Breeding Bird Surveys
Arkwright Summit Wind Project
Chautauqua County, New York

Final Report

May 2013 – July 2013

Prepared for:

EDP Renewables

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WEST Inc.

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

EXECUTIVE SUMMARY

EDP Renewables (EDPR) has proposed to develop the Arkwright Summit Wind Project (Project) in Chautauqua County, New York. EDPR contracted Western EcoSystems Technology, Inc. (WEST) to conduct breeding bird surveys within the proposed Project Area to assist in evaluating potential impacts that the development of a wind energy facility, associated construction, and operations might have on breeding birds in the Project area.

The principal objectives of the study were to: 1) provide site-specific data on avian resources and use of the Project area that would be useful in evaluating potential impacts from the proposed wind energy facility, 2) provide information that could be useful in project planning and design of the facility to minimize potential impacts to birds, and 3) recommend further studies or potential mitigation measures, if warranted.

Eighty-five transect surveys were conducted during four visits at the Project between May 25 and July 15, 2013. Surveys were conducted at 300-meter (984 feet) transects located at 14 proposed turbine locations and eight reference areas. Dominant landcover was classified each 50-meter (164 feet) segment of transects; the dominant land classifications in the study area included forested, edge, grassland, agricultural and shrub/scrub.

Seventy-three bird species were recorded during the breeding bird transect surveys, and the species richness was 6.45 species per transect per survey. A total of 1,168 bird observations within 914 separate groups were recorded. Approximately 95 percent of all birds observed were passerines, and the most commonly observed passerine subtypes were blackbirds/orioles (n=375), warblers (n=168), thrushes (n=147), and grassland sparrows (n=123). Overall mean use was 13.71 birds per transect per survey. Two New York State Department of Environmental Conservation species of concern, cerulean warbler (n=2), American bittern (n=1), and one federally listed species of concern, olive-sided flycatcher (n=1), were observed during the surveys.

There was no significant difference between bird type use at turbine and reference transects. Overall mean bird use was highest at a proposed turbine transect, with 27.00 birds per survey, where the dominant landcover type was grassland. Among reference transects, highest mean bird use was 17.25 birds per survey, where the dominant landcover was also grassland. While passerines dominated the species composition at all transects, no noticeable differences in composition were observed between the turbine and reference transects.

Results of these surveys provide a baseline of data and analyses for future comparison under a Before-After-Control-Impact study design to investigate displacement type effects to breeding birds after the Project is constructed.

STUDY PARTICIPANTS

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William Lukins	Project Manager
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INTRODUCTION

EDP Renewables (EDPR) has proposed to develop a commercial scale wind energy project, the Arkwright Summit Wind Project (Project), in Chautauqua County, New York. EDPR contracted Western EcoSystems Technology, Inc. (WEST) to conduct breeding bird surveys (BBS) within the proposed Project Area to assist in evaluating potential impacts that the development of a wind energy facility, associated construction, and operations might have on breeding birds in the Project area. The following report contains results of the BBS surveys conducted in the spring/summer 2013.

The principal objectives of the study were to: 1) provide site-specific data on avian resources and use of the Project area that would be useful in evaluating potential impacts from the proposed wind energy facility, 2) provide information that could be useful in project planning and design of the facility to minimize potential impacts to birds, and 3) recommend further studies or potential mitigation measures, if warranted. More specifically, the study design was developed under a Before-After-Control-Impact (BACI) framework and this study would provide data that could be used as pre-project baseline data for comparison with post-construction data to help with the impact assessment

The BBS study design was developed with the New York State Department of Environmental Conservation (NYSDEC) guidelines and with an objective of addressing future indirect effects such as potential displacement of birds from the Project facilities. Breeding bird studies provide valuable baseline data on avian use and occurrence that can be compared to the results of post-construction surveys following the same methods for assessing displacement type effects and fatality studies for assessing direct effects.

PROJECT AREA

The Project is located in the northwestern Chautauqua County, New York. The Project study area is about two miles west of Fredonia and approximately three miles south of Lake Erie (Figure 1). The Project is located on relatively broad hilltops with an elevation range between 750 to 1900 feet, generally increasing from north to south. The Project intersects with Canadaway Creek Wildlife Management Area and abuts the Boutwell Hill State Forest. Primary roads through the Project area include Route 39 to the north, Straight Road near the center and Route 83 towards the south. An existing 115kv transmission line runs along the western boundary and an existing 230kv transmission line runs along the northern boundary. The Project vicinity is characterized mainly by a mix of deciduous and mixed forests and agricultural lands with scattered areas of grassland and shrub/scrub.

Approximately 68% of the Project area is in deciduous and mixed forests, and 20% is comprised of pastureland (grassland) (Figure 2). The remaining percentage includes urban, recreational grasses, with smaller inclusions of evergreen forests, open water, and commercial/industrial resources. The primary cover types are distributed fairly evenly throughout the Project area,

with some concentration of mixed forests and urban, recreational grasses in the northern portion of the area, and a concentration of deciduous forests in the southern portion.

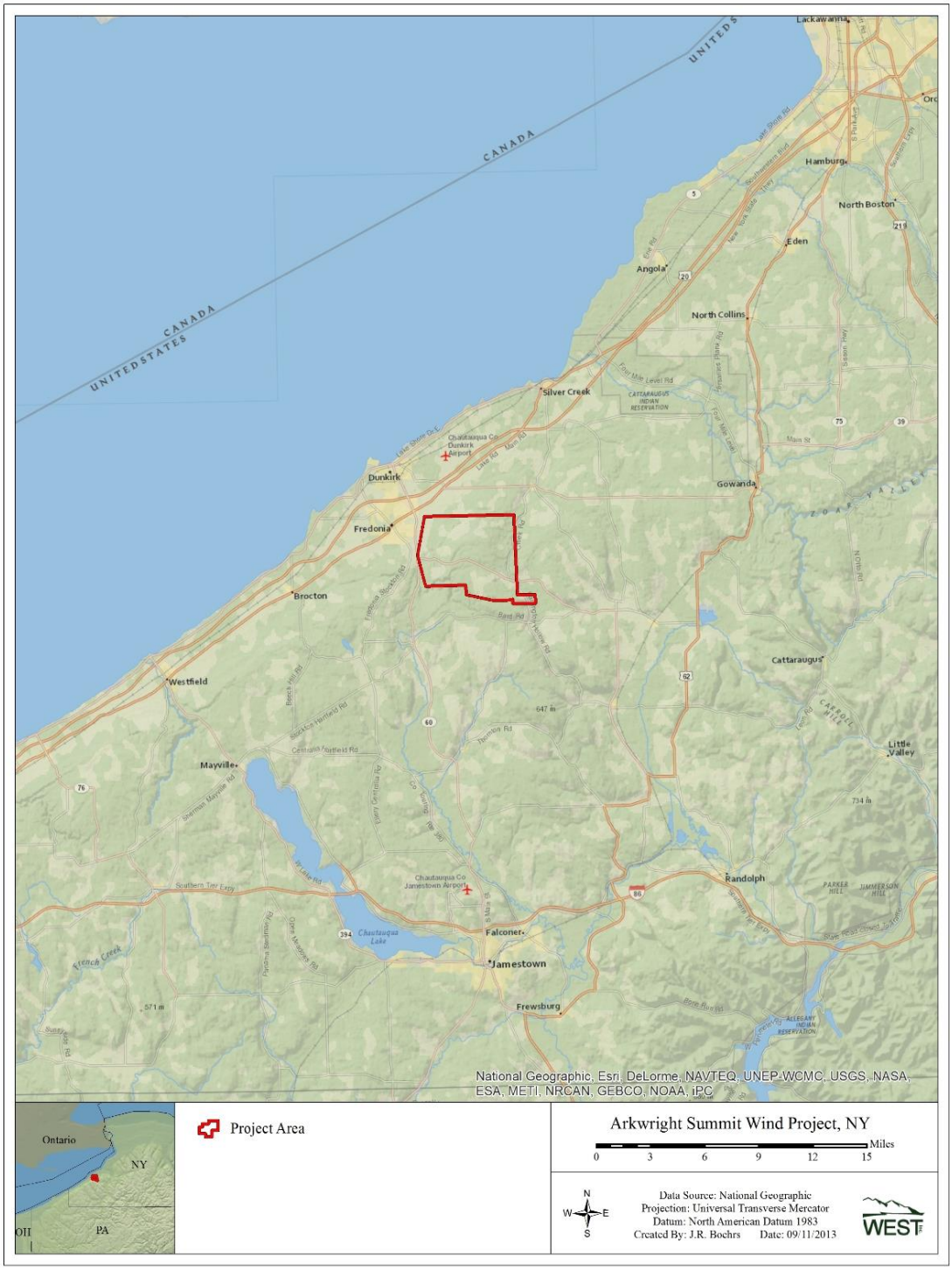


Figure 1. Location of the proposed Arkwright Summit Wind Project Area.

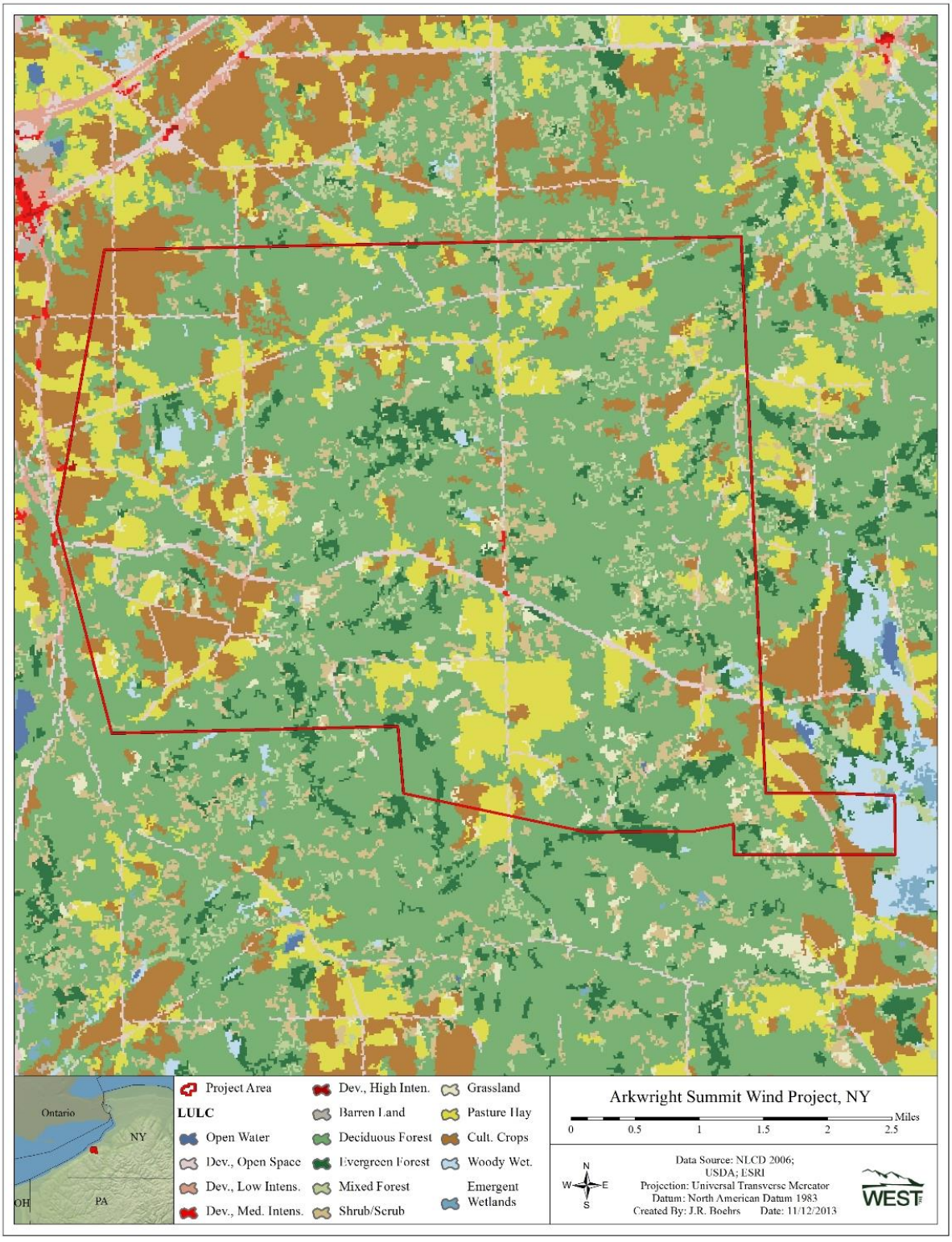


Figure 2. Landcover types in the proposed Arkwright Summit Wind Project Area.

METHODS

Breeding Bird Survey

The BBS surveys were conducted along 22 pre-established transects located at 14 proposed turbine locations and eight reference locations in similar vegetation types (Figure 3). The reference transects were located in areas where landowners had agreed to study participation but away from proposed turbine locations. Transects were located to avoid cultivated (plowed agriculture) fields and were selected to broadly cover the habitat types present in the Project.

Each transect was 300 meters (m) [approximately 984 feet 9ft)] in length. The observer recorded all birds seen or heard, but focused on birds within 50 m (164 ft) of both sides of the transect, creating a 300-m by 100-m (984-ft by 328-ft) rectangular survey plot encompassing approximately 30,000 square meters (m^2) [322,917 square feet ft^2)] bisected by the transect line. Each transect was divided into 50-m segments. Information on birds observed and dominant vegetation type recorded by each 50-m segment.

Field surveys were conducted by an experienced field biologist with experience identifying New York bird species by sight and sound. The observer recorded all birds; however, the focus of the survey was on songbirds and observations within 50 m of the observer. Detections of birds either seen or heard were recorded on standard data forms. The approximate distance to each bird was recorded for each observation. Data recorded for each survey included the start and end time of the transect survey period and weather information such as temperature, wind speed, wind direction, and cloud cover. Species identification, number of individuals of each species, type of observation (visual or auditory), and behavior (nesting, flying, perching, singing, etc.) were recorded.

Surveys were conducted during the period between a half-hour before to four hours after sunrise on days without inclement weather [e.g., rain, strong winds greater than 10-15 miles per hour (mph)]. For analysis purposes, a visit was defined by the number of days to complete surveys of all the transects. Visits were defined according to the following criteria: 1) a single visit had to be completed within a season, in this case the breeding season, and 2) a visit could be spread across multiple dates, but a single date could not contain surveys from multiple visits. Under certain circumstances, such as extreme weather conditions, plots were not surveyed during some visits. In these cases, a visit might not have included a survey at all plots.

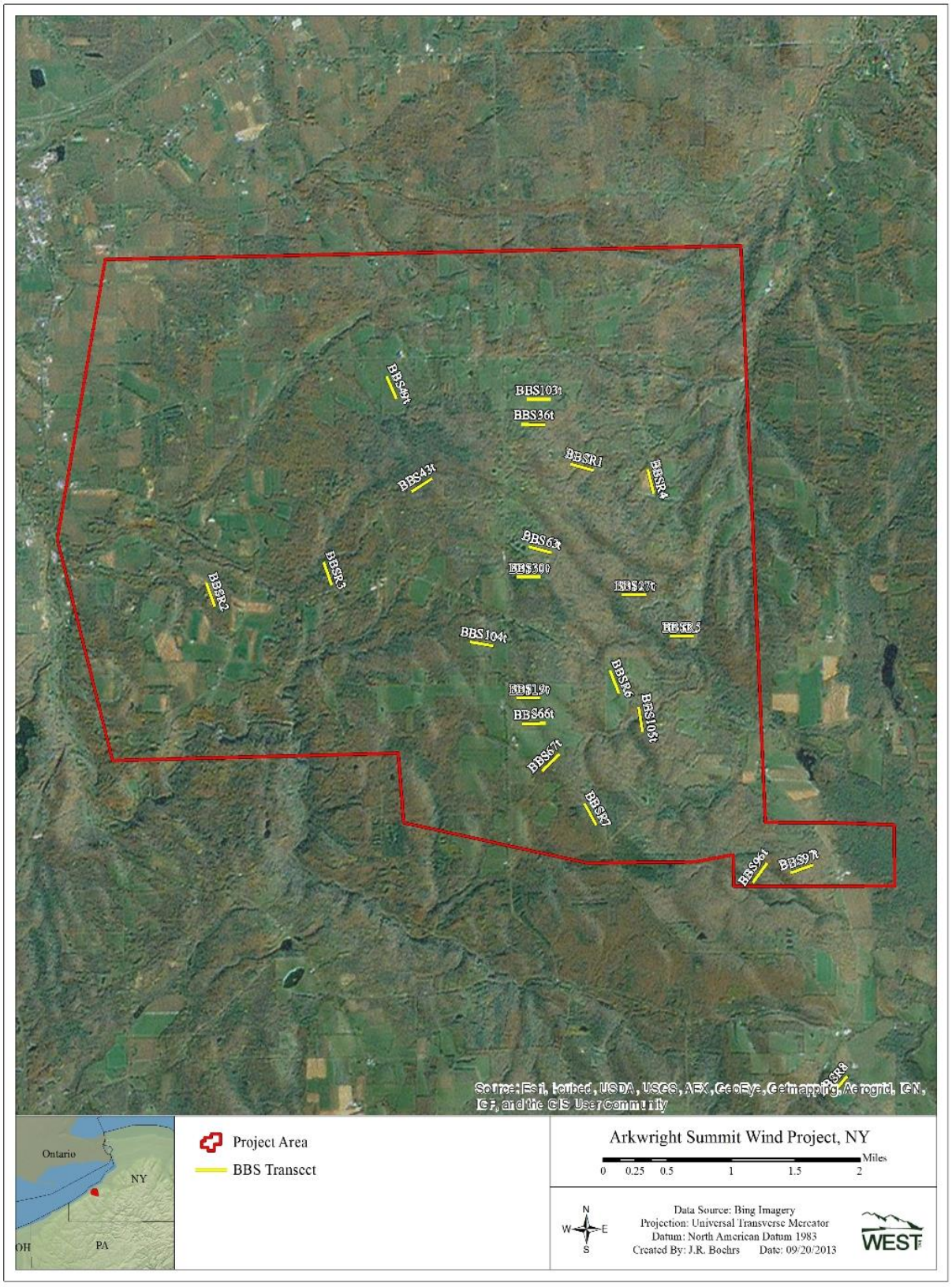


Figure 3. Transect locations within the Arkwright Summit Wind Project Area.

