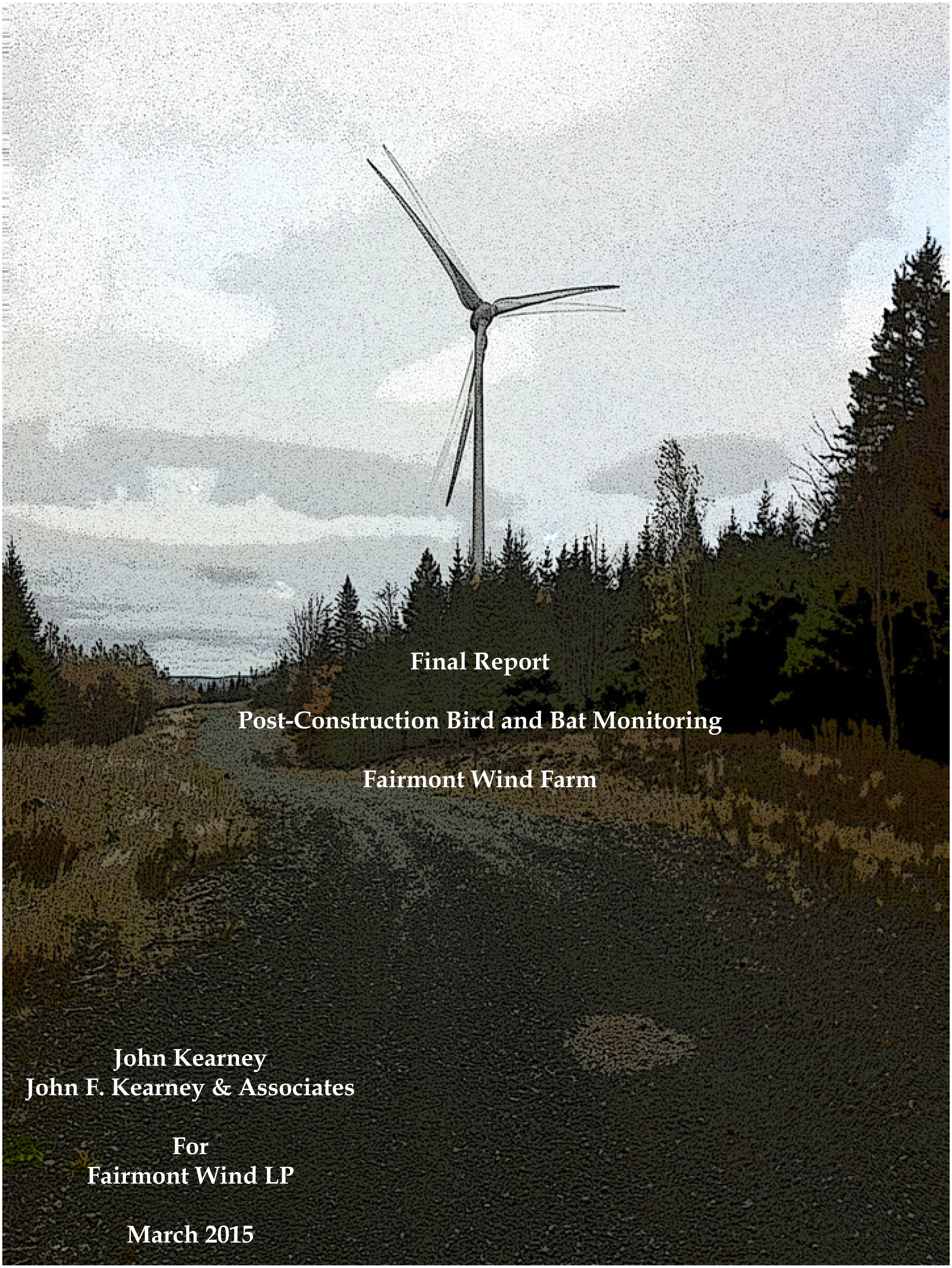

Final Report

Post-Construction Bird and Bat Monitoring

Fairmont Wind Farm

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For
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Abstract

Two years of post-construction studies indicate that the avifauna of the Fairmont Wind Farm is similar to other upland areas of Nova Scotia where wind energy facilities have been constructed. Post-construction changes to bird populations appear to be limited to a few species that are positively or negatively affected by forest disturbance. Bird mortality from collisions was below the national average. Bat mortality at the wind farm is very small.

Introduction

The Fairmont Wind Farm was commissioned in November 2012. It consists of two turbines with a combined plate capacity of 4.6 megawatts. It is located approximately six kilometers from the Town of Antigonish in the Province of Nova Scotia.

This document reports on the results of two years of bird and bat studies as proposed in the post-construction monitoring plan approved by the Canadian Wildlife Service and the Nova Scotia Department of Natural Resources (Kearney 2012). The studies include the following components: bird and bat mortality, bird migration stop-over and diurnal passage, and breeding birds.

Study Area

The study area is the forested land to the west of the Fairmont Road to approximately 500 meters west of Turbine 1 (See map in Figure 1). Most of this area is mixedwood forest with some softwood (spruce-fir) stands. There are also a few small patches of hardwood composed of Sugar Maple and Yellow Birch. The turbine access roads are largely upgraded versions of pre-existing wood roads. The upland location of the wind farm provides sweeping views of the valley to the west and the agricultural lands in the settlement of North Grant.

Mortality Study

Methods

The mortality study at the Fairmont Wind Farm closely follows the protocols established by the Canadian Wildlife Service (Environment Canada 2007) and the methods of analysis that it recommends (Ontario Ministry of Natural Resources 2011). It also adapts a grid searching method proposed by Broders and Burns (2010) for the gravel pads which surround the turbine towers. As this grid system was originally developed for bat carcass searches, it can thus be used simultaneously to search for both bird and bat carcasses.

