecological importance is defined as Relative Frequency (the percentage of inventory points occupied by a given species) + Relative Density + Relative Dominance (total basal area of each species per unit area; feet^2 per meter^2).