Statistical Analysis

Bird Diversity and Species Richness

Bird diversity was illustrated as the total number of unique species observed. Species lists of all observations and the number of groups was generated for each round of surveys and for the entire study period, regardless of the distance from the transect. Species richness was calculated as the mean number of species observed per survey.

Bird Use, Percent of Use, and Frequency of Occurrence

For the standardized bird use estimates, only observations of birds detected within 50-m (164-ft) on either side of a given transect were used. Estimates of bird use were calculated as the number of birds observed per transect per survey (for observations within 50-m on either side of a given transect). Use by visit was calculated by averaging use over all transects surveyed during that visit. Bird use for the season was calculated by averaging use over all visits made during the season.

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

Spatial Use

Differences in bird use and species composition were compared between turbine transects and reference transects. Differences between bird use as a function of distance from proposed turbines was assessed by comparing bird use for each 50-m segment of transect.

In order to test whether there was a spatial gradient of increasing or decreasing bird use along transects (the sequence of the six 50-m blocks progressing from the start of each transect to the end of transects), bird use was regressed against block numbers 1 through 6. The regression slope was considered to be a measure of increasing or decreasing bird use along transects for each habitat type at each of the reference and turbine transects types

Test for Differences in Bird Use Means

A bootstrap technique was used for testing the null hypothesis of no difference between each reference transect block by habitat type mean and turbine transect block by habitat type mean[1]. The significance test was the bootstrap permutation test for comparing the means of two independent samples. In this case, the null hypothesis is that the samples in the reference transect vector (*r*) come from the same underlying distribution as the samples in the turbine transect vector (*t*). Therefore, a re-sampling method that is consistent with the null hypothesis is

[1] Due to non-normally distributed bird use datasets with outliers and small sample sizes, tests of the difference between reference transect mean bird use and turbine transect mean bird use for each bird type at each of the six block distances for each of the two habitat types and confidence intervals for these differences of means were carried out using non-parametric bootstrap methods. The bootstrap re-samples from the original data in a way that mimics the original population distribution (Manly 2006, Davison and Hinkley 1997).

one that randomly chooses with replacement one data point at a time from the entire vector consisting of placing the vectors *r* and *t* end to end as one dataset to create many new bootstrap simulated reference transect and turbine transect paired vectors, $\left(r_1^*, t_1^*\right), \left(r_2^*, t_2^*\right), \left(r_3^*, t_3^*\right), ..., \left(r_{5,000}^*, t_{5,000}^*\right)$. We then computed 5,000 of the bootstrap statistics of interest, which is the difference between the reference mean and the turbine mean, one for each bootstrap sample pair of *r** and *t** to obtain $\left(\overline{r}_1^* - \overline{t}_1^*\right), \left(\overline{r}_2^* - \overline{t}_2^*\right), \left(\overline{r}_3^* - \overline{t}_3^*\right), ..., \left(\overline{r}_{5,000}^* - \overline{t}_{5,000}^*\right)$.

These bootstrap differences in means are an estimate of the sampling distribution of the null hypothesis statistic. The two-sided p-value was then computed as the proportion of the bootstrap differences of means which are as extreme or more extreme than the difference of means for the original observed data.

Confidence Intervals for the Difference in Bird Use Means

Ninety percent bootstrap percentile confidence intervals for the difference between reference transect mean bird use and turbine transect mean bird for each block by habitat type combination were computed by re-sampling with replacement separately from the reference data vector *r* and the turbine data vector *t* to obtain 5,000 bootstrap differences between means or $\left(\overline{r}_1^* - \overline{t}_1^*\right), \left(\overline{r}_2^* - \overline{t}_2^*\right), \left(\overline{r}_3^* - \overline{t}_3^*\right), ..., \left(\overline{r}_{5,000}^* - \overline{t}_{5,000}^*\right)$. The lower and upper 90 percent confidence interval endpoints were taken as the 5th and 95th percentiles, respectively, of the ordered set of these bootstrap differences.

RESULTS

Breeding Bird Surveys

Breeding bird surveys were conducted at the Project during four visits (rounds) during the spring and summer. A total of 85 surveys were conducted within the Project area from May 25 to July 15, 2013 (Table 1). Each transect was surveyed once during four visits (a complete round of surveys of all transects) to the study area. The first visit occurred between May 25 and 27, the second visit occurred between June 14 and 16, the third visit occurred on June 26 and 27 and the fourth visit occurred between July 13 and 15.

Table 1. Summary of number of surveys, mean bird use (birds/transect/survey), number of species and species richness (species/survey) recorded during the breeding bird transect surveys.

Visit	Number of Surveys Conducted*	Mean Use	Number of Species	Species Richness
1	22	16.09	56	8.23
2	22	12.68	43	6.50
3	22	13.27	46	5.82
4	19	12.79	32	5.26
Overall	**85**	**13.71**	**73**	**6.45**

* = Due to restricted access transects 19T, 66T and 67T were only surveyed three times each

Bird Diversity and Species Richness

Seventy three unique species were identified during the breeding bird surveys (Table 1). A total of 1,168 individual bird observations within 914 separate groups were recorded (Appendix A). The mean number of species observed per transect per survey was 6.45. Cumulatively, five species (6.8% of all species) comprised 52.1% of the birds observed: bobolink (*Dolichonyx oryzivorus*), red-winged blackbird (*Agelaius phoeniceus*), red-eyed vireo (*Vireo olivaceus*), American robin (*Turdus migratorius*) and savannah sparrow (*Passerculus sandwichensis)* (Appendix A).

Bird Use, Percent of Use, and Frequency of Occurrence

Mean bird use estimates, percent of total use, and frequency of occurrence for all species and bird types are shown in Table 2. A complete list of use estimates, percent of total composition, and frequency of occurrence for all birds is presented in Appendix B.

Waterbirds

Two waterbird species were observed, American bittern (*Botaurus lentiginosus*) and great blue heron (*Ardea herodias*), resulting in use of 0.03 birds/transect/survey. Waterbirds were only observed in 2.3% of the surveys and only composed 0.2% of the overall use (Table 2).

Waterfowl

Two waterfowl species were seen, Canada goose (*Branta canadensis*) and mallard (*Anas platyrhynchos*), resulting in a use estimate of 0.07 birds/transect/survey. Waterfowl were only observed in 2.3% of the surveys and only composed 0.5% of the overall use (Table 2).

Shorebirds

Only one species of shorebird was observed, killdeer (*Charadrius vociferus*), resulting in a use estimate of 0.11 birds/transect/survey. Killdeer were observed in 4.5% of the surveys and only composed 0.8% of the overall use (Table 2).

Raptors

A single raptor species, American kestrel (*Falco sparverius*) was observed within the 50-m view shed resulting in a use of 0.01 birds/transect/survey. Kestrels were only observed in 1.3% of the surveys and only composed <0.1% of the overall use (Table 2).

Upland Game Birds

Two upland game birds species were observed, ruffed grouse (*Bonasa umbellus*) and wild turkey (*Meleagris gallopavo*), resulting in use of 0.06 birds/transect/survey. Upland game birds were only observed in 3.4% of the surveys and only composed 0.4% of the overall use (Table 2).

Dove/Piegons

Two dove/pigeon species were observed, mourning dove (*Zenaida macroura*) and rock pigeon (*Columba livia*), resulting in use of 0.24 birds/transect/survey. Dove/pigeons were only observed in 8.1% of the surveys and only composed 1.8% of the overall use (Table 2).

Large Corvids

Two large corvid species were observed, American crow (*Corvus brachyrhynchos*) and common raven (*Corvus corax*), resulting in use of 0.06 birds/transect/survey. Large corvids were only observed in 4.5% of the surveys and only composed 0.4% of the overall use (Table 2).

Cuckoos

One cuckoo species was observed, black-billed cuckoo (*Coccyzus erythropthalmus*), resulting in use of 0.01 birds/transect/survey. Cuckoos were only observed in 1.1% of the surveys and only composed <0.1% of the overall use (Table 2).

Passerines

Mean use was highest for passerines (13.01 birds/transect/survey), mostly consisting of the subtype blackbirds/orioles and warblers (4.45 and 1.95 birds/transect/survey, respectively; Table 2). Within passerines, bobolink (2.06 birds/transect/survey), red-winged blackbird (1.95 birds/transect/survey), and red-eyed vireo observations (1.32 birds/transect/survey), were the species with the highest mean use (Appendix B). Passerines were observed more frequently and in greater numbers than all other bird types; passerines were seen at 100% of surveys and composed 94.9% of overall bird use (Table 2).

Table 2 Mean bird use (number of birds/transect/survey), percent of use, and frequency of occurrence for each bird type and passerine subtype during the breeding bird transect surveys at the Arkwright Summit Wind Project; May 25 to July 15, 2013.

Bird Type / Species	Mean Use	Percent of Use	Frequency of Occurrence
Waterbirds	0.03	0.2	2.3
Waterfowl	0.07	0.5	2.3
Shorebirds	0.11	0.8	4.5
Diurnal Raptors	0.01	<0.1	1.3
Upland Game Birds	0.06	0.4	3.4
Doves/Pigeons	0.24	1.8	8.1
Large Corvids	0.06	0.4	4.5
Cuckoos	0.01	<0.1	1.1
Passerines	13.01	94.9	100
Blackbirds/Orioles	*4.45*	*32.4*	*50.3*
Creepers/Nuthatches	*0.11*	*0.8*	*8.3*
Finches/Crossbills	*0.07*	*0.5*	*3.4*
Flycatchers	*0.23*	*1.7*	*20.6*
Gnatcatchers/Kinglet	*0.01*	*<0.1*	*1.1*
Sparrows	*1.44*	*10.5*	*68.4*
Mimids	*0.30*	*2.2*	*23.3*
Swallows	*0.28*	*2.1*	*6.8*
Tanagers/Grosbeaks/Cardinals	*0.32*	*2.3*	*24.0*
Thrushes	*1.72*	*12.6*	*64.7*
Titmice/Chickadees	*0.23*	*1.7*	*11.5*
Vireos	*1.32*	*9.6*	*45.2*
Warblers	*1.95*	*14.3*	*74.1*
Waxwings	*0.07*	*0.5*	*4.5*

Table 2 Mean bird use (number of birds/transect/survey), percent of use, and frequency of occurrence for each bird type and passerine subtype during the breeding bird transect surveys at the Arkwright Summit Wind Project; May 25 to July 15, 2013.

Bird Type / Species	Mean Use	Percent of Use	Frequency of Occurrence
Wrens	*0.37*	*2.7*	*24.0*
Corvids	*0.19*	*1.4*	*11.5*
Woodpeckers	0.10	0.8	9.3
Overall	**13.71**	**100**	

Spatial Use

Mean Use by Transect

There was no significant difference between major bird type or subtype use at turbine and reference transects (Table 3). Overall mean bird use was highest at turbine transect 66T (27.00 birds/20-min survey; Appendix C1), where the dominant landcover type was grassland (Table 4). High use at turbine transect 66T was based on use by several passerine subtypes: blackbirds/orioles (21.67 birds/ 20-min survey), thrushes (1.00), waxwings (0.67), flycatchers (0.33), and warblers (0.33) (Appendix C1). Among reference transects, highest mean bird use was at reference transect 4 (17.25 bird/20-min survey; Appendix C2), where the overall use was attributable to use by subtypes: shorebirds (0.75), doves/pigeons (3.75), blackbirds/orioles (8.00), finches/crossbills (0.50), grassland/sparrows (1.00), mimids (0.75), thrushes (0.50), warblers (0.75), waxwings (0.50), and wrens (0.75) (Appendix C2). The dominant landcover at reference transect 4 was also grassland (Table 4).

Table 3. Comparison of overall mean use at reference and turbine transects for all bird types and passerine subtypes observed during breeding bird transect surveys.

Bird Type	Mean Use at Reference Transects	Mean Use at Turbine Transects	Difference of Means	t-statistic p-value	90% Confidence Interval Lower limit	90% Confidence Interval Upper limit
Waterbirds	0.08	0.02	-0.06	0.50	*-0.23*	*0.11*
Waterfowl	0.17	0.04	-0.13	0.50	*-0.46*	*0.21*
Shorebirds	0.13	0.15	0.02	0.93	*-0.36*	*0.40*
Diurnal Raptors	0.00	0.02	0.02	0.33	*-0.01*	*0.04*
Upland Game Birds	0.00	0.09	0.09	0.16	*-0.02*	*0.21*
Doves/Pigeons	0.75	0.06	-0.69	0.31	*-1.91*	*0.53*
Large Corvids	0.04	0.07	0.03	0.69	*-0.10*	*0.17*
Cuckoos	0.00	0.02	0.02	0.33	*-0.01*	*0.04*
Passerines	11.96	13.75	1.79	0.24	*-0.75*	*4.33*
Blackbirds/Orioles	*3.75*	*4.91*	*1.16*	*0.72*	*-4.41*	*6.73*
Creepers/Nuthatches	*0.08*	*0.11*	*0.03*	*0.84*	*-0.19*	*0.24*
Finches/Crossbills	*0.21*	*0.02*	*-0.19*	*0.22*	*-0.47*	*0.08*
Flycatchers	*0.21*	*0.27*	*0.06*	*0.69*	*0.19*	*0.30*
Gnatcatchers/Kinglet	*0.04*	*0.00*	*-0.04*	*0.36*	*-0.13*	*0.04*
Grassland/Sparrows	*1.29*	*1.58*	*0.29*	*0.56*	*-0.54*	*1.11*
Mimids	*0.50*	*0.24*	*-0.26*	*0.25*	*-0.62*	*0.11*
Swallows	*0.42*	*0.31*	*-0.11*	*0.81*	*-0.88*	*0.66*
Tanagers/Grosbeaks/Cardinals	*0.29*	*0.35*	*0.06*	*0.75*	*-0.25*	*0.37*

Table 3. Comparison of overall mean use at reference and turbine transects for all bird types and passerine subtypes observed during breeding bird transect surveys.

Bird Type	Mean Use at Reference Transects	Mean Use at Turbine Transects	Difference of Means	t-statistic p-value	90% Confidence Interval	
					Lower limit	Upper limit
Thrushes	*0.96*	*2.01*	*1.05*	*0.14*	*-0.13*	*2.23*
Titmice/Chickadees	*0.21*	*0.24*	*0.04*	*0.89*	*-0.40*	*0.47*
Vireos	*1.08*	*1.35*	*0.27*	*0.70*	*-0.90*	*1.43*
Warblers	*2.33*	*1.80*	*-0.54*	*0.38*	*-1.56*	*0.49*
Waxwings	*0.13*	*0.06*	*-0.07*	*0.45*	*-0.22*	*0.08*
Wrens	*0.33*	*0.39*	*0.05*	*0.79*	*-0.29*	*0.39*
Corvids	0.17	0.20	0.03	0.86	*-0.27*	*0.33*
Woodpeckers	0.13	0.10	-0.03	0.76	*-0.17*	*0.12*

Table 4. Dominant and secondary landcover along each transect surveyed during the breeding bird transect surveys.