Each grid is a square of 112 meters on each side with the turbine base located in the centre of the grid. The potential search area is 12,544 square meters. The grid is further subdivided in 112 squares that are 8x14 meters, each with a unique grid coordinate, e.g., a1, b2, c3, etc. The layout of a

Figure 1. Map of Study Area

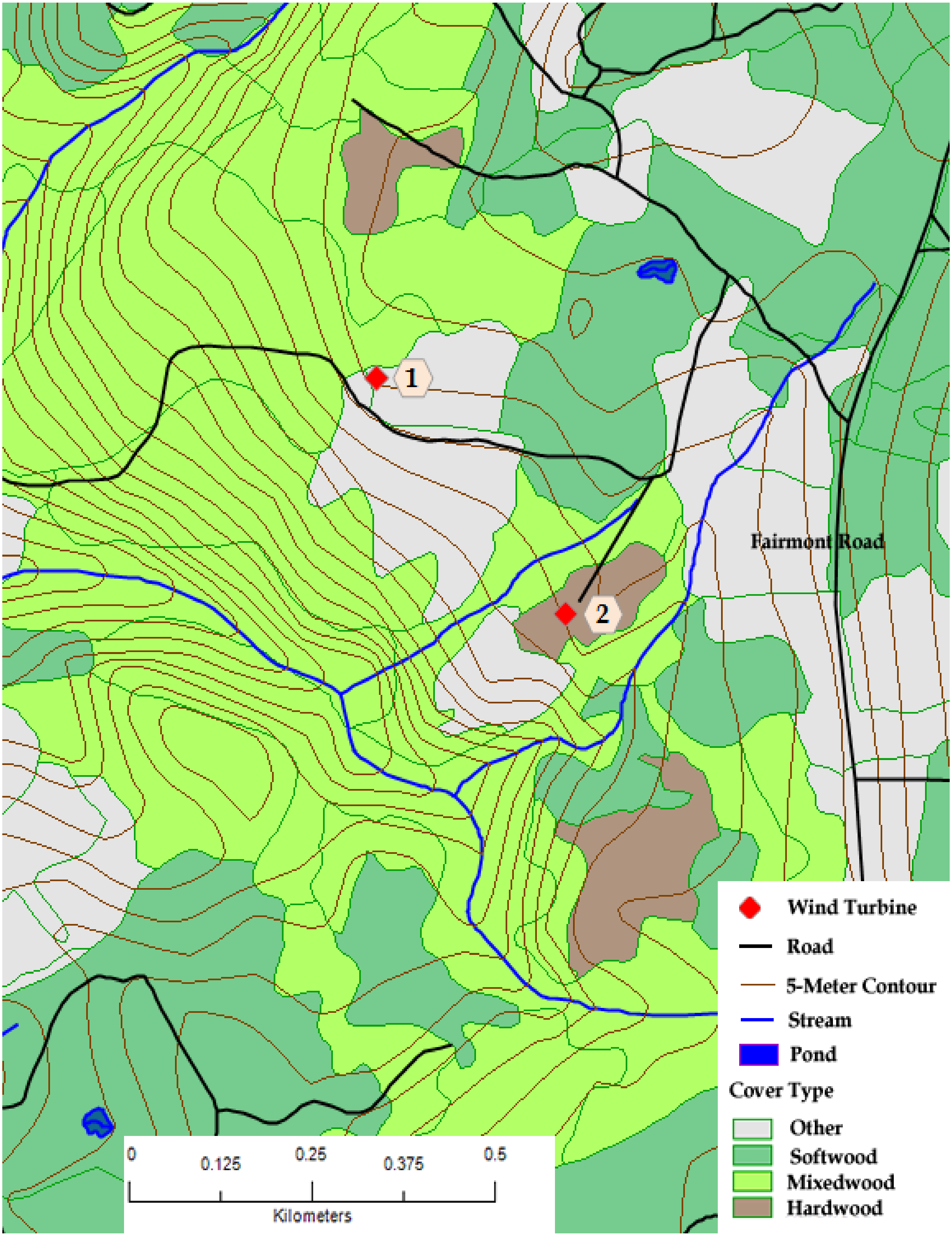
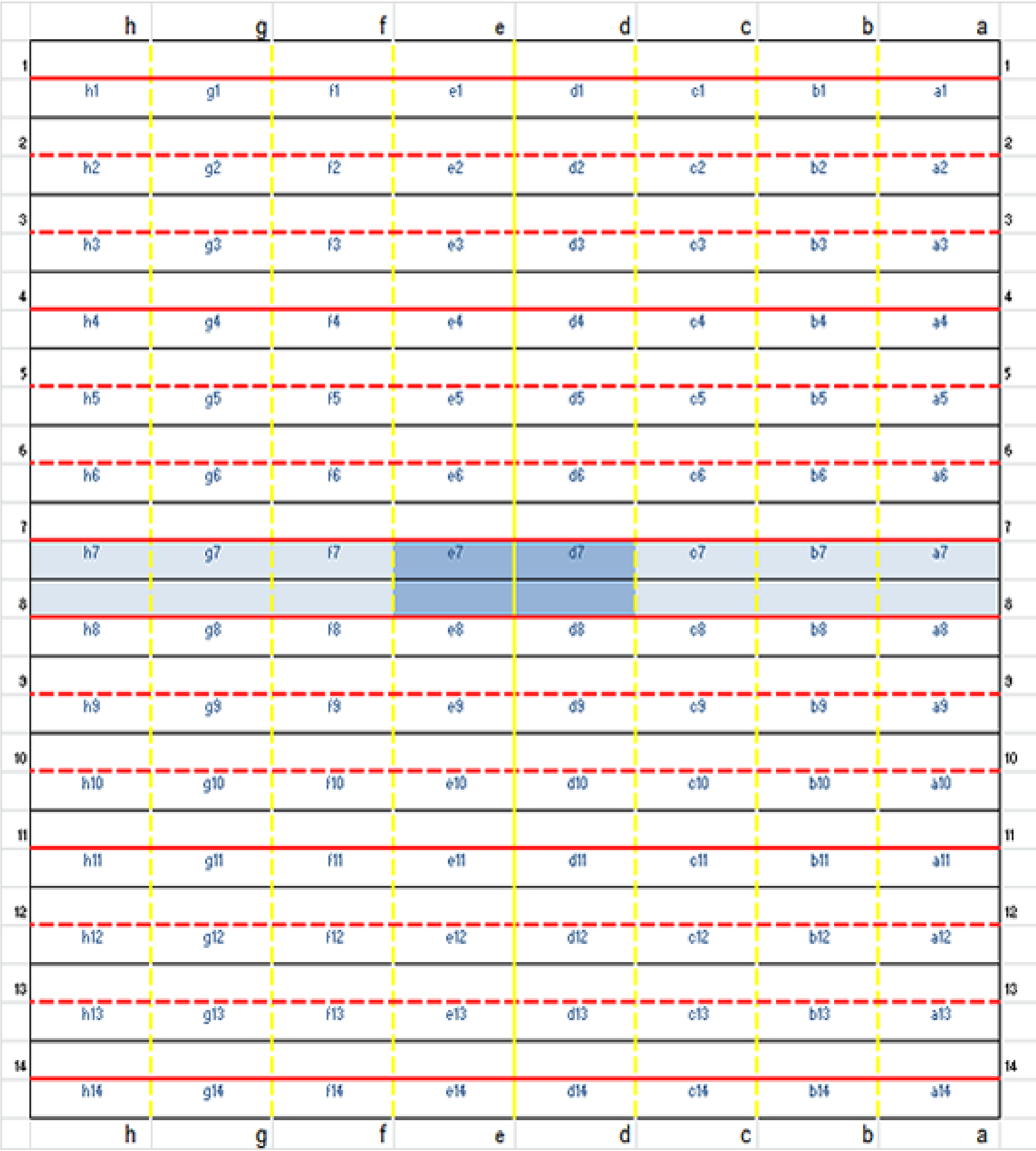