Transect	Dominant Landcover Type	Secondary Landcover Type
19T	Crop	Grassland
27T	Mixed Forest	Shrub
30T	Shrub	Mixed Forest
36T	Mixed Forest	Shrub
43T	Mixed Forest	Shrub
49T	Grassland	Shrub
63T	Grassland	Shrub
66T	Grassland	Shrub
67T	Shrub	Mixed Forest
96T	Deciduous Forest	Coniferous Forest
97T	Mixed Forest	Shrub
103T	Grassland	Shrub
104T	Grassland	Shrub
105T	Mixed Forest	Shrub
REF1	Mixed Forest	Shrub
REF2	Grassland	Shrub
REF3	Deciduous Forest	Coniferous Forest
REF4	Grassland	Crop
REF5	Shrub	Mixed Forest
REF6	Grassland	Shrub
REF7	Mixed Forest	Shrub
REF8	Pasture	Shrub

Species Composition at Turbine and Reference Transects

Among bird types, passerines dominated the species composition at all breeding bird transects (Figure 4). The other bird types observed during surveys conducted at turbine transects were diurnal raptors, woodpeckers, doves and pigeons, gamebirds, shorebirds, waterbirds, waterfowl, and cuckoos. Among reference transects large corvids, woodpeckers, doves and pigeons, shorebirds, and waterfowl were observed (Figure 4). While the percent composition of passerine subtypes varied among transects, there were no striking differences in species composition at turbine and reference transects (Figure 5).

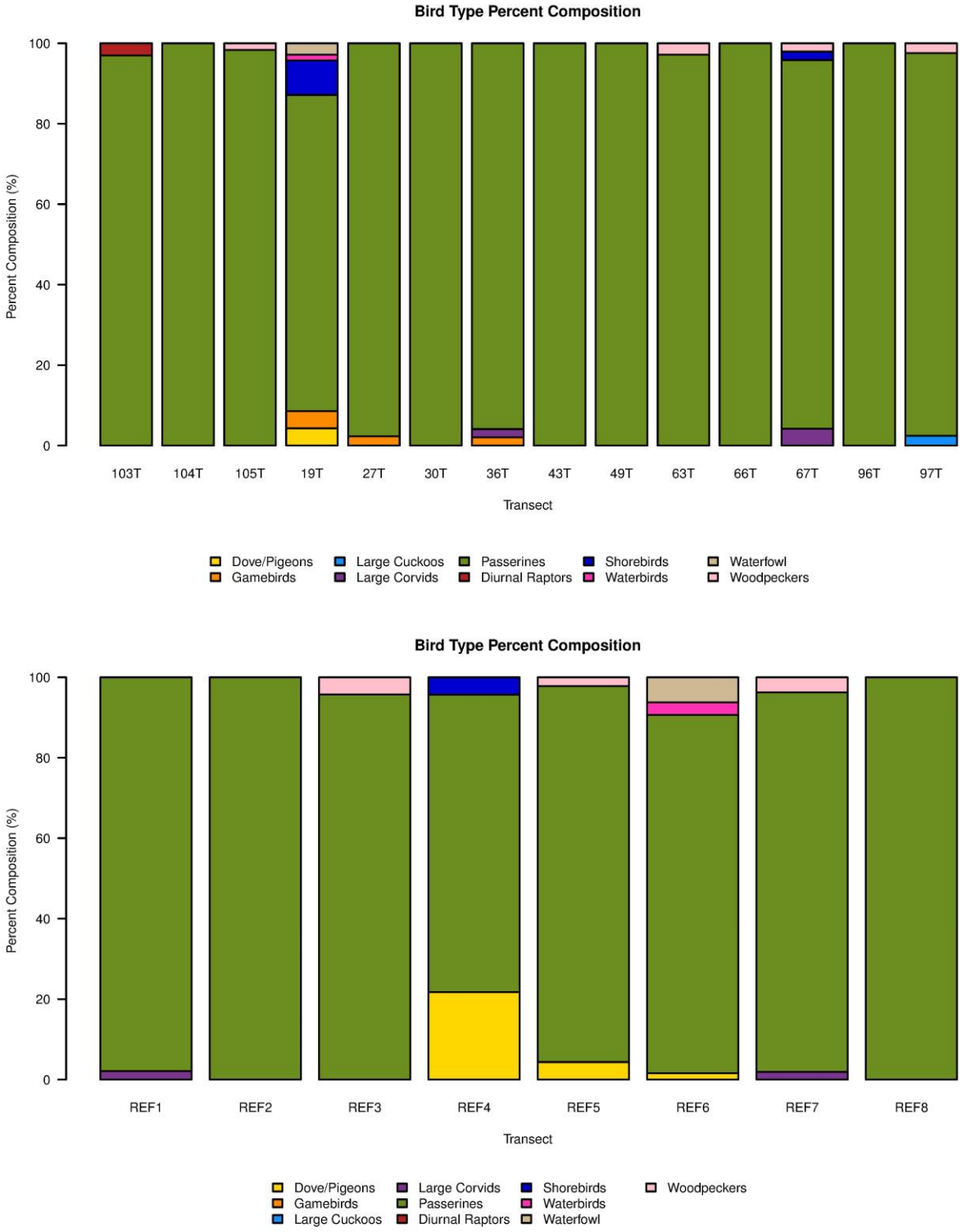


Figure 4. Percent composition of major bird types at turbine (top) and reference (bottom) transects observed during breeding bird transect surveys at the Arkwright Summit Wind Project; May 25 to July 15, 2013.

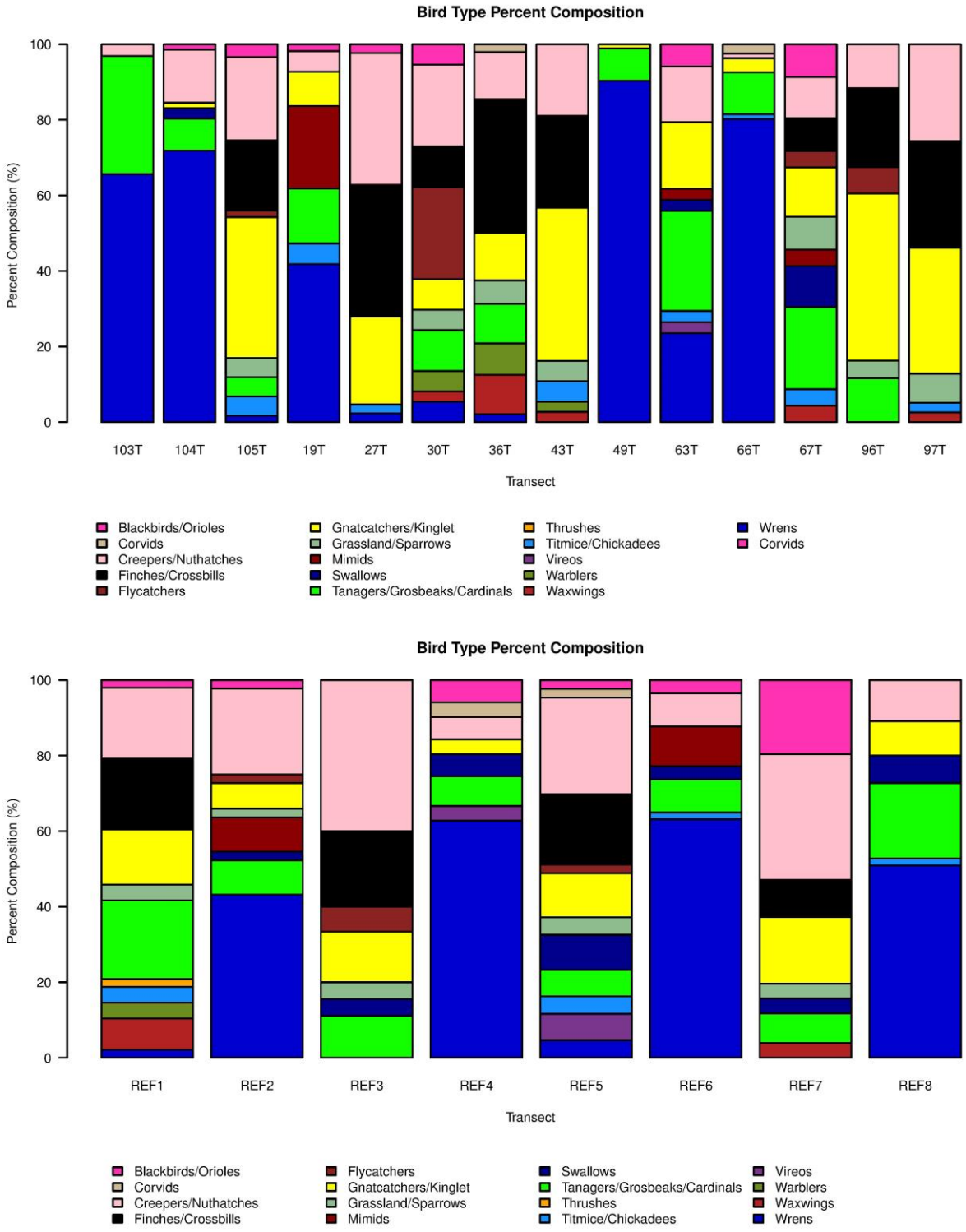


Figure 5. Percent composition of passerine subtypes at turbine (top) and reference (bottom) transects observed during breeding bird transect surveys.

Difference in Mean Use Between Reference and Turbine Transects

Comparisons using t-tests were made between reference and turbine transects in grassland and forest for passerine subtypes and species at each 50-m segment (Appendix D). Although significant differences were observed between reference and turbine plots in some segments for a few passerine subtypes, no strong patterns of avoidance were evident (Appendix D). No patterns of avoidance were detected for most species, with the exception of American robin (*Turdus migratorius*), common yellowthroat (*Geothlypis trichas*), chestnut-sided warbler (*Setophaga pensylvanica*), red-eyed vireo (*Vireo olivaceus*), red-winged blackbird (*Agelaius phoeniceus*), and savannah sparrow (Table 5). American robin showed a significant difference in mean use for the turbine transect in forested landcover while the common yellowthroat and chestnut-sided warbler showed a preference for forested landcover at reference transects. Red-eyed vireo showed a slight preference for forest landcover at both reference and turbine transects. Red-winged blackbird and savannah sparrow showed a preference for grassland landcover at reference and turbine transects.

Table 5. Difference in mean use of several representative passerine species at turbines and reference transects in forest and grassland vegetation types. Blocks with significant differences between the reference and turbine means are bolded.

50-m Block	Reference Mean	Turbine Mean	Difference of Means*	p-value	90% CI Lower	90% CI Upper
American Robin						
Forest						
1	0.31	0.21	0.10	0.54	-0.16	0.38
2	**0.00**	**0.29**	**-0.29**	**0.09**	**-0.47**	**-0.14**
3	0.30	0.29	0.01	0.96	-0.22	0.21
4	0.06	0.28	-0.22	0.25	-0.41	0.00
5	0.19	0.50	-0.31	0.17	-0.56	-0.06
6	0.31	0.32	-0.01	0.98	-0.42	0.41
Grassland						
1	0.00	0.25	-0.25	0.20	-0.46	-0.04
2	0.06	0.13	-0.06	0.62	-0.21	0.08
3	0.08	0.11	-0.03	0.86	-0.22	0.17
4	0.06	0.00	0.06	0.31	0.00	0.19
5	0.13	0.11	0.01	0.95	-0.21	0.19
6	0.25	0.06	0.19	0.33	-0.11	0.50
Common Yellowthroat						
Forest						
1	0	0.07	-0.07	0.55	-0.14	0
2	0	0.03	-0.03	0.63	-0.09	0
3	0.05	0.11	-0.06	0.56	-0.23	0.07
4	**0.25**	**0**	**0.25**	**0.06**	**0**	**0.50**
5	0.06	0	0.06	0.28	0	0.13
6	0	0.04	-0.04	0.62	-0.13	0
Grassland						
1	0.19	0.14	0.04	0.79	-0.19	0.28
2	0	0.08	-0.08	0.26	-0.17	0
3	0.08	0.04	0.04	0.77	-0.08	0.17
4	0.19	0.14	0.05	0.65	-0.12	0.19
5	0.06	0.11	-0.05	0.68	-0.22	0.13
6	**0.19**	**0**	**0.19**	**0.09**	**0.06**	**0.38**

Table 5. Difference in mean use of several representative passerine species at turbines and reference transects in forest and grassland vegetation types. Blocks with significant differences between the reference and turbine means are bolded.

50-m Block	Reference Mean	Turbine Mean	Difference of Means*	p-value	90% CI Lower	90% CI Upper
Chestnut-sided Warbler						
Forest						
1	**0.31**	**0**	**0.31**	**0.03**	**0.13**	**0.56**
2	0	0.03	-0.03	0.63	-0.09	0
3	0.05	0	0.05	0.24	0	0.15
4	0.06	0.03	0.03	0.78	-0.06	0.13
5	0	0.03	-0.03	0.63	-0.09	0
6	0	0.03	-0.03	0.64	-0.09	0
Grassland						
1	0	0.05	-0.05	0.53	-0.14	0
2	0	0	0	--	--	--
3	0	0	0	--	--	--
4	0	0	0	--	--	--
5	0	0	0	--	--	--
6	0	0	0	--	--	--
Red-eyed Vireo						
Forest						
1	**0.63**	**0.32**	**0.30**	**0.05**	**0.13**	**0.45**
2	0.50	0.57	-0.07	0.71	-0.31	0.16
3	0.30	0.45	-0.15	0.63	-0.61	0.26
4	**0.19**	**0.52**	**-0.33**	**0.06**	**-0.56**	**-0.10**
5	0.06	0.22	-0.16	0.27	-0.34	0
6	0.19	0.38	-0.19	0.40	-0.47	0.09
Grassland						
1	0	0	0	--	--	--
2	0	0	0	--	--	--
3	0	0	0	--	--	--
4	0	0	0	--	--	--
5	0	0	0	--	--	--
6	0	0	0	--	--	--
Red-winged Blackbird						
Forest						
1	0.06	0	0.06	0.27	0	0.13
2	0	0	0	--	--	--
3	0.40	0	0.40	0.28	0	1.20
4	0	0	0	--	--	--
5	0.06	0	0.06	0.26	0	0.13
6	0	0	0	--	--	--
Grassland						
1	1.56	0.86	0.71	0.39	-0.52	1.80
2	**1.06**	**0.33**	**0.73**	**0.08**	**0.04**	**1.41**
3	0.58	0.36	0.22	0.42	-0.24	0.76
4	0.31	1.17	-0.85	0.18	-1.71	-0.08
5	0.38	0.31	0.07	0.80	-0.37	0.60
6	0.69	0.56	0.13	0.78	-0.60	1.08

Table 5. Difference in mean use of several representative passerine species at turbines and reference transects in forest and grassland vegetation types. Blocks with significant differences between the reference and turbine means are bolded.

50-m Block	Reference Mean	Turbine Mean	Difference of Means*	p-value	90% CI Lower	90% CI Upper
Savannah Sparrow						
Forest						
1	0	0	0	--	--	--
2	0	0	0	--	--	--
3	0	0	0	--	--	--
4	0	0	0	--	--	--
5	0	0	0	--	--	--
6	0	0	0	--	--	--
Grassland						
1	**0**	**0.33**	**-0.33**	**0.01**	**-0.45**	**-0.23**
2	**0.06**	**0.44**	**-0.38**	**0.07**	**-0.62**	**-0.15**
3	0.42	0.29	0.13	0.40	-0.08	0.31
4	0.31	0.38	-0.06	0.68	-0.31	0.22
5	0.25	0.13	0.13	0.57	-0.19	0.44
6	0.19	0.17	0.02	0.90	-0.15	0.17

Sensitive Species Observations

Two cerulean warblers were detected during spring surveys at the Project (Table 6) a species of special concern in New York. In addition single observations of an American bittern and an olive-sided flycatcher were observed during surveys (Table 3). The American bittern is also considered a species of special concern in New York, while the olive side flycatcher is a federally listed species of conservation concern.

Table 6. Summary of sensitive species observed during the breeding bird surveys.

Species	Scientific Name	Status	Number of Groups	Number of Individuals
cerulean warbler	*Setophaga cerulea*	SSC	2	2
American bittern	*Botaurus lentiginosus*	SSC	1	1
olive-sided flycatcher	*Contopus cooperi*	SOC	1	1
Total	**3 species**		**4**	**4**

DISCUSSION

The results of the breeding bird surveys were typical of mixed deciduous forest and agricultural land vegetation communities in the eastern US. Among bird types, passerines dominated the species composition at all transects along with having the highest mean bird use, percent of use, and frequency of occurrence. Several species of open-land passerines were frequently recorded including bobolink, red-winged blackbird, American robin, as well as common species of forested vegetation such as red-eyed vireo and ovenbird. While the percent composition of passerine subtypes varied among transects, there were no differences in bird use and species composition or diversity between turbine and reference transects at the species or subtype level. For most species the number of observations were too few for meaningful comparisons to

be made between vegetation types or transect type at the species level (see Appendix A), however by lumping species by bird type and Passerine subtype allows some comparisons to be made.

Because there are currently no turbines present at the site, the comparison between transect types and along transects at this stage validate the adequacy of the study plots (the transects) for future comparison investigating whether displacement type effects have occurred due to the presence of the turbines. The study design for the BBS was set up as a BACI study. A repeat of the same methods and using the same transects post-construction can allow for investigating whether the Project leads to displacement type effects to typical breeding birds in the Project area. This year's study provides the Before component for both the Control (the reference transects) and Impact (the turbine transects). Repeating the same surveys post-construction would allow the comparisons of bird use and composition after construction. The Control transects will control for other variables that may influence breeding bird populations in the area absent the turbines such as land use changes, general species population dynamics, variable weather conditions, etc. The similarities, or the lack of significant differences observed between the turbine transects and reference transects, confirm the suitability of the reference transects to provide an adequate comparison to the turbine transects. Similarities among the transect types seen this year is likely the result of both turbine and reference transects being situated in similar mixed habitats in which bird use is currently similar.

REFERENCES

Bing. 2013. Bing Aerial Maps. Microsoft Corporation.

Davidson, A. C. and D. V. Hinkley. 1997. Bootstrap Methods and Their Application. Cambridge University Press. 582 pp.

DeLorme. 2013. Topo North America. Digital Topographic Map Data. DeLorme, Yarmouth, Maine.

ESRI. 2013. Geographic Information System (GIS) Online Topographic Base Map. ESRI, producers of ArcGIS software. Redlands, California.

Google Earth. 2012. Google Earth 6.2. Image data: 2012 GeoEye and USDA Farm Services Agency. Online at: http://www.google.com/earth/index.html

Manly, B. F. J. 2006. Randomization, Bootstrap and Monte Carlo Methods in Biology. Third Edition. Chapman and Hall/CRC, Boca Raton, Florida.

National Geographic Society (National Geographic). 2013. TOPO! Digital Topographic Map.

NAVTEQ. 2013. Digital map data. Chicago, Illinois.

North American Datum (NAD). 1983. NAD83 Geodetic Datum.

US Geological Survey (USGS) National Land Cover Database (NLCD). 2006. NLCD Land Cover 2006. USGS, Sioux Falls, South Dakota. Publication date: February 16, 2011.

Appendix A. All Bird Types and Species Observed at the Arkwright Summit Wind Resource Area during Breeding Bird Use Surveys, May 25 to July 15, 2013

Appendix A. Total number of groups and individuals for each bird type, passerine subtype, and species during the breeding bird transect surveys at the Arkwright Wind Project; May 25 to July 15, 2013.

		Visit One		Visit Two		Visit Three		Visit Four		Total	
Bird Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Waterbirds		**0**	**0**	**0**	**0**	**2**	**3**	**0**	**0**	**2**	**3**
American bittern	*Botaurus lentiginosus*	0	0	0	0	1	1	0	0	1	1
great blue heron	*Ardea herodias*	0	0	0	0	1	2	0	0	1	2
Waterfowl		**2**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**6**
Canada goose	*Branta canadensis*	1	4	0	0	0	0	0	0	1	4
mallard	*Anas platyrhynchos*	1	2	0	0	0	0	0	0	1	2
Shorebirds		**1**	**1**	**2**	**3**	**3**	**6**	**0**	**0**	**6**	**10**
killdeer	*Charadrius vociferus*	1	1	2	3	3	6	0	0	6	10
Diurnal Raptors		**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
American kestrel	*Falco sparverius*	0	0	0	0	0	0	1	1	1	1
Upland Game Birds		**2**	**2**	**1**	**3**	**0**	**0**	**0**	**0**	**3**	**5**
ruffed grouse	*Bonasa umbellus*	1	1	0	0	0	0	0	0	1	1
wild turkey	*Meleagris gallopavo*	1	1	1	3	0	0	0	0	2	4
Doves/Pigeons		**1**	**2**	**1**	**5**	**6**	**12**	**1**	**2**	**9**	**21**
mourning dove	*Zenaida macroura*	0	0	0	0	3	5	0	0	3	5
rock pigeon	*Columba livia*	1	2	1	5	3	7	1	2	6	16
Large Corvids		**0**	**0**	**1**	**1**	**3**	**4**	**0**	**0**	**4**	**5**
American crow	*Corvus brachyrhynchos*	0	0	1	1	2	3	0	0	3	4
common raven	*Corvus corax*	0	0	0	0	1	1	0	0	1	1
Cuckoos		**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
black-billed cuckoo	*Coccyzus erythropthalmus*	1	1	0	0	0	0	0	0	1	1
Passerines		**303**	**338**	**227**	**264**	**200**	**266**	**147**	**239**	**877**	**1,107**
Blackbirds/Orioles		*85*	*102*	*47*	*57*	*55*	*112*	*21*	*104*	*208*	*375*
Baltimore oriole	*Icterus galbula*	0	0	1	1	0	0	1	1	2	2
bobolink	*Dolichonyx oryzivorus*	35	44	26	34	17	50	6	46	84	174
brown-headed cowbird	*Molothrus ater*	2	2	2	2	1	1	0	0	5	5
common grackle	*Quiscalus quiscula*	0	0	0	0	1	1	1	6	2	7
eastern meadowlark	*Sturnella magna*	10	10	6	6	4	4	3	3	23	23
red-winged blackbird	*Agelaius phoeniceus*	38	46	12	14	32	56	10	48	92	164
Creepers/Nuthatches		*4*	*4*	*1*	*1*	*1*	*1*	*2*	*3*	*8*	*9*
brown creeper	*Certhia americana*	1	1	0	0	0	0	0	0	1	1
red-breasted nuthatch	*Sitta canadensis*	1	1	1	1	1	1	0	0	3	3
white-breasted nuthatch	*Sitta carolinensis*	2	2	0	0	0	0	2	3	4	5

Appendix A. Total number of groups and individuals for each bird type, passerine subtype, and species during the breeding bird transect surveys at the Arkwright Wind Project; May 25 to July 15, 2013.

		Visit One		Visit Two		Visit Three		Visit Four		Total	
Bird Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Finches/Crossbills		*1*	*2*	*2*	*3*	*1*	*1*	*0*	*0*	*4*	*6*
American goldfinch	*Spinus tristis*	1	2	2	3	0	0	0	0	3	5
house finch	*Haemorhous mexicanus*	0	0	0	0	1	1	0	0	1	1
Flycatchers		*10*	*10*	*6*	*6*	*3*	*3*	*1*	*1*	*20*	*20*
Acadian flycatcher	*Empidonax virescens*	0	0	0	0	1	1	0	0	1	1
eastern kingbird	*Tyrannus tyrannus*	2	2	1	1	0	0	1	1	4	4
eastern phoebe	*Sayornis phoebe*	2	2	2	2	1	1	0	0	5	5
eastern wood-pewee	*Contopus virens*	3	3	2	2	1	1	0	0	6	6
great crested flycatcher	*Myiarchus crinitus*	1	1	1	1	0	0	0	0	2	2
olive-sided flycatcher	*Contopus cooperi*	1	1	0	0	0	0	0	0	1	1
willow flycatcher	*Empidonax traillii*	1	1	0	0	0	0	0	0	1	1
Gnatcatchers/Kinglet		*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*
golden-crowned kinglet	*Regulus satrapa*	1	1	0	0	0	0	0	0	1	1
Grassland/Sparrows		*33*	*34*	*37*	*38*	*25*	*25*	*26*	*26*	*121*	*123*
chipping sparrow	*Spizella passerina*	1	1	1	1	0	0	0	0	2	2
dark-eyed junco	*Junco hyemalis*	7	7	6	7	3	3	5	5	21	22
eastern towhee	*Pipilo erythrophthalmus*	1	2	11	11	5	5	3	3	20	21
Savannah sparrow	*Passerculus sandwichensis*	17	17	14	14	13	13	14	14	58	58
song sparrow	*Melospiza melodia*	7	7	5	5	4	4	4	4	20	20
Mimids		*11*	*11*	*5*	*5*	*6*	*6*	*4*	*4*	*26*	*26*
brown thrasher	*Toxostoma rufum*	0	0	0	0	1	1	0	0	1	1
gray catbird	*Dumetella carolinensis*	11	11	5	5	5	5	4	4	25	25
Swallows		*2*	*7*	*3*	*9*	*1*	*9*	*0*	*0*	*6*	*25*
barn swallow	*Hirundo rustica*	2	7	3	9	1	9	0	0	6	25
Tanagers/Grosbeaks/Cardinals		*13*	*14*	*7*	*7*	*6*	*6*	*1*	*1*	*27*	*28*
indigo bunting	*Passerina cyanea*	1	1	0	0	0	0	0	0	1	1
northern cardinal	*Cardinalis cardinalis*	1	1	1	1	1	1	0	0	3	3
rose-breasted grosbeak	*Pheucticus ludovicianus*	5	6	3	3	2	2	1	1	11	12
scarlet tanager	*Piranga olivacea*	6	6	3	3	3	3	0	0	12	12
Thrushes		*24*	*30*	*39*	*51*	*36*	*36*	*26*	*30*	*125*	*147*
American robin	*Turdus migratorius*	13	19	30	42	25	25	12	16	80	102
eastern bluebird	*Sialia sialis*	1	1	0	0	0	0	1	1	2	2
veery	*Catharus fuscescens*	3	3	2	2	3	3	2	2	10	10
wood thrush	*Hylocichla mustelina*	7	7	7	7	8	8	11	11	33	33

Appendix A. Total number of groups and individuals for each bird type, passerine subtype, and species during the breeding bird transect surveys at the Arkwright Wind Project; May 25 to July 15, 2013.

		Visit One		Visit Two		Visit Three		Visit Four		Total	
Bird Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Titmice/Chickadees		*3*	*6*	*2*	*6*	*4*	*4*	*1*	*4*	*10*	*20*
black-capped chickadee	*Poecile atricapilla*	2	5	2	6	4	4	1	4	9	19
tufted titmouse	*Baeolophus bicolor*	1	1	0	0	0	0	0	0	1	1
Vireos		*33*	*33*	*32*	*32*	*16*	*16*	*30*	*30*	*111*	*111*
red-eyed vireo	*Vireo olivaceus*	33	33	32	32	16	16	30	30	111	111
Warblers		*73*	*74*	*31*	*31*	*38*	*38*	*25*	*25*	*167*	*168*
American redstart	*Setophaga ruticilla*	4	5	0	0	0	0	0	0	4	5
black-and-white warbler	*Mniotilta varia*	1	1	0	0	0	0	0	0	1	1
black-throated green warbler	*Setophaga virens*	11	11	4	4	9	9	3	3	27	27
Blackburnian warbler	*Setophaga fusca*	1	1	0	0	0	0	0	0	1	1
blue-winged warbler	*Vermivora cyanoptera*	3	3	0	0	0	0	0	0	3	3
cerulean warbler	*Setophaga cerulea*	0	0	0	0	2	2	0	0	2	2
chestnut-sided warbler	*Setophaga pensylvanica*	7	7	0	0	4	4	1	1	12	12
common yellowthroat	*Geothlypis trichas*	18	18	11	11	3	3	4	4	36	36
hooded warbler	*Setophaga citrina*	2	2	1	1	2	2	1	1	6	6
magnolia warbler	*Setophaga magnolia*	0	0	2	2	0	0	1	1	3	3
mourning warbler	*Geothlypis philadelphia*	5	5	1	1	1	1	1	1	8	8
northern Parula	*Setophaga americana*	1	1	0	0	0	0	0	0	1	1
ovenbird	*Seiurus aurocapilla*	10	10	7	7	11	11	14	14	42	42
unidentified warbler		0	0	0	0	3	3	0	0	3	3
yellow warbler	*Setophaga petechia*	10	10	5	5	3	3	0	0	18	18
Waxwings		*0*	*0*	*3*	*4*	*1*	*2*	*0*	*0*	*4*	*6*
cedar waxwing	*Bombycilla cedrorum*	0	0	3	4	1	2	0	0	4	6
Wrens		*10*	*10*	*7*	*7*	*5*	*5*	*9*	*9*	*31*	*31*
house wren	*Troglodytes aedon*	9	9	6	6	4	4	8	8	27	27
winter wren	*Troglodytes hiemalis*	1	1	1	1	1	1	1	1	4	4
Corvids		*0*	*0*	*5*	*7*	*2*	*2*	*1*	*2*	*8*	*11*
blue jay	*Cyanocitta cristata*	0	0	5	7	2	2	1	2	8	11
Woodpeckers		**4**	**4**	**3**	**3**	**1**	**1**	**1**	**1**	**9**	**9**
downy woodpecker	*Picoides pubescens*	0	0	2	2	1	1	0	0	3	3
hairy woodpecker	*Picoides villosus*	0	0	0	0	0	0	1	1	1	1
pileated woodpecker	*Dryocopus pileatus*	1	1	0	0	0	0	0	0	1	1
yellow-bellied sapsucker	*Sphyrapicus varius*	3	3	1	1	0	0	0	0	4	4
Overall		**314**	**354**	**235**	**279**	**215**	**292**	**150**	**243**	**914**	**1,168**

Appendix B. Mean Use, Percent of Use, and Frequency of Occurrence for all Birds Observed during Breeding Bird Surveys at the Arkwright Summit Wind Resource Area from May 25, to July 15, 2013

Appendix B. Mean bird use (number of birds/plot/20-min survey), percent of use, and frequency of occurrence for each bird type, passerine subtype, and species during each visit of the breeding bird surveys at the Arkwright Wind Project; May 25 to July 15, 2013.