Figure 2. Generic Grid Design for Carcass Searching



generic grid is shown in Figure 2. The searcher walks through the centre of the grid squares following the red lines shown in Figure 2. Color coded and numbered posts at each end of the grid guide the searcher in following a straight line while looking 4 meters to each side for a bird or bat carcass. Coded and numbered posts to the far left or right of the searcher indicate the “letter” of the grid square. The turbine base is surrounded by squares d7, e7, d8, and e8 as shown in Figure 2. In addition, the road area between 56 meters and 100 meters was also searched.

Each search grid and road area at the two turbines was searched three times each week during the spring and fall migration (April 1-June 10 and August 15-October 31). During the breeding season (11 June-14 August), searches were conducted once every week.

For every carcass found, the following information was recorded:

1. The size of the area searched,
2. The date, start and end times of searching,
3. The time a carcass was found,
4. The state of decomposition,
5. The extent and type of injury sustained,
6. The species, sex, and age (where possible) of the specimen,
7. The grid and GPS coordinates of where the specimen was found, and
8. The substrate where it was found.

For the safe handling of birds and bats, and particularly bats, the guidelines of the Ontario Ministry of Health and Long-Term Care were followed (Ontario Ministry of Health and Long-Term Care 2010). These procedures are illustrated in the video of the U.S. Fish and Wildlife Service (2009).

Scavenger trials and searcher trials were conducted following the guidelines of the Canadian Wildlife Service (Environment Canada 2007). Scavenger trials were conducted throughout each season. Culled farm quail were the specimens used for the scavenger trials. Carcasses were laid out in the search areas late in the day on turbine pads that were to be searched the next day. Carcasses persisting until the morning of the next day were recorded and left on the pad for up to two weeks. The presence or absence of the carcass was noted each time the pad was searched. Scavenger trials were evenly distributed over the project site.

Searcher trials were also conducted throughout each season. Test carcasses were randomly placed on the pad the evening before the test and then checked again as soon as possible after the search in order to determine if those carcasses which were not found were still there or had been scavenged during the night. Brown mice (resembling a bat carcass), culled farm quail, and wild birds from the carcass searching were used for the searcher testing. As much as possible, wild birds were used instead of quail for the searcher trials. Carcasses for searcher trials were evenly distributed over the project site and proportionately distributed on substrate types according to the abundance of that substrate on the pads.

Estimated mortality was calculated using the formula recommended by the Canadian Wildlife Service (Ontario Ministry of Natural Resources 2011):

$C = c/(Se * Sc * Ps)$ where

C=the corrected number of bird mortalities, c=the number of carcasses found, Se=proportion of carcasses expected to be found by searchers (searcher efficiency), Sc=proportion of carcasses not removed by scavengers over the search period, and Ps=percent of area searched within a 50 meter radius of the turbines. Correction factors for time of year and distances beyond 50 meters were derived from Zimmerling et al. (2013).

Results

SEARCH AREA

Due to the configuration of each turbine pad relative to the physical characteristics of the surrounding areas, the search grid usually cannot fit completely on each pad. Thus some grids become forests at their edges or are terminated prematurely by a very steep rise in terrain. This makes it necessary to record the search area for each turbine. Thus out of a potential 12,544 square meters of search area within the generic grid, Turbine 1 yielded only 6,440 square meters of search area (Figure 3). Turbine 2 had 5,336 square meters of search area (Figure 4). Thus the percent of search area searched (Ps) is 51.34% for Turbine 1 and 42.54% for Turbine 2. The value of Ps (for 112X112 meter square) for the two turbines combined is 46.94%.

Figure 3. Turbine 1 Search Area (unshaded) on 112X112 Meter Grid and Superimposed 50-Meter Radius Circle

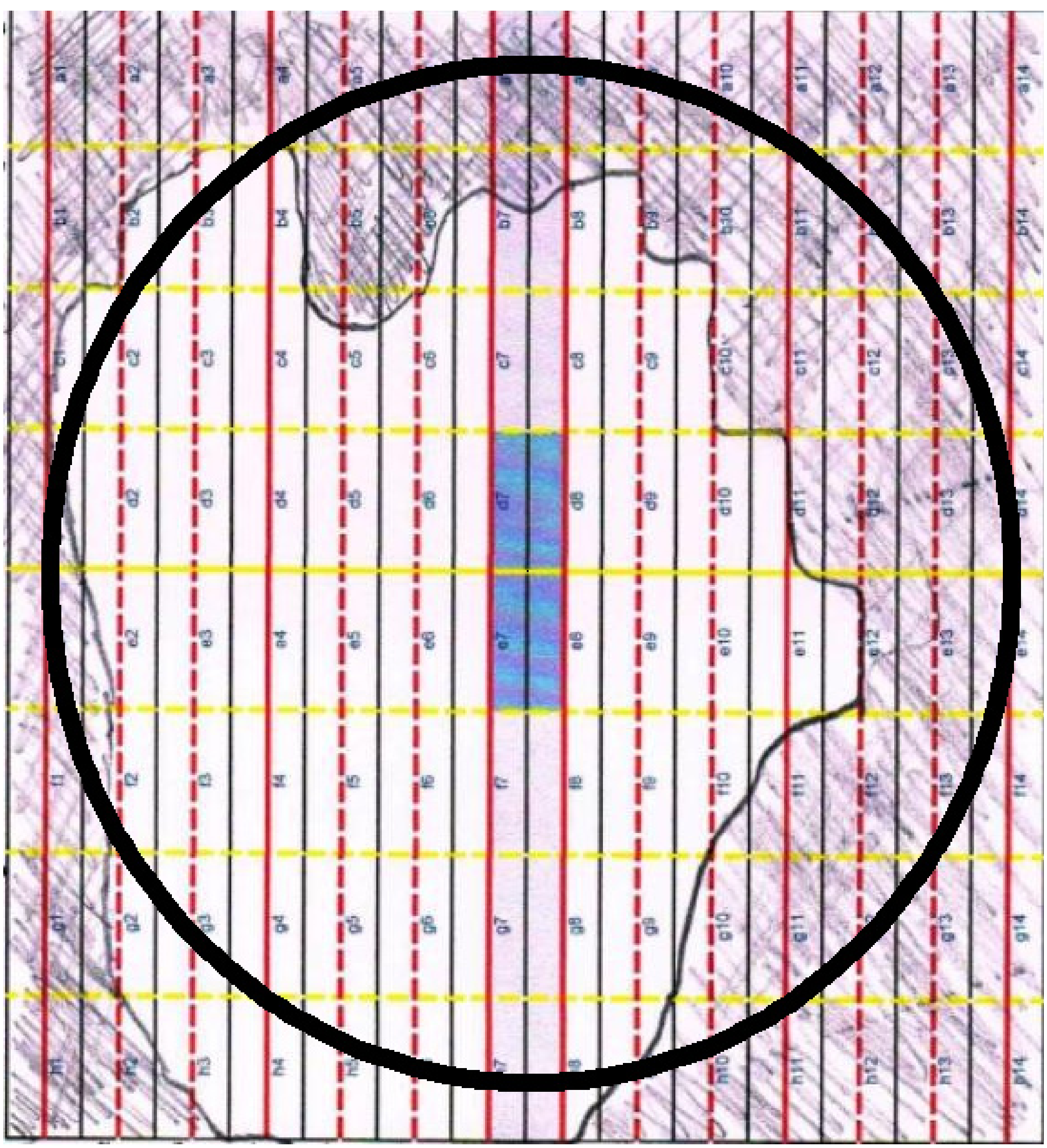
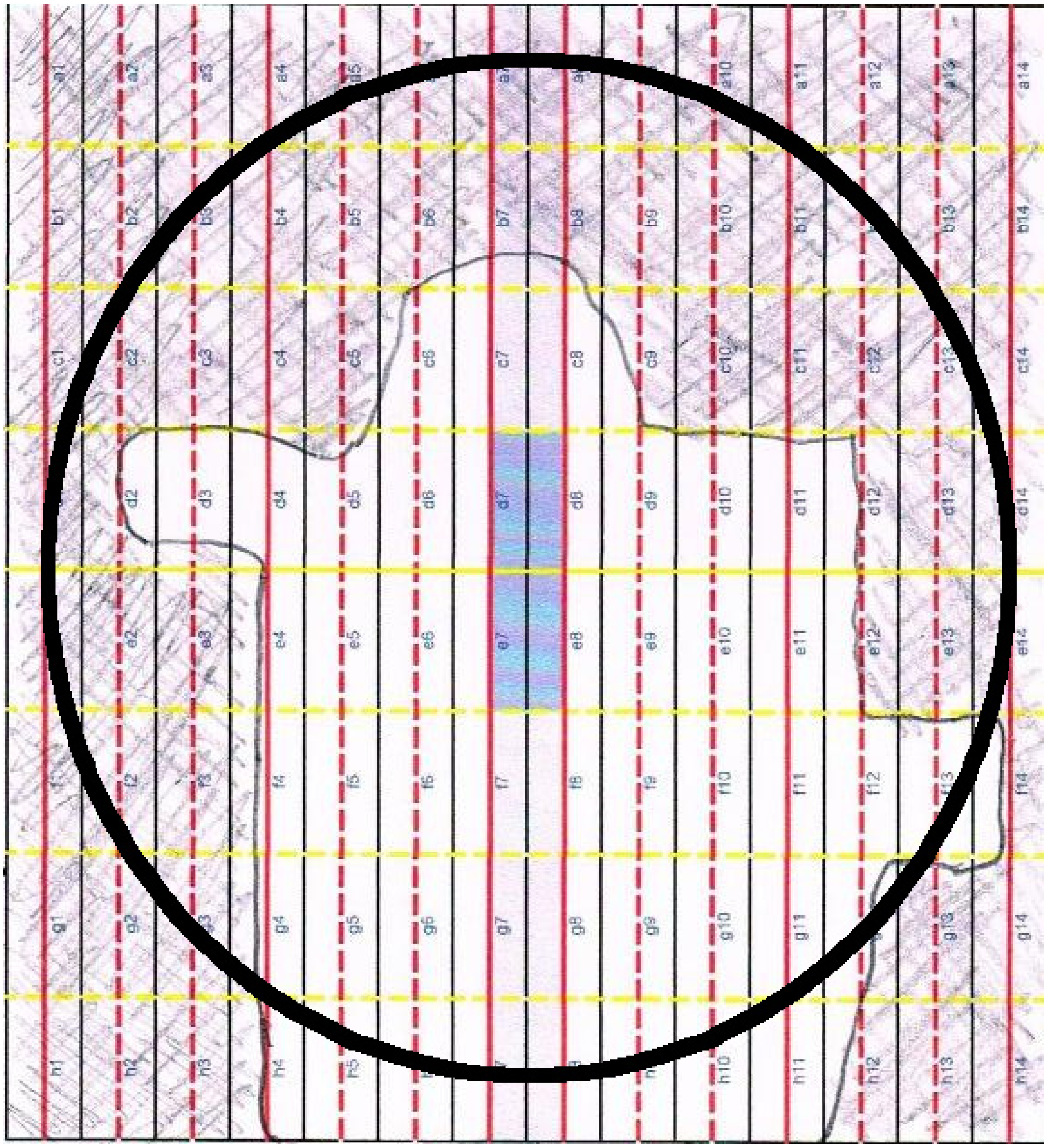