	Mean Use					Percent of Use					Frequency of Occurrence				
Type / Species	**Visit 1**	**Visit 2**	**Visit 3**	**Visit 4**	**All**	**Visit 1**	**Visit 2**	**Visit 3**	**Visit 4**	**All**	**Visit 1**	**Visit 2**	**Visit 3**	**Visit 4**	**All**
Waterbirds	**0**	**0**	**0.14**	**0**	**0.03**	**0**	**0**	**1.0**	**0**	**0.2**	**0**	**0**	**9.1**	**0**	**2.3**
American bittern	0	0	0.05	0	0.01	0	0	0.3	0	<0.1	0	0	4.5	0	1.1
great blue heron	0	0	0.09	0	0.02	0	0	0.7	0	0.2	0	0	4.5	0	1.1
Waterfowl	**0.27**	**0**	**0**	**0**	**0.07**	**1.7**	**0**	**0**	**0**	**0.5**	**9.1**	**0**	**0**	**0**	**2.3**
Canada goose	0.18	0	0	0	0.05	1.1	0	0	0	0.3	4.5	0	0	0	1.1
mallard	0.09	0	0	0	0.02	0.6	0	0	0	0.2	4.5	0	0	0	1.1
Shorebirds	**0.05**	**0.14**	**0.27**	**0**	**0.11**	**0.3**	**1.1**	**2.1**	**0**	**0.8**	**4.5**	**9.1**	**4.5**	**0**	**4.5**
killdeer	0.05	0.14	0.27	0	0.11	0.3	1.1	2.1	0	0.8	4.5	9.1	4.5	0	4.5
Diurnal Raptors	**0**	**0**	**0**	**0.05**	**0.01**	**0**	**0**	**0**	**0.4**	**<0.1**	**0**	**0**	**0**	**5.3**	**1.3**
American kestrel	0	0	0	0.05	0.01	0	0	0	0.4	<0.1	0	0	0	5.3	1.3
Upland Game Birds	**0.09**	**0.14**	**0**	**0**	**0.06**	**0.6**	**1.1**	**0**	**0**	**0.4**	**9.1**	**4.5**	**0**	**0**	**3.4**
ruffed grouse	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
wild turkey	0.05	0.14	0	0	0.05	0.3	1.1	0	0	0.3	4.5	4.5	0	0	2.3
Doves/Pigeons	**0.09**	**0.23**	**0.55**	**0.11**	**0.24**	**0.6**	**1.8**	**4.1**	**0.8**	**1.8**	**4.5**	**4.5**	**18.2**	**5.3**	**8.1**
mourning dove	0	0	0.23	0	0.06	0	0	1.7	0	0.4	0	0	13.6	0	3.4
rock pigeon	0.09	0.23	0.32	0.11	0.19	0.6	1.8	2.4	0.8	1.4	4.5	4.5	9.1	5.3	5.9
Large Corvids	**0**	**0.05**	**0.18**	**0**	**0.06**	**0**	**0.4**	**1.4**	**0**	**0.4**	**0**	**4.5**	**13.6**	**0**	**4.5**
American crow	0	0.05	0.14	0	0.05	0	0.4	1.0	0	0.3	0	4.5	9.1	0	3.4
common raven	0	0	0.05	0	0.01	0	0	0.3	0	<0.1	0	0	4.5	0	1.1
Cuckoos	**0.05**	**0**	**0**	**0**	**0.01**	**0.3**	**0**	**0**	**0**	**<0.1**	**4.5**	**0**	**0**	**0**	**1.1**
black-billed cuckoo	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
Passerines	**15.36**	**12.00**	**12.09**	**12.58**	**13.01**	**95.5**	**94.6**	**91.1**	**98.4**	**94.9**	**100**	**100**	**100**	**100**	**100**
Blackbirds/Orioles	*4.64*	*2.59*	*5.09*	*5.47*	*4.45*	*28.8*	*20.4*	*38.4*	*42.8*	*32.4*	*54.5*	*54.5*	*50.0*	*42.1*	*50.3*
Baltimore oriole	0	0.05	0	0.05	0.02	0	0.4	0	0.4	0.2	0	4.5	0	5.3	2.5
bobolink	2.00	1.55	2.27	2.42	2.06	12.4	12.2	17.1	18.9	15.0	36.4	36.4	31.8	26.3	32.7
brown-headed cowbird	0.09	0.09	0.05	0	0.06	0.6	0.7	0.3	0	0.4	9.1	9.1	4.5	0	5.7
common grackle	0	0	0.05	0.32	0.09	0	0	0.3	2.5	0.7	0	0	4.5	5.3	2.5
eastern meadowlark	0.45	0.27	0.18	0.16	0.27	2.8	2.2	1.4	1.2	1.9	13.6	13.6	13.6	15.8	14.2
red-winged blackbird	2.09	0.64	2.55	2.53	1.95	13.0	5.0	19.2	19.8	14.2	45.5	31.8	40.9	31.6	37.4
Creepers/Nuthatches	*0.18*	*0.05*	*0.05*	*0.16*	*0.11*	*1.1*	*0.4*	*0.3*	*1.2*	*0.8*	*13.6*	*4.5*	*4.5*	*10.5*	*8.3*
brown creeper	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
red-breasted nuthatch	0.05	0.05	0.05	0	0.03	0.3	0.4	0.3	0	0.2	4.5	4.5	4.5	0	3.4
white-breasted nuthatch	0.09	0	0	0.16	0.06	0.6	0	0	1.2	0.5	9.1	0	0	10.5	4.9

Appendix B. Mean bird use (number of birds/plot/20-min survey), percent of use, and frequency of occurrence for each bird type, passerine subtype, and species during each visit of the breeding bird surveys at the Arkwright Wind Project; May 25 to July 15, 2013.

	Mean Use					Percent of Use					Frequency of Occurrence				
Type / Species	**Visit 1**	**Visit 2**	**Visit 3**	**Visit 4**	**All**	**Visit 1**	**Visit 2**	**Visit 3**	**Visit 4**	**All**	**Visit 1**	**Visit 2**	**Visit 3**	**Visit 4**	**All**
Finches/Crossbills	*0.09*	*0.14*	*0.05*	*0*	*0.07*	*0.6*	*1.1*	*0.3*	*0*	*0.5*	*4.5*	*4.5*	*4.5*	*0*	*3.4*
American goldfinch	0.09	0.14	0	0	0.06	0.6	1.1	0	0	0.4	4.5	4.5	0	0	2.3
house finch	0	0	0.05	0	0.01	0	0	0.3	0	<0.1	0	0	4.5	0	1.1
Flycatchers	*0.45*	*0.27*	*0.14*	*0.05*	*0.23*	*2.8*	*2.2*	*1.0*	*0.4*	*1.7*	*40.9*	*27.3*	*9.1*	*5.3*	*20.6*
Acadian flycatcher	0	0	0.05	0	0.01	0	0	0.3	0	<0.1	0	0	4.5	0	1.1
eastern kingbird	0.09	0.05	0	0.05	0.05	0.6	0.4	0	0.4	0.3	9.1	4.5	0	5.3	4.7
eastern phoebe	0.09	0.09	0.05	0	0.06	0.6	0.7	0.3	0	0.4	9.1	9.1	4.5	0	5.7
eastern wood-pewee	0.14	0.09	0.05	0	0.07	0.8	0.7	0.3	0	0.5	13.6	9.1	4.5	0	6.8
great crested flycatcher	0.05	0.05	0	0	0.02	0.3	0.4	0	0	0.2	4.5	4.5	0	0	2.3
olive-sided flycatcher	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
willow flycatcher	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
Gnatcatchers/Kinglet	*0.05*	*0*	*0*	*0*	*0.01*	*0.3*	*0*	*0*	*0*	*<0.1*	*4.5*	*0*	*0*	*0*	*1.1*
golden-crowned kinglet	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
Grassland/Sparrows	*1.55*	*1.73*	*1.14*	*1.37*	*1.44*	*9.6*	*13.6*	*8.6*	*10.7*	*10.5*	*77.3*	*72.7*	*50.0*	*73.7*	*68.4*
chipping sparrow	0.05	0.05	0	0	0.02	0.3	0.4	0	0	0.2	4.5	4.5	0	0	2.3
dark-eyed junco	0.32	0.32	0.14	0.26	0.26	2.0	2.5	1.0	2.1	1.9	18.2	18.2	9.1	21.1	16.6
eastern towhee	0.09	0.50	0.23	0.16	0.24	0.6	3.9	1.7	1.2	1.8	4.5	27.3	13.6	10.5	14.0
Savannah sparrow	0.77	0.64	0.59	0.74	0.68	4.8	5.0	4.5	5.8	5.0	36.4	31.8	31.8	42.1	35.5
song sparrow	0.32	0.23	0.18	0.21	0.23	2.0	1.8	1.4	1.6	1.7	22.7	18.2	18.2	15.8	18.7
Mimids	*0.50*	*0.23*	*0.27*	*0.21*	*0.30*	*3.1*	*1.8*	*2.1*	*1.6*	*2.2*	*36.4*	*22.7*	*18.2*	*15.8*	*23.3*
brown thrasher	0	0	0.05	0	0.01	0	0	0.3	0	<0.1	0	0	4.5	0	1.1
gray catbird	0.50	0.23	0.23	0.21	0.29	3.1	1.8	1.7	1.6	2.1	36.4	22.7	18.2	15.8	23.3
Swallows	*0.32*	*0.41*	*0.41*	*0*	*0.28*	*2.0*	*3.2*	*3.1*	*0*	*2.1*	*9.1*	*13.6*	*4.5*	*0*	*6.8*
barn swallow	0.32	0.41	0.41	0	0.28	2.0	3.2	3.1	0	2.1	9.1	13.6	4.5	0	6.8
Tanagers/Grosbeaks/Cardinals	*0.64*	*0.32*	*0.27*	*0.05*	*0.32*	*4.0*	*2.5*	*2.1*	*0.4*	*2.3*	*40.9*	*27.3*	*22.7*	*5.3*	*24.0*
indigo bunting	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
northern cardinal	0.05	0.05	0.05	0	0.03	0.3	0.4	0.3	0	0.2	4.5	4.5	4.5	0	3.4
rose-breasted grosbeak	0.27	0.14	0.09	0.05	0.14	1.7	1.1	0.7	0.4	1.0	22.7	13.6	9.1	5.3	12.7
scarlet tanager	0.27	0.14	0.14	0	0.14	1.7	1.1	1.0	0	1.0	27.3	13.6	13.6	0	13.6
Thrushes	*1.36*	*2.32*	*1.64*	*1.58*	*1.72*	*8.5*	*18.3*	*12.3*	*12.3*	*12.6*	*54.5*	*72.7*	*68.2*	*63.2*	*64.7*
American robin	0.86	1.91	1.14	0.84	1.19	5.4	15.1	8.6	6.6	8.7	40.9	72.7	68.2	42.1	56.0
eastern bluebird	0.05	0	0	0.05	0.02	0.3	0	0	0.4	0.2	4.5	0	0	5.3	2.5
Veery	0.14	0.09	0.14	0.11	0.12	0.8	0.7	1.0	0.8	0.9	13.6	4.5	4.5	10.5	8.3
wood thrush	0.32	0.32	0.36	0.58	0.39	2.0	2.5	2.7	4.5	2.9	22.7	22.7	13.6	36.8	24.0

Appendix B. Mean bird use (number of birds/plot/20-min survey), percent of use, and frequency of occurrence for each bird type, passerine subtype, and species during each visit of the breeding bird surveys at the Arkwright Wind Project; May 25 to July 15, 2013.

	Mean Use					Percent of Use					Frequency of Occurrence				
Type / Species	**Visit 1**	**Visit 2**	**Visit 3**	**Visit 4**	**All**	**Visit 1**	**Visit 2**	**Visit 3**	**Visit 4**	**All**	**Visit 1**	**Visit 2**	**Visit 3**	**Visit 4**	**All**
Titmice/Chickadees	*0.27*	*0.27*	*0.18*	*0.21*	*0.23*	*1.7*	*2.2*	*1.4*	*1.6*	*1.7*	*13.6*	*9.1*	*18.2*	*5.3*	*11.5*
black-capped chickadee	0.23	0.27	0.18	0.21	0.22	1.4	2.2	1.4	1.6	1.6	9.1	9.1	18.2	5.3	10.4
tufted titmouse	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
Vireos	*1.5*	*1.45*	*0.73*	*1.58*	*1.32*	*9.3*	*11.5*	*5.5*	*12.3*	*9.6*	*50.0*	*45.5*	*27.3*	*57.9*	*45.2*
red-eyed vireo	1.5	1.45	0.73	1.58	1.32	9.3	11.5	5.5	12.3	9.6	50.0	45.5	27.3	57.9	45.2
Warblers	*3.36*	*1.41*	*1.73*	*1.32*	*1.95*	*20.9*	*11.1*	*13.0*	*10.3*	*14.3*	*86.4*	*72.7*	*63.6*	*73.7*	*74.1*
American redstart	0.23	0	0	0	0.06	1.4	0	0	0	0.4	9.1	0	0	0	2.3
black-and-white warbler	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
black-throated green warbler	0.5	0.18	0.41	0.16	0.31	3.1	1.4	3.1	1.2	2.3	22.7	9.1	18.2	10.5	15.1
Blackburnian warbler	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
blue-winged warbler	0.14	0	0	0	0.03	0.8	0	0	0	0.2	9.1	0	0	0	2.3
cerulean warbler	0	0	0.09	0	0.02	0	0	0.7	0	0.2	0	0	4.5	0	1.1
chestnut-sided warbler	0.32	0	0.18	0.05	0.14	2.0	0	1.4	0.4	1.0	27.3	0	13.6	5.3	11.5
common yellowthroat	0.82	0.50	0.14	0.21	0.42	5.1	3.9	1.0	1.6	3.0	45.5	45.5	13.6	21.1	31.4
hooded warbler	0.09	0.05	0.09	0.05	0.07	0.6	0.4	0.7	0.4	0.5	4.5	4.5	4.5	5.3	4.7
magnolia warbler	0	0.09	0	0.05	0.04	0	0.7	0	0.4	0.3	0	4.5	0	5.3	2.5
mourning warbler	0.23	0.05	0.05	0.05	0.09	1.4	0.4	0.3	0.4	0.7	22.7	4.5	4.5	5.3	9.3
northern Parula	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
Ovenbird	0.45	0.32	0.5	0.74	0.5	2.8	2.5	3.8	5.8	3.7	40.9	22.7	40.9	47.4	38.0
unidentified warbler	0	0	0.14	0	0.03	0	0	1.0	0	0.2	0	0	9.1	0	2.3
yellow warbler	0.45	0.23	0.14	0	0.2	2.8	1.8	1.0	0	1.5	31.8	22.7	13.6	0	17.0
Waxwings	*0*	*0.18*	*0.09*	*0*	*0.07*	*0*	*1.4*	*0.7*	*0*	*0.5*	*0*	*13.6*	*4.5*	*0*	*4.5*
cedar waxwing	0	0.18	0.09	0	0.07	0	1.4	0.7	0	0.5	0	13.6	4.5	0	4.5
Wrens	*0.45*	*0.32*	*0.23*	*0.47*	*0.37*	*2.8*	*2.5*	*1.7*	*3.7*	*2.7*	*31.8*	*13.6*	*13.6*	*36.8*	*24.0*
house wren	0.41	0.27	0.18	0.42	0.32	2.5	2.2	1.4	3.3	2.3	27.3	9.1	9.1	31.6	19.3
winter wren	0.05	0.05	0.05	0.05	0.05	0.3	0.4	0.3	0.4	0.3	4.5	4.5	4.5	5.3	4.7
Corvids	0	0.32	0.09	0.11	0.13	0	2.5	0.7	0.8	0.9	0	18.2	9.1	5.3	8.1
blue jay	0	0.32	0.09	0.11	0.13	0	2.5	0.7	0.8	0.9	0	18.2	9.1	5.3	8.1
Woodpeckers	**0.18**	**0.14**	**0.05**	**0.05**	**0.10**	**1.1**	**1.1**	**0.3**	**0.4**	**0.8**	**18.2**	**9.1**	**4.5**	**5.3**	**9.3**
downy woodpecker	0	0.09	0.05	0	0.03	0	0.7	0.3	0	0.2	0	9.1	4.5	0	3.4
hairy woodpecker	0	0	0	0.05	0.01	0	0	0	0.4	<0.1	0	0	0	5.3	1.3
pileated woodpecker	0.05	0	0	0	0.01	0.3	0	0	0	<0.1	4.5	0	0	0	1.1
yellow-bellied sapsucker	0.14	0.05	0	0	0.05	0.8	0.4	0	0	0.3	13.6	4.5	0	0	4.5
Overall	**16.09**	**12.68**	**13.27**	**12.79**	**13.71**	**100**	**100**	**100**	**100**	**100**					

Appendix C: Mean Use for each Transect Surveyed during the Breeding Bird Transect Surveys at the Arkwright Wind Project; May 25 to July 15, 2013

Appendix C1. Mean use (number of birds/20-minute survey) for major bird types and passerine subtypes observed at each turbine transect during breeding bird surveys at the Arkwright Wind Project; May 25 to July 15, 2013.

	Survey Transect													
Bird Type	**103T**	**104T**	**105T**	**19T**	**27T**	**30T**	**36T**	**43T**	**49T**	**63T**	**66T**	**67T**	**96T**	**97T**
Waterbirds	0	0	0	0.33	0	0	0	0	0	0	0	0	0	0
Waterfowl	0	0	0	0.67	0	0	0	0	0	0	0	0	0	0
Shorebirds	0	0	0	2.00	0	0	0	0	0	0	0	0.33	0	0
Diurnal Raptors	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland Game Birds	0	0	0	1.00	0.25	0	0.25	0	0	0	0	0	0	0
Doves/Pigeons	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0
Large Corvids	0	0	0	0	0	0	0.25	0	0	0	0	0.67	0	0
Cuckoos	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25
Passerines	8.00	17.75	14.75	18.33	10.75	9.25	11.75	9.25	23.25	8.50	27.00	14.67	10.75	9.75
Blackbirds/Orioles	*5.25*	*12.75*	*0.25*	*7.67*	*0.25*	*0.5*	*0.25*	*0*	*21.00*	*2.00*	*21.67*	*0*	*0*	*0*
Creepers/Nuthatches	*0*	*0*	*0*	*0*	*0*	*0.5*	*1.00*	*0.25*	*0*	*0*	*0*	*0*	*0*	*0*
Finches/Crossbills	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0.25*	*0*	*0*	*0*	*0*
Flycatchers	*0*	*0*	*0.75*	*1.00*	*0.25*	*0*	*0*	*0.5*	*0*	*0.25*	*0.33*	*0.67*	*0*	*0.25*
Gnatcatchers/Kinglet	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Grassland/Sparrows	*2.50*	*1.50*	*0.75*	*2.67*	*0*	*1.00*	*1.25*	*0*	*2.00*	*2.25*	*3.00*	*3.33*	*1.25*	*0*
Mimids	*0*	*0.5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0.25*	*0*	*1.67*	*0*	*0*
Swallows	*0*	*0*	*0*	*4.00*	*0*	*0*	*0*	*0*	*0*	*0.25*	*0*	*0.67*	*0*	*0*
Tanagers/Grosbeaks/ Cardinals	*0*	*0*	*0.75*	*0*	*0*	*0.50*	*0.75*	*0.50*	*0*	*0*	*0*	*1.33*	*0.50*	*0.75*
Thrushes	*0*	*0.25*	*5.50*	*1.67*	*2.50*	*0.75*	*1.50*	*3.75*	*0.25*	*1.50*	*1.00*	*2.00*	*4.75*	*3.25*
Titmice/Chickadees	*0*	*0*	*0.25*	*0*	*0*	*2.25*	*0*	*0*	*0*	*0*	*0*	*0.67*	*0.75*	*0*
Vireos	*0*	*0*	*2.75*	*0*	*3.75*	*1.00*	*4.25*	*2.25*	*0*	*0*	*0*	*1.33*	*2.25*	*2.75*
Warblers	*0.25*	*2.50*	*3.25*	*1.00*	*3.75*	*2.00*	*1.50*	*1.75*	*0*	*1.25*	*0.33*	*1.67*	*1.25*	*2.50*
Waxwings	*0*	*0*	*0*	*0*	*0*	*0*	*0.25*	*0*	*0*	*0*	*0.67*	*0*	*0*	*0*
Wrens	*0*	*0.25*	*0.50*	*0.33*	*0.25*	*0.50*	*0*	*0*	*0*	*0.50*	*0*	*1.33*	*0*	*0*
Corvids	*0*	*0*	*0*	*0*	*0*	*0.25*	*1.25*	*0.25*	*0*	*0*	*0*	*0.67*	*0*	*0.25*
Woodpeckers	0	0	0.25	0	0	0	0	0	0	0.25	0	0.33	0	0.25
All Birds	**8.25**	**17.75**	**15.00**	**23.33**	**11.00**	**9.25**	**12.25**	**9.25**	**23.25**	**8.75**	**27.00**	**16.00**	**10.75**	**10.25**

Appendix C2. Mean use (number of birds/20-minute survey) for major bird types and passerine subtypes observed at each reference transect during breeding bird transect surveys at the Arkwright Wind Project; May 25 to July 15, 2013.

Bird Type	Survey Transect							
	REF1	**REF2**	**REF3**	**REF4**	**REF5**	**REF6**	**REF7**	**REF8**
Waterbirds	0	0	0	0	0	0.5	0	0
Waterfowl	0	0	0	0	0	1.00	0	0
Shorebirds	0	0	0	0.75	0	0	0	0
Diurnal Raptors	0	0	0	0	0	0	0	0
Upland Game Birds	0	0	0	0	0	0	0	0
Doves/Pigeons	0	0	0	3.75	0.50	0.25	0	0
Large Corvids	0.25	0	0	0	0	0	0.25	0
Large Cuckoos	0	0	0	0	0	0	0	0
Passerines	11.75	11.00	11.25	12.75	10.75	14.25	12.5	13.75
Blackbirds/Orioles	*0.25*	*4.75*	*0*	*8.00*	*0.5*	*9.00*	*0*	*7.00*
Creepers/Nuthatches	*0.50*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Finches/Crossbills	*0*	*0*	*0*	*0.50*	*0.75*	*0*	*0*	*0*
Flycatchers	*0.50*	*0*	*0*	*0*	*0.50*	*0.25*	*0*	*0.25*
Gnatcatchers/Kinglet	*0.25*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Grassland/Sparrows	*2.50*	*1.00*	*1.25*	*1.00*	*0.75*	*1.25*	*1.00*	*2.75*
Mimids	*0*	*0.25*	*0.50*	*0.75*	*1.00*	*0.50*	*0.50*	*1.00*
Swallows	*0*	*1.00*	*0*	*0*	*0*	*1.50*	*0*	*0*
Tanagers/Grosbeaks/Cardinals	*0.50*	*0.25*	*0.50*	*0*	*0.50*	*0*	*0.50*	*0*
Thrushes	*1.75*	*0.75*	*1.50*	*0.50*	*1.25*	*0*	*2.25*	*1.25*
Titmice/Chickadees	*0*	*0.25*	*0.75*	*0*	*0.25*	*0*	*0*	*0*
Vireos	*2.25*	*0*	*2.25*	*0*	*2.00*	*0*	*1.25*	*0*
Warblers	*2.25*	*2.50*	*4.50*	*0.75*	*2.75*	*1.25*	*4.25*	*1.50*
Waxwings	*0*	*0*	*0*	*0.50*	*0.25*	*0*	*0*	*0*
Wrens	*0.25*	*0.25*	*0*	*0.75*	*0.25*	*0.50*	*2.50*	*0*
Corvids	*1.00*	*0*	*0*	*0*	*0*	*0*	*0.50*	*0*
Woodpeckers	0	0	0.5	0	0.25	0	0.50	0
All Birds	**12.00**	**11.00**	**11.75**	**17.25**	**11.50**	**16.00**	**13.25**	**13.75**

Appendix D: The Difference between Mean Use Recorded at Turbine and Reference Plots, by Habitat Type, for Passerine Subtypes Observed during Breeding Bird Transect Surveys at the Arkwright Wind Energy Project; May 25 to July 15, 2013

Appendix D. Results of t-test between the mean of passerine subtypes observed during breeding bird surveys at turbine plots and reference plots, by habitat type, at the Arkwright Wind Project; May 25 to July 15, 2013. There was a statically significant difference in the mean at turbines and reference plot blocks that are bolded.

Passerine Subtype	Habitat Type	Block	Reference Mean	Turbine Mean	Difference of Means	p-value	90% CI Low	90% CI High
Blackbirds/ Orioles	Grassland	1	0.81	3.10	-2.28	0.31	-5.3	0.3
		2	0.63	1.40	-0.78	0.26	-1.7	0.1
		3	1.00	0.83	0.17	0.64	-0.5	0.8
		4	1.00	2.46	-1.46	0.15	-2.9	-0.1
		5	0.56	1.43	-0.87	0.14	-1.6	-0.2
		6	0.63	1.40	-0.78	0.21	-1.6	0.1
	Forest	**1**	**0.13**	**0**	**0.13**	**0.06**	**0**	**0.3**
		2	0	0	0	--	--	--
		3	0.30	0.03	0.27	0.26	-0.1	0.9
		4	0	0.13	-0.13	0.24	-0.2	0
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
Creepers/ Nuthatches	Grassland	1	0	0	0	--	--	--
		2	0	0	0	--	--	--
		3	0	0	0	--	--	--
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
	Forest	1	0	0.04	-0.04	0.53	-0.1	0
		2	0.06	0.03	0.03	0.78	-0.1	0.1
		3	0	0.06	-0.06	0.51	-0.2	0
		4	0	0.03	-0.03	0.60	-0.1	0
		5	0	0.03	-0.03	0.63	-0.1	0
		6	0.06	0.03	0.03	0.79	-0.1	0.1
Finches/ Crossbills	Grassland	1	0	0	0	--	--	--
		2	0.13	0.04	0.08	0.38	-0.1	0.3
		3	0	0	0	--	--	--
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
	Forest	1	0	0	0	--	--	--
		2	0	0	0	--	--	--
		3	0.15	0	0.15	0.29	0	0.5
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
Flycatchers	Grassland	1	0.06	0.05	0.01	0.84	-0.1	0.1
		2	0	0.04	-0.04	0.49	-0.1	0
		3	0	0	0	--	--	--
		4	0	0.06	-0.06	0.50	-0.2	0
		5	0	0.06	-0.06	0.50	-0.2	0
		6	0.06	0.11	-0.05	0.63	-0.2	0.1
	Forest	1	0	0.04	-0.04	0.50	-0.1	0
		2	0.13	0.04	0.08	0.24	0	0.2
		3	0	0.09	-0.09	0.30	-0.2	0
		4	0.06	0.03	0.03	0.77	-0.1	0.1
		5	0.06	0.03	0.03	0.77	-0.1	0.1
		6	0	0.03	-0.03	0.62	-0.1	0

Appendix D. Results of t-test between the mean of passerine subtypes observed during breeding bird surveys at turbine plots and reference plots, by habitat type, at the Arkwright Wind Project; May 25 to July 15, 2013. There was a statically significant difference in the mean at turbines and reference plot blocks that are bolded.

Passerine Subtype	Habitat Type	Block	Reference Mean	Turbine Mean	Difference of Means	p-value	90% CI Low	90% CI High
Gnatcatchers/ Kinglets	Grassland	1	0	0	0	--	--	--
		2	0	0	0	--	--	--
		3	0	0	0	--	--	--
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
	Forest	1	0.06	0	0.06	0.25	0	0.2
		2	0	0	0	--	--	--
		3	0	0	0	--	--	--
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
Grassland/ Sparrows	Grassland	1	0.13	0.46	-0.34	0.11	-0.6	-0.1
		2	**0.06**	**0.49**	**-0.42**	**0.03**	**-0.6**	**-0.2**
		3	0.42	0.39	0.03	0.90	-0.2	0.2
		4	0.31	0.42	-0.10	0.28	-0.2	0
		5	0.25	0.26	-0.01	0.95	-0.3	0.3
		6	0.13	0.32	-0.19	0.21	-0.4	0
	Forest	1	0	0.07	-0.07	0.32	-0.1	0
		2	0.13	0.18	-0.05	0.76	-0.3	0.1
		3	**0.50**	**0.21**	**0.29**	**0.06**	**0.1**	**0.5**
		4	0.25	0.07	0.18	0.30	-0.1	0.6
		5	0.13	0.09	0.03	0.88	-0.1	0.2
		6	0.19	0.14	0.05	0.63	-0.1	0.2
Mimids	Grassland	1	0.31	0.10	0.22	0.16	0	0.4
		2	0.06	0	0.06	0.31	0	0.1
		3	0	0.04	-0.04	0.60	-0.1	0
		4	0.06	0.04	0.02	0.76	-0.1	0.1
		5	0	0	0	--	--	--
		6	0	0.04	-0.04	0.51	-0.1	0
	Forest	1	0.06	0	0.06	0.26	0	0.2
		2	0.06	0	0.06	0.28	0	0.2
		3	0.05	0.08	-0.03	0.69	-0.2	0.1
		4	0	0.04	-0.04	0.60	-0.1	0
		5	0.19	0	0.19	0.26	0	0.4
		6	0.06	0	0.06	0.27	0	0.2
Swallows	Grassland	1	0.38	0.10	0.28	0.37	-0.2	0.8
		2	0	0	0	--	--	--
		3	0.33	0	0.33	0.28	0	0.7
		4	0	0	0	--	--	--
		5	0	0.54	-0.54	0.37	-1.5	0
		6	0	0.17	-0.17	0.49	-0.5	0
	Forest	1	0	0	0	--	--	--
		2	0	0	0	--	--	--
		3	0	0	0	--	--	--
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--

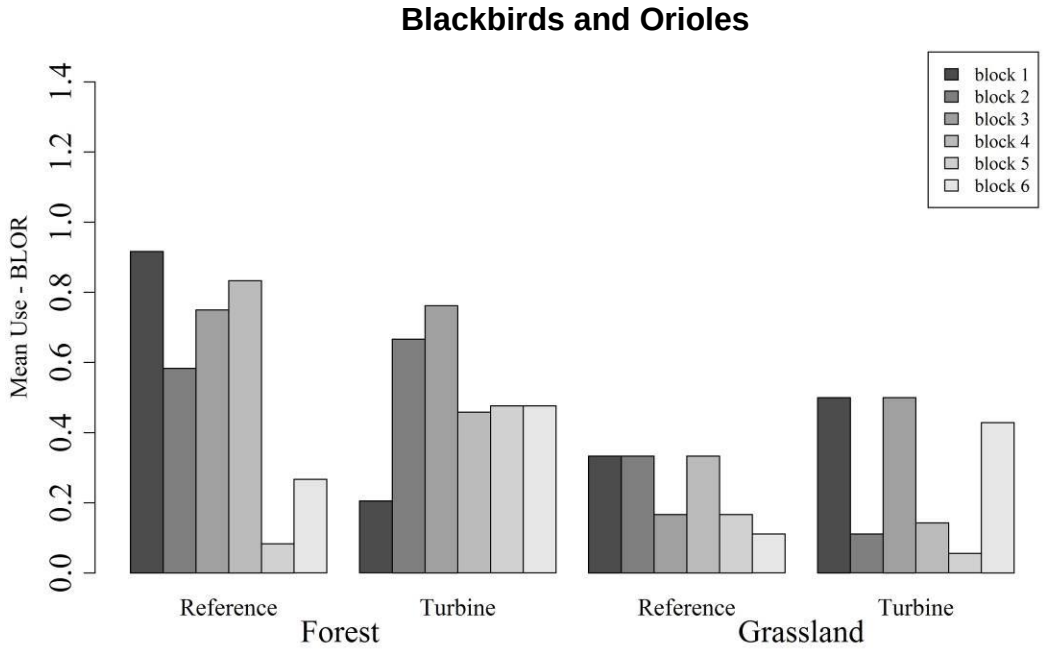
Appendix D. Results of t-test between the mean of passerine subtypes observed during breeding bird surveys at turbine plots and reference plots, by habitat type, at the Arkwright Wind Project; May 25 to July 15, 2013. There was a statically significant difference in the mean at turbines and reference plot blocks that are bolded.

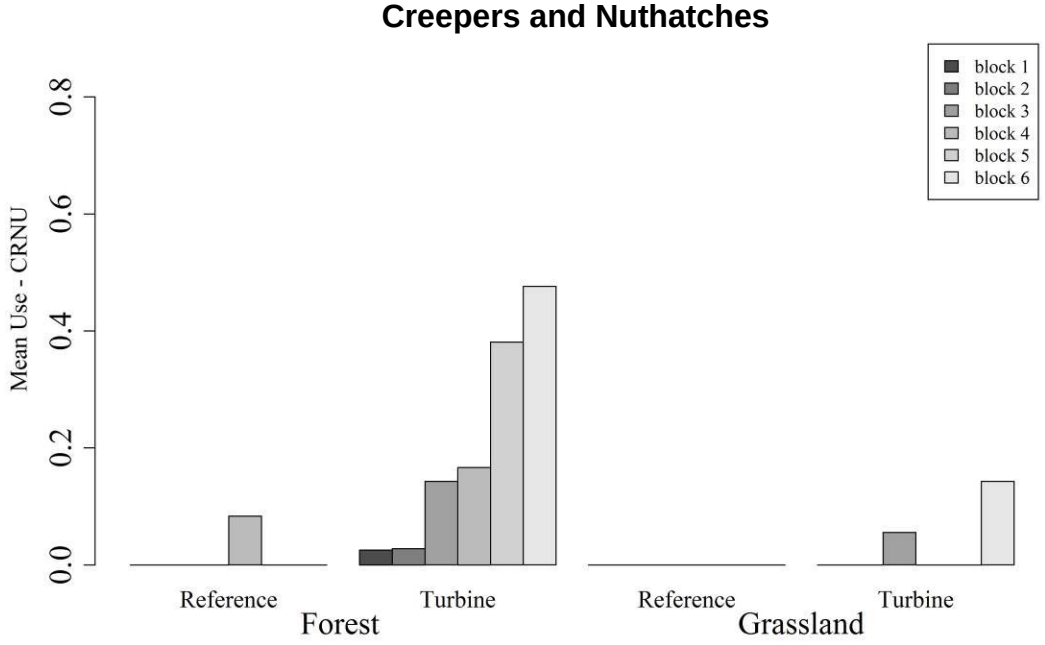
Passerine Subtype	Habitat Type	Block	Reference Mean	Turbine Mean	Difference of Means	p-value	90% CI Low	90% CI High
Tanagers/ Grosbeaks/ Cardinals	Grassland	1	0	0.05	-0.05	0.52	-0.1	0
		2	0.06	0	0.06	0.28	0	0.1
		3	0	0	0	--	--	--
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
	Forest	1	0.25	0.11	0.14	0.18	0	0.3
		2	0	0.10	-0.10	0.20	-0.2	0
		3	0	0.03	-0.03	0.51	-0.1	0
		4	**0**	**0.14**	**-0.14**	**0.09**	**-0.2**	**-0.1**
		5	0.19	0.19	0	1.00	-0.2	0.2
		6	0	0.04	-0.04	0.61	-0.1	0
Thrushes	Grassland	1	0	0.25	-0.25	0.21	-0.5	0
		2	0	0.13	-0.13	0.28	-0.3	0
		3	0.08	0.11	-0.03	0.86	-0.2	0.2
		4	0	0	0	--	--	--
		5	0.13	0.15	-0.03	0.83	-0.2	0.1
		6	0.25	0.10	0.15	0.44	-0.2	0.6
	Forest	1	0.25	0.36	-0.11	0.52	-0.4	0.2
		2	0.06	0.39	-0.32	0.13	-0.6	-0.1
		3	0.30	0.60	-0.30	0.15	-0.6	0
		4	**0.06**	**0.44**	**-0.38**	**0.07**	**-0.6**	**-0.2**
		5	**0.13**	**0.56**	**-0.44**	**0.07**	**-0.7**	**-0.2**
		6	0.25	0.42	-0.17	0.56	-0.6	0.3
Titmice/ Chickadees	Grassland	1	0	0	0	--	--	--
		2	0	0	0	--	--	--
		3	0	0	0	--	--	--
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
	Forest	1	0.06	0	0.06	0.28	0	0.2
		2	0	0.03	-0.03	0.63	-0.1	0
		3	0	0.06	-0.06	0.54	-0.2	0
		4	0.19	0.03	0.16	0.26	-0.1	0.5
		5	0	0.16	-0.16	0.35	-0.4	0
		6	0	0.21	-0.21	0.34	-0.4	0
Vireos	Grassland	1	0	0	0	--	--	--
		2	0	0	0	--	--	--
		3	0	0	0	--	--	--
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
	Forest	1	0.50	0.32	0.18	0.24	0	0.4
		2	0.50	0.57	-0.07	0.67	-0.3	0.2
		3	0.25	0.45	-0.20	0.45	-0.6	0.2
		4	**0.19**	**0.52**	**-0.33**	**0.07**	**-0.6**	**-0.1**
		5	0.06	0.22	-0.16	0.28	-0.3	0
		6	0.19	0.38	-0.19	0.43	-0.4	0.1