Figure 4. Turbine 2 Search Area (unshaded) on 112X112 Meter Grid and Superimposed 50-Meter Radius Circle



Following the recommended guidelines of the Canadian Wildlife Service (Ontario Ministry of Natural Resources 2011), it is also necessary to calculate the mortality within a 50-meter radius circle. Thus, a circle of this size is superimposed on the grids and search areas in Figure 3 and 4. Turbine 1 has approximately 5,488 square meters of search area within the circle having an area of 7,850 square meters giving a Ps of 69.91%. Turbine 2 has approximately 4,592 square meters of search area within the circle for a Ps of 58.50%. The combined Ps is 64.20%. These values are summarized in Table 1.

SCAVENGER EFFICIENCY

Scavenger efficiency (Sc) is the proportion of carcasses not removed by scavengers during a

Table 1: Percent of Search Area Searched (Ps)

Search Type	Turbine 1	Turbine 2	Combined
112X112 Grid	0.5134	0.4254	0.4694
50-Meter Radius Circle	0.6991	0.5850	0.6420

Table 2: Proportion of Carcasses Not Removed by Scavengers over the Search Period (Sc)

Season & Year	Number of Trials	Proportion Not Removed
Spring 2013	20	0.8500
Spring 2014	31	0.9032
Spring Total	51	0.8824
Summer 2013	6	0.6667
Summer 2014	0	N/A
Summer Total	6	0.6667
Autumn 2013	45	0.8889
Autumn 2014	23	0.7826
Autumn Total	68	0.8529
All Seasons 2013	71	0.8592
All Seasons 2014	54	0.8519
All Seasons Total	125	0.8560

search period. It is calculated with the following formula (Ontario Ministry of Natural Resources 2011):

Sc = nvisit1 + nvisit2 + nvisit3/ nvisit0 + nvisit1 + nvisit2 where: Sc is the proportion of carcasses not removed by scavengers over the search period, nvisit0 is the total number of carcasses placed, and nvisit1 – nvisit3… are the numbers of carcasses remaining on visits 1 through 3

Table 2 shows the results of the scavenger efficiency trials at the Fairmont Wind Farm in 2013 and 2014. Scavengers had a low impact on the number of carcasses persisting on the turbine pads during tests. Results were similar in both 2013 and 2014 with a combined percentage of 85.60 carcasses not removed by scavengers.

SEARCHER EFFICIENCY

Searcher efficiency is the number of test carcasses found by a searcher that were not first removed by a scavenger. At the Fairmont Wind Farm, three carcass searchers were employed over the two-year period. Table 3 shows the efficiency of each searcher with a weighted total efficiency based on the proportion of all searches conducted by an individual searcher. This weighted efficiency is 0.7000.

Table 3: Searcher Efficiency (Se)

Searcher	Year	Trials	% of All Searches	Efficiency	Weighted Efficiency
1	2013	15	49.00%	0.5333	0.2613
2	2014	8	36.73%	1.0000	0.3673
3	2014	4	14.29%	0.5000	0.0714
All	2013-14	27	100.00%	0.6400	0.7000

OBSERVED MORTALITY

Observed mortality (c) is the number of carcasses found during the carcass searches. A total of 4 bird and 1 bat carcass were found in 2013 and 2 bird and 0 bat carcasses in 2014. Table 4 shows the distribution of these carcasses by season and turbine. Most fatalities, 71%, were in the autumn season, and at Turbine 1, also 71%. Table 5 lists the species of the carcasses found. The one bat specimen was a Little Brown Myotis, and the birds were all warblers with Common Yellowthroat the only species with multiple fatalities.

Table 4: Distribution of Carcasses by Season, Year, and Turbine

Season	Spring		Summer		Autumn		Turbine 1	Turbine 2
Year	2013	2014	2013	2014	2013	2014	2013	2014
Bird	1	1	0	0	3	1	4	2
Bat	0	0	0	0	1	0	1	0
Total	2		0		5		5	2

The six bird carcasses were, on average, 27 meters from the base of the turbine. The bird closest to a turbine was 14 meters away while the furthest was 46 meters. The one bat carcass was 13 meters from a turbine.