Appendix D. Results of t-test between the mean of passerine subtypes observed during breeding bird surveys at turbine plots and reference plots, by habitat type, at the Arkwright Wind Project; May 25 to July 15, 2013. There was a statically significant difference in the mean at turbines and reference plot blocks that are bolded.

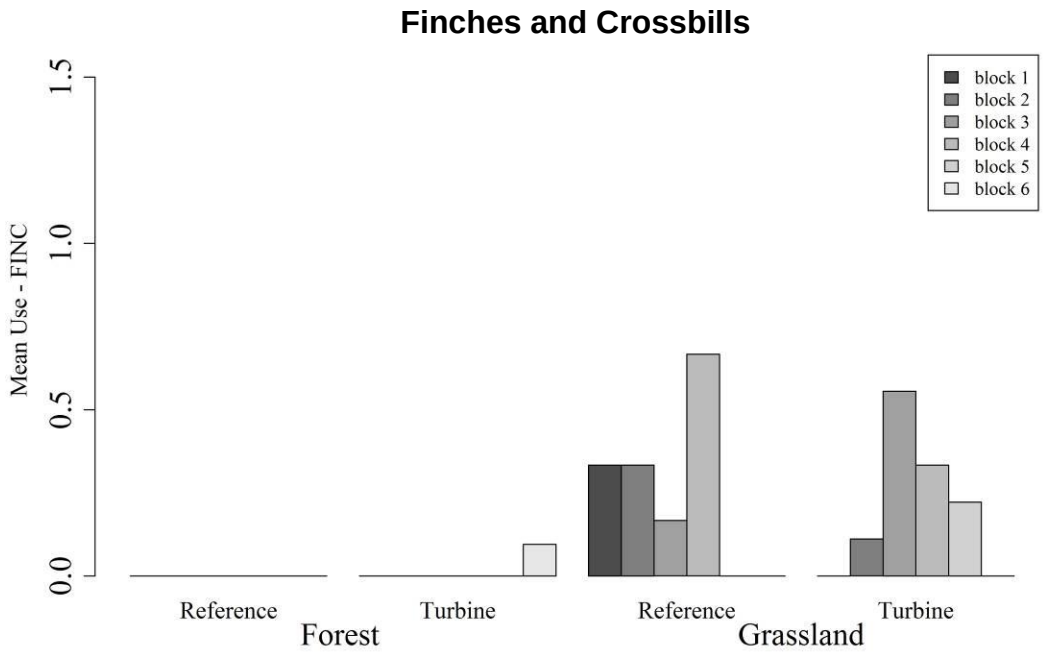
Passerine Subtype	Habitat Type	Block	Reference Mean	Turbine Mean	Difference of Means	p-value	90% CI Low	90% CI High
Warblers	Grassland	1	0.63	0.23	0.40	0.13	0	0.8
		2	0.06	0.17	-0.10	0.41	-0.3	0
		3	0.08	0.18	-0.10	0.48	-0.3	0.1
		4	0.19	0.18	0.01	0.94	-0.1	0.2
		5	0.06	0.11	-0.05	0.68	-0.3	0.1
		6	**0.31**	**0.04**	**0.27**	**0.01**	**0.2**	**0.4**
	Forest	1	0.63	0.54	0.09	0.63	-0.1	0.4
		2	0.38	0.35	0.02	0.92	-0.3	0.4
		3	0.25	0.33	-0.08	0.61	-0.4	0.2
		4	**0.69**	**0.16**	**0.53**	**0.02**	**0.2**	**0.9**
		5	0.31	0.28	0.03	0.95	-0.3	0.4
		6	0.06	0.39	-0.32	0.10	-0.5	-0.1
Waxwings	Grassland	1	0.13	0	0.13	0.24	0	0.4
		2	0	0.11	-0.11	0.49	-0.3	0
		3	0	0	0	--	--	--
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
	Forest	1	0.06	0	0.06	0.27	0	0.2
		2	0	0	0	--	--	--
		3	0	0.03	-0.03	0.51	-0.1	0
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
Wrens	Grassland	**1**	**0.13**	**0**	**0.13**	**0.04**	**0.1**	**0.3**
		2	0	0	0	--	--	--
		3	0	0.04	-0.04	0.63	-0.1	0
		4	0.06	0.04	0.02	0.77	-0.1	0.1
		5	0	0.06	-0.06	0.55	-0.2	0
		6	0.13	0.04	0.08	0.27	0	0.2
	Forest	1	0	0.04	-0.04	0.53	-0.1	0
		2	0.13	0.03	0.09	0.38	-0.1	0.3
		3	0.15	0.06	0.09	0.36	-0.1	0.3
		4	0.06	0.04	0.02	0.78	-0.1	0.1
		5	0.19	0.07	0.11	0.25	-0.1	0.3
		6	0.06	0.08	-0.02	0.85	-0.2	0.1
Corvids	Grassland	1	0	0	0	--	--	--
		2	0	0	0	--	--	--
		3	0	0	0	--	--	--
		4	0	0	0	--	--	--
		5	0	0	0	--	--	--
		6	0	0	0	--	--	--
	Forest	1	0	0.07	-0.07	0.30	-0.1	0
		2	0.19	0	0.19	0.26	0	0.6
		3	0.05	0.06	-0.01	0.92	-0.1	0.1
		4	0	0.06	-0.06	0.61	-0.2	0
		5	0	0.03	-0.03	0.61	-0.1	0
		6	0	0	0	--	--	--

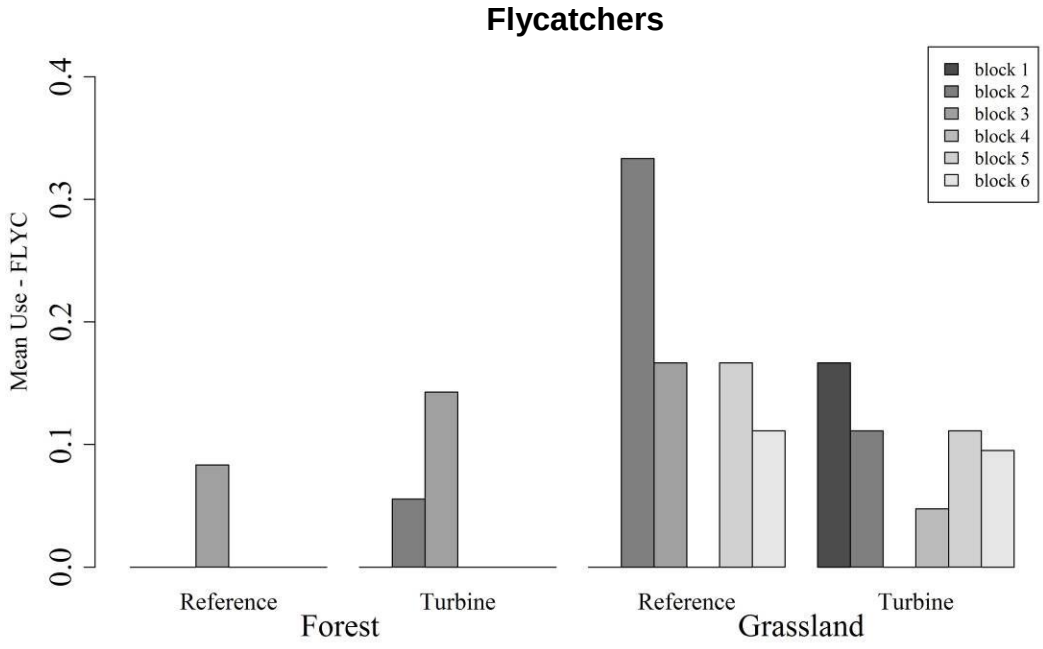
Appendix E: Mean Use by Passerine Subtypes, Separated by Forested and Grassland Landcover, at each 50-meter Block of the Reference and Turbine Transects during Breeding Bird Surveys at the Arkwright Wind Project; May 25 to July 15, 2013



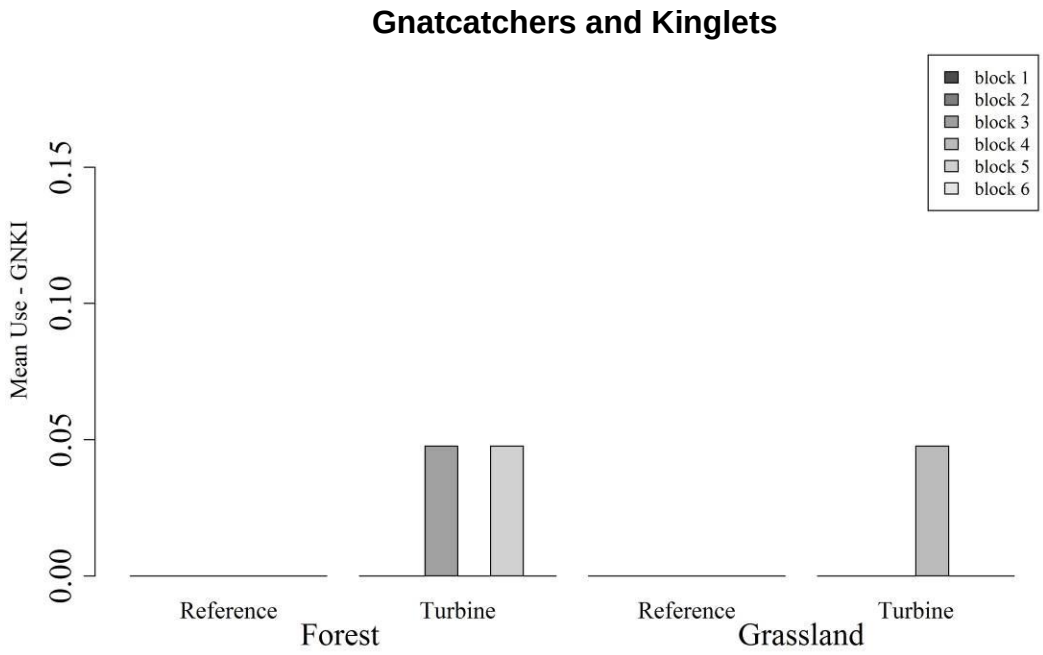


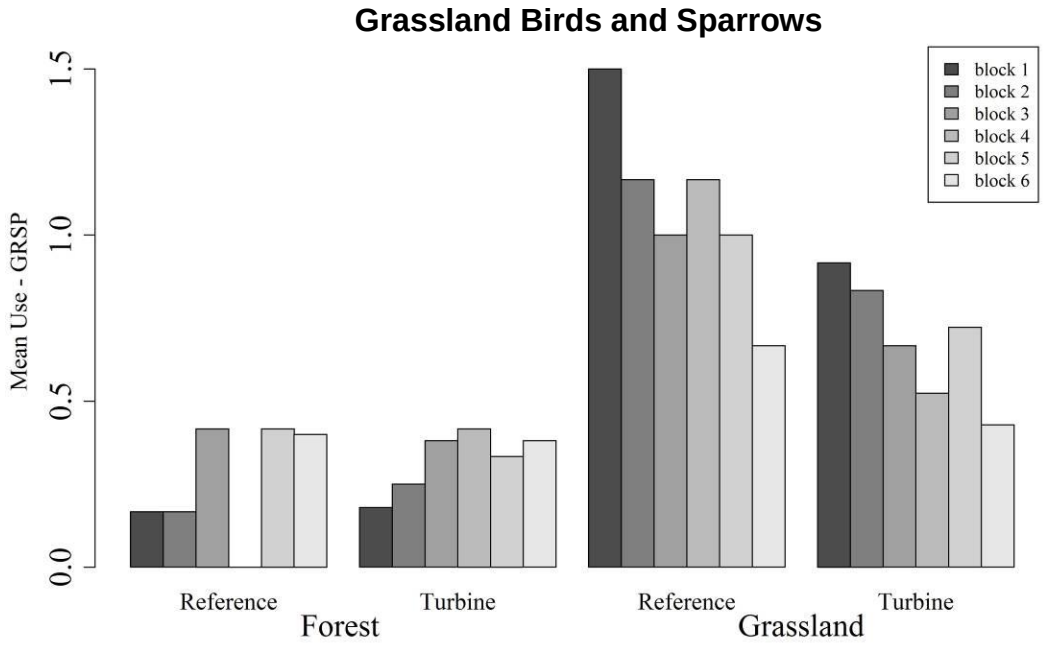
Appendix E. Mean use by passerine subtypes (birds/transect/survey), separated by forested and grassland landcover, at each 50-meter block of the reference and turbine transects surveyed during breeding bird surveys at the Arkwright Wind Project; May 25-to July 15, 2013.





Appendix E. Mean use by passerine subtypes (birds/transect/survey), separated by forested and grassland landcover, at each 50-meter block of the reference and turbine transects surveyed during breeding bird surveys at the Arkwright Wind Project; May 25 to July 15, 2013.