Table 5: Species of Carcasses Found

Species	Numbe
Little Brown Myotis	1
Black-and-White Warbler	1
Common Yellowthroat	3
Magnolia Warbler	1
Yellow-rumped Warbler	1

CORRECTED MORTALITY ESTIMATES

Bird mortality estimates were calculated for the 112X112 grid and for a 50-meter radius circle (see Table 6). These were calculated using suggested formulas and parameters discussed in the paper published by researchers of the Canadian Wildlife Service (Zimmerling et al. 2013). For the 112X112 squares, the corrected estimated mortality (C) was 5.33 birds per turbine per year. For the 50-meter radius square, (C) was 3.90/turbine/year. However, Zimmerling et al. (2013) use two correction factors for the 50-meter radius circle. The first is a correction for the birds that fall beyond 50 meters and the other is for birds that collide with the turbines during those times of the year when searches are not carried out. Using these correction factors, the corrected estimated mortality at Fairmont Wind Farm was 8.64 birds per turbine using the 50-meter radius circle calculation.

The corrected estimate for the 112X112 square grid was adjusted for the months when searching did not take place. It was not adjusted for birds found beyond 50 meters because it was already adjusted for a much larger search area that is as far as 79 meters from the turbine. It also has between 320 or 400 meters of search area at the two turbines along the access road out to 100 meters. No carcasses were found in any search area further than 50 meters from a turbine. The corrected estimate for the 112X112 square adjusted for the whole year was 5.67 birds/turbine/year.

Table 6: Corrected Estimated Bird Mortality Using Different Calculation Methods

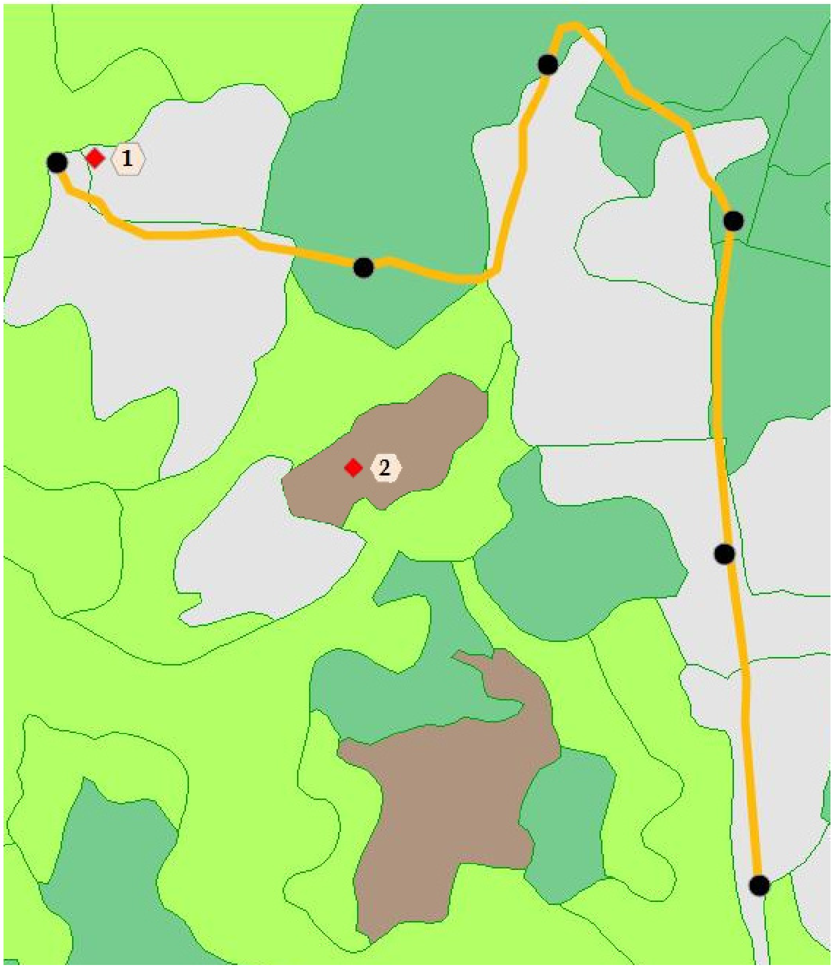
Calculation Method	Estimated Mortality/Turbine/Year
112X112 meter grid (April-October)	5.33
112X112 meter grid (January-December)	5.67
50-meter Radius Circle (April-October)	3.90
50-meter Radius Circle (January-December) adjusted for > 50 meters	8.64

The corrected estimate for 112X112 square grid for bat mortality was 0.89 per turbine per year and 0.65/turbine/year for the 50-meter radius circle. These estimates were not adjusted for distance since bats are known to fall much closer to the turbine than birds. They were not adjusted for time of year as bats do not normally fly during the winter months.

Discussion

The average corrected estimate of bird mortality across Canada is 8.2 per turbine per year plus or minus 1.4 at the 95% confidence level (Zimmerling et al. 2013). This puts three out of the four estimates in this study below this range. The fourth estimate of 8.64 birds/turbine/year is within this range. This fourth estimate is higher because of an adjustment factor predicting that only 48% of all birds colliding with wind turbines fall within 50 meters of the turbine. The value of this parameter appears to be inappropriate for the highland areas of Nova Scotia where the vast majority of bird mortality is of small passerines that are not thrown as far in collision as larger birds. In two other studies by this author, only 4% of all bird carcasses were found beyond 50 meters (Kearney 2013a, b). These studies used the same search grid and methods as this one. It is thus proposed that 5.67 birds/turbine/year is the most realistic estimate of bird mortality at the Fairmont Wind Farm. Since it very unusual for a bat carcass to fall beyond 50 meters, 0.65 bats/turbine/year is proposed as the most realistic estimate (using the 50-meter radius circle estimate).

Figure 5. Location of Stop-over Transect with Stop Counts



Migration Stop-over

Migration stop-over surveys count the number of birds using an area to feed and rest during their migration travels. It is a measure of the importance of the habitat to migratory birds and an indicator of the magnitude of the number of birds passing over the area during the night or day.