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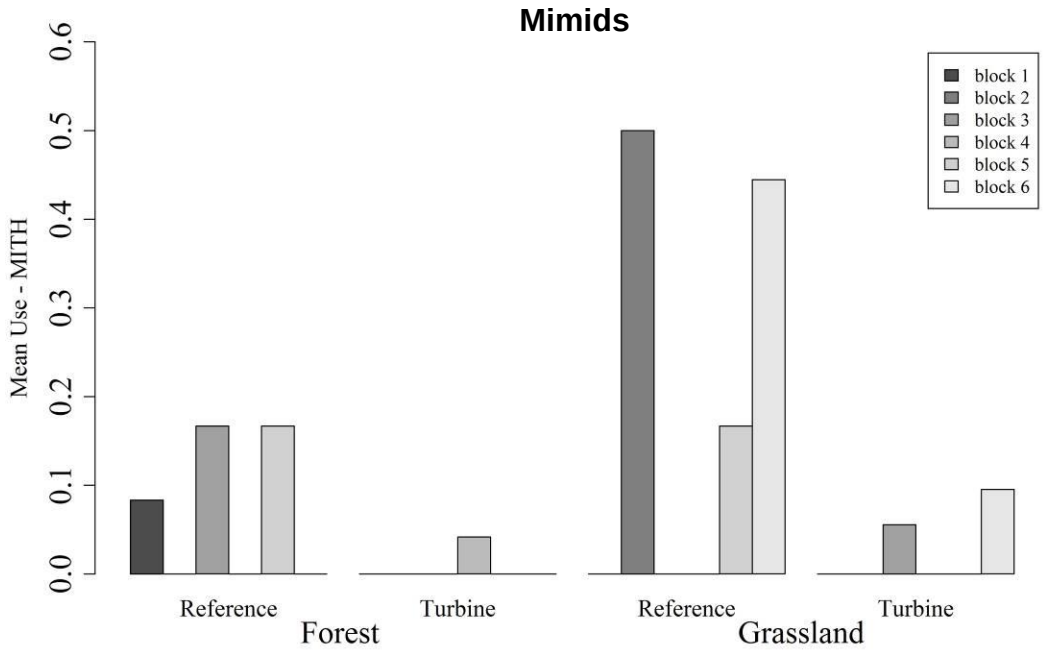

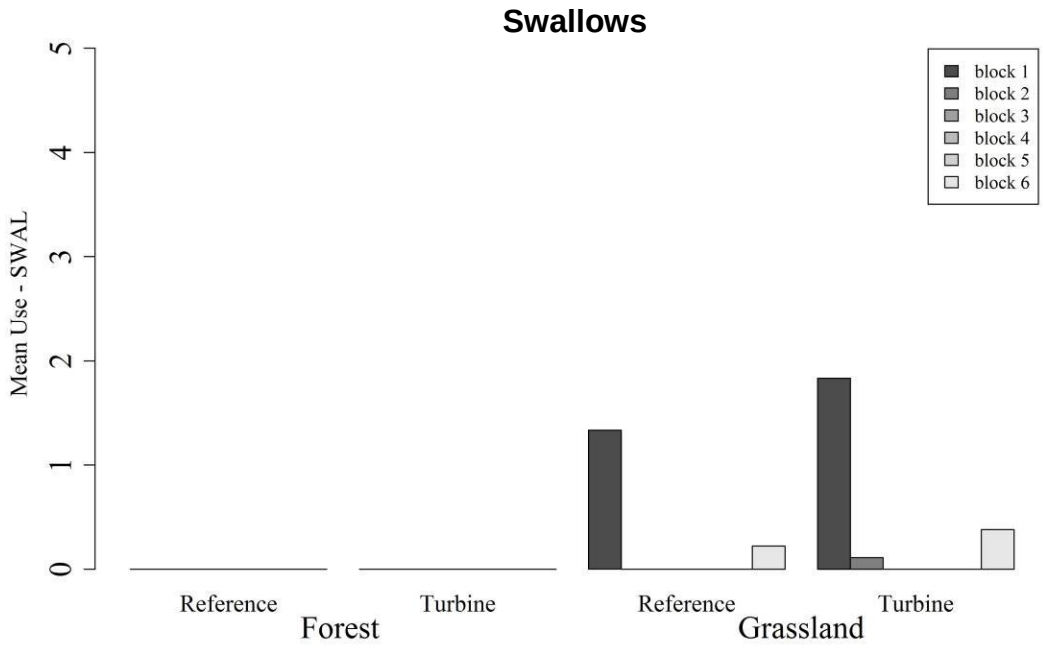

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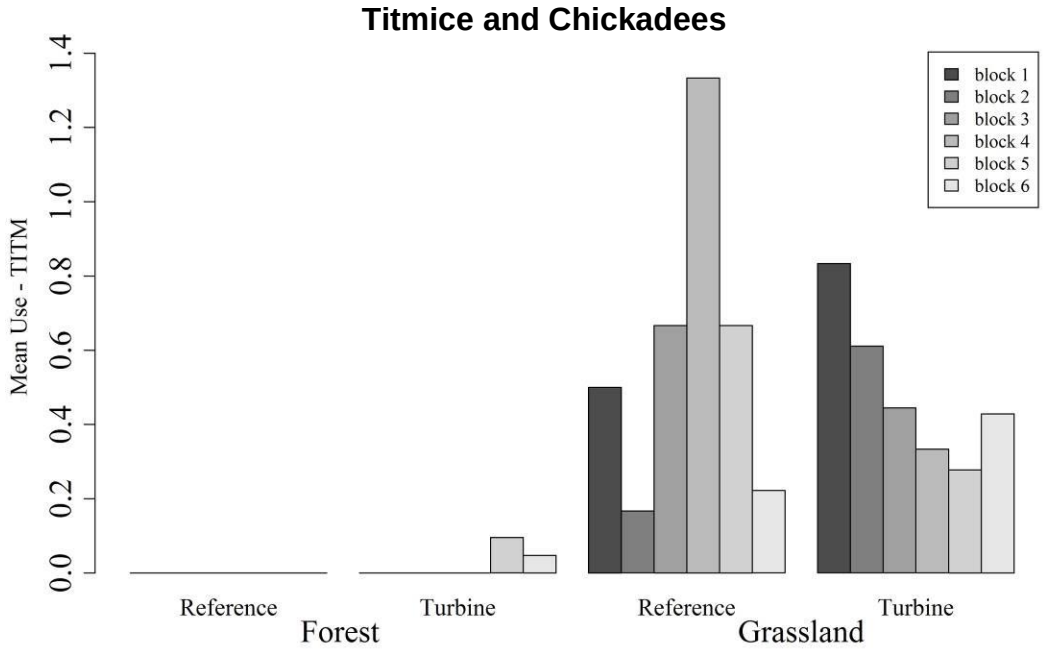

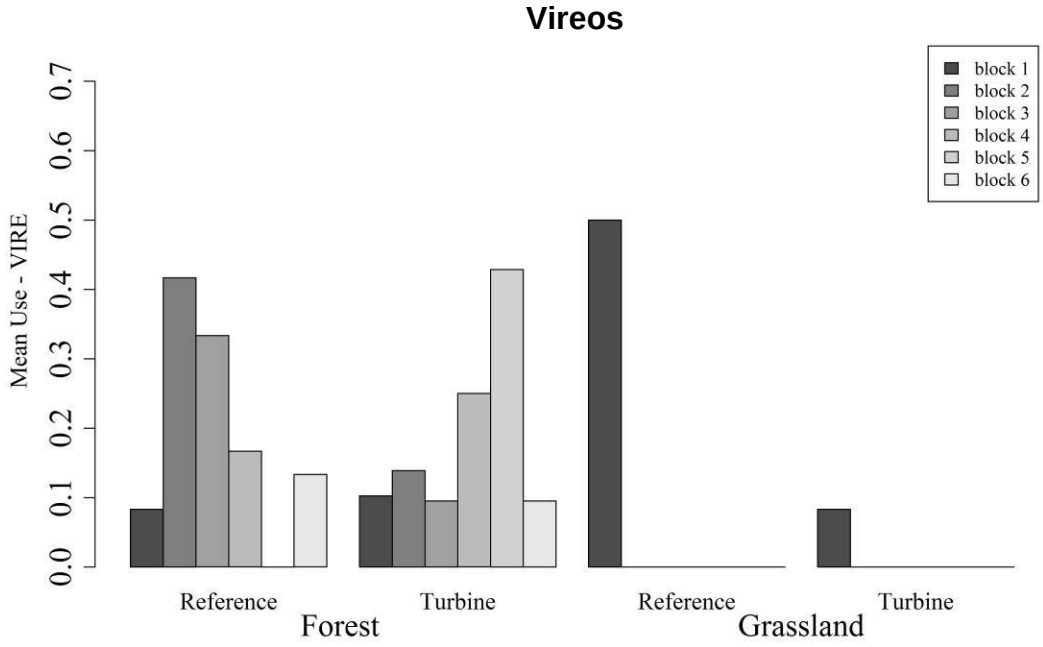

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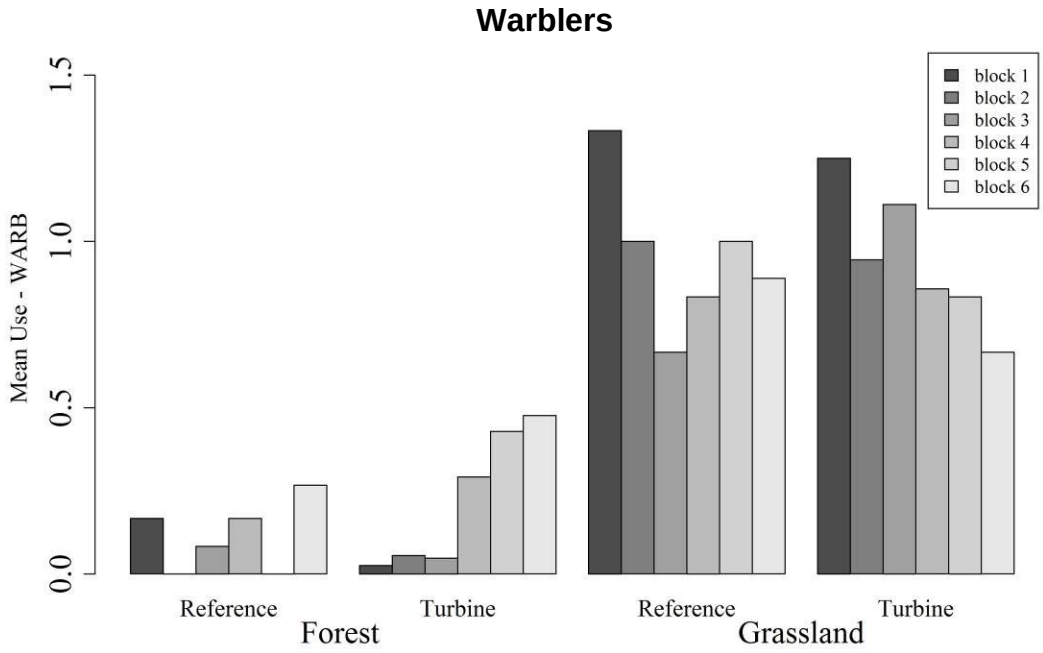

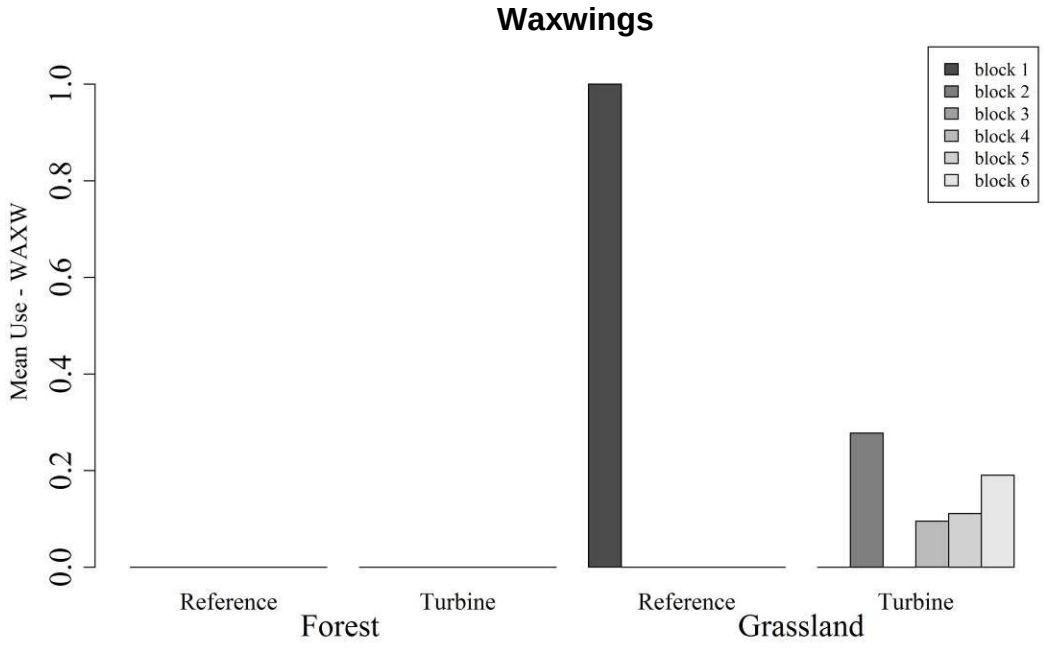

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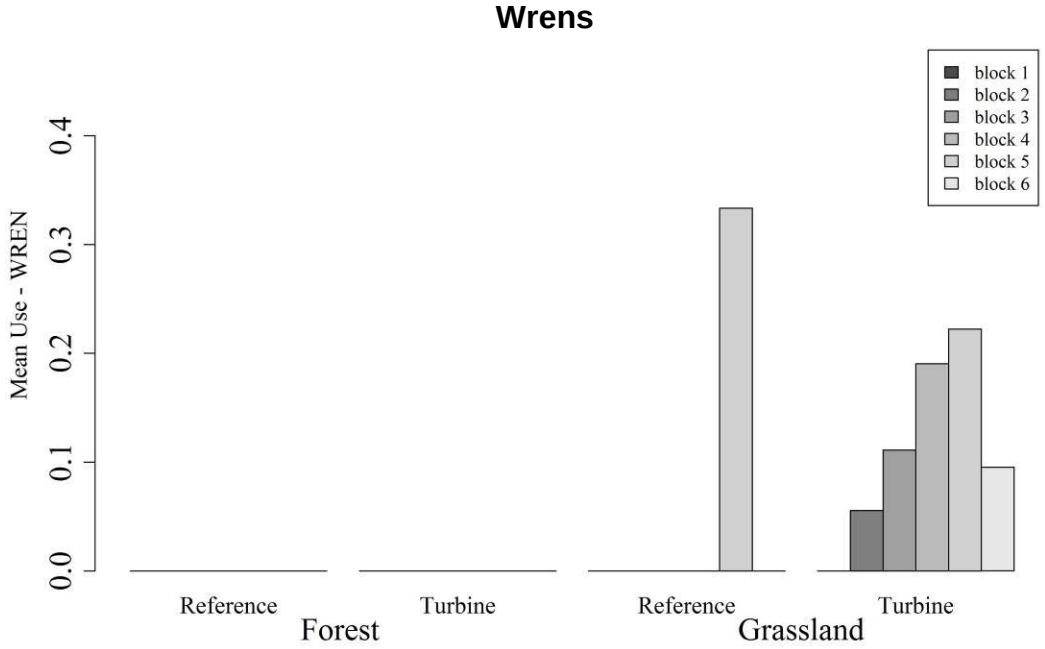

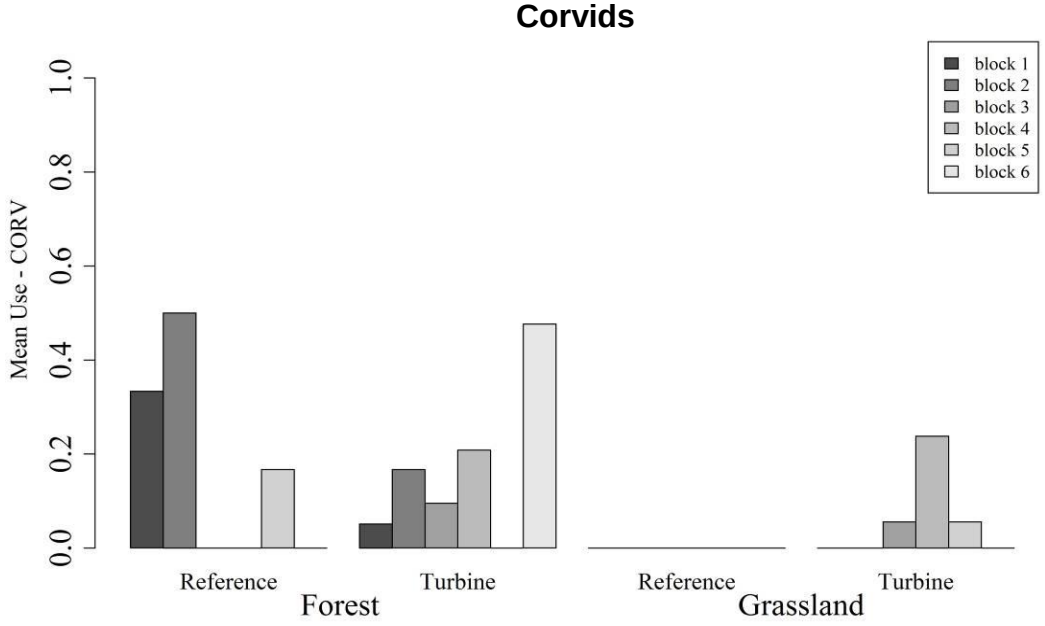

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