Methods

Figure 5 shows the line-transect that was used for the study of stop-over. The transect is 1,500 meters in length with all birds seen or heard recorded in the following distance categories from the observer: <50 meters, 50-100 meters, >100 meters, and flying overhead.

Figure 6. Total Birds on Stop-over Transect by Date in the Spring, 2013-2014

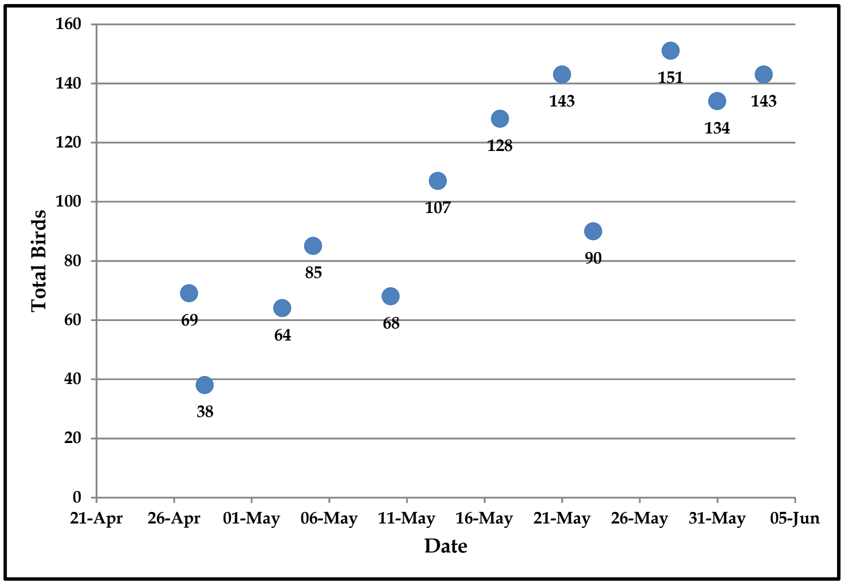


Figure 7. Total Species on Stop-over Transect by Date in the Spring, 2013-2014

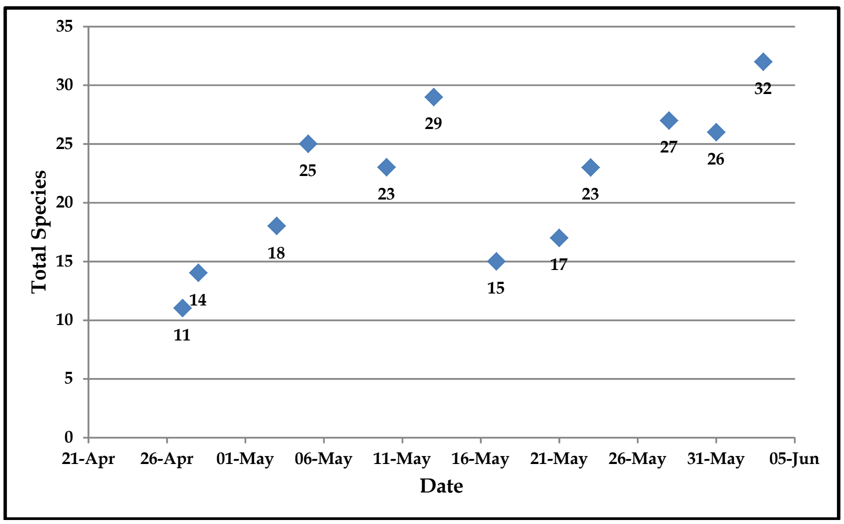
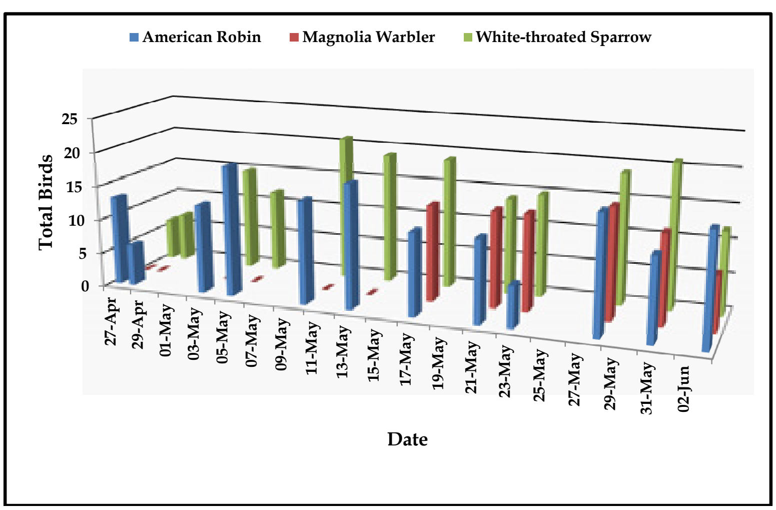


Figure 8. Number of Selected Species on Stop-over Transect by Date in the Spring, 2013-2014



Along the transect are six stop counts. The duration of each stop count is ten minutes with birds recorded in the same distance categories as the rest of the transect. The stop-counts slow down the pace of the transect run. The transect was surveyed once per week during the entire migration period. These periods are from April 27 to June 3 in the spring and from August 18 to October 23 in the autumn. The same transect was used in the spring and autumn migrations. A part of the initial transect was modified during the spring of 2013 due to the fact that it passed through a Black Bear nursery area.

Results

Figure 6 graphs the total birds on the stop-over transect in spring by date during the two-year study. Peak numbers are reached in late May and early June. By this time, birds on the transects include early migrants (April arrivals) now on their breeding territory and late spring migrants in stop-over. The total birds on the transect in the spring over the two year period was 1,220 with a mean of 101.67 birds per survey day.

Figure 7 shows two peaks in the number of species of birds on the transect, in early May and then late May and June. These two peaks would represent waves of early and late migrants. A total of 47 species were seen on the spring transect over two years with a mean 21.67 per survey day.

Figure 8 graphs the occurrence

Figure 9. Comparison of Total Birds on Stop-over Transect during the Spring in 2013 and 2014

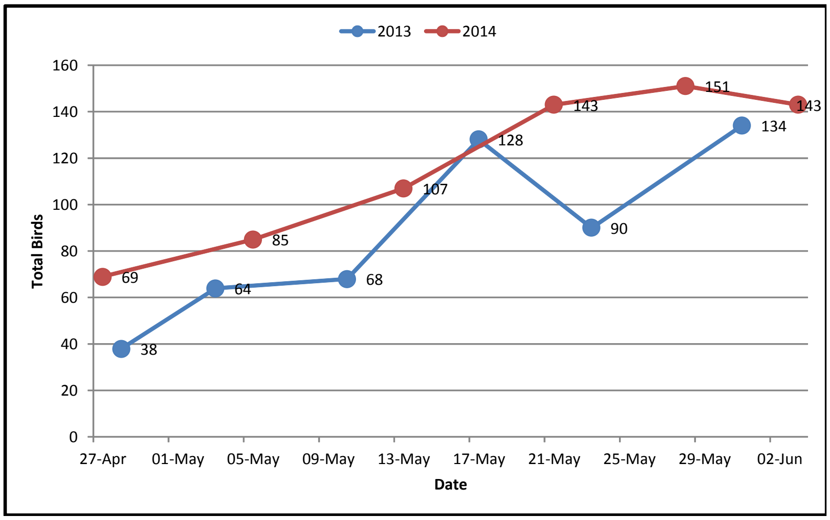


Figure 10. Total Birds on Stop-over Transect by Date in the Autumn, 2013-2014

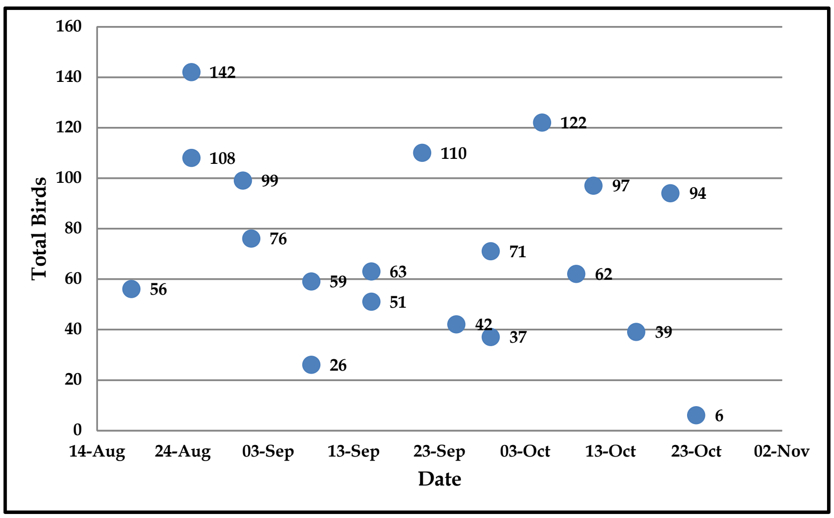
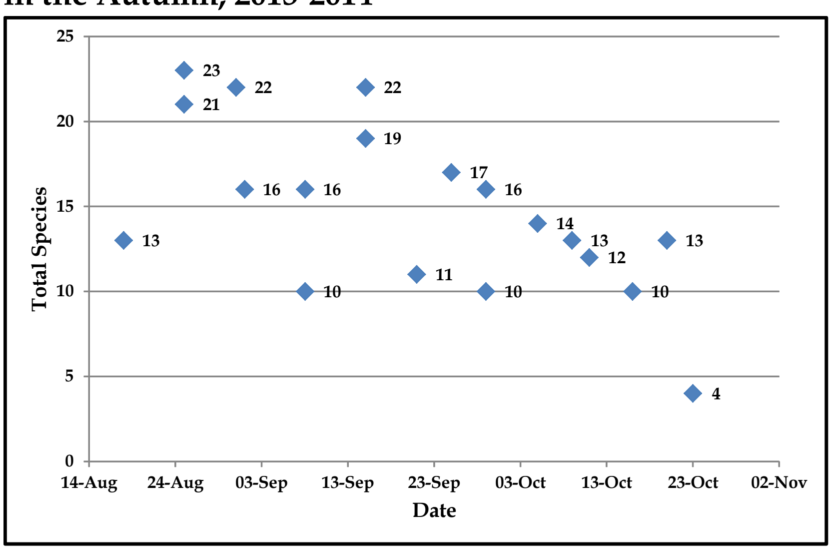


Figure 11. Total Species on Stop-over Transect by Date in the Autumn, 2013-2014



of the three most common species in the spring migration. American Robin (159 birds over two years) is an early migrant, Magnolia Warbler (79 birds) is a late migrant, and White-throated Sparrow (180 birds) is also an early migrant but builds up in numbers later than the American Robin.

Figure 9 compares the total birds on the stop-over transect during the spring of 2013 and 2014. Numbers were consistently higher in 2014.

During the autumn migration surveys were carried out from August 18 to October 23. As shown in Figure 10, there was considerable variation in the total number of birds detected in stop-over throughout the season. Highest numbers occurred in late August, the third week of September, and the first week of October. The total birds on the transects over the two year period was 1,360 with a mean count of 71.58 per survey day.

Total species on the transect are graphed in Figure 11. The numbers of species present on the transect are also variable but show a clear decline after mid-September. Total species seen in the autumn on the transect over the two year period was 48 with a mean of 14.84 per survey day.

The three most common birds in the autumn were Blue Jay (239 total for the two seasons), Black-capped Chickadee (151), and Yellow-rumped Warbler (129). These three species are graphed in Figure 12. Although both the Blue Jay and Black-capped Chickadee are

Figure 12. Number of Selected Species on Stop-over Transect by Date in the Autumn, 2013-2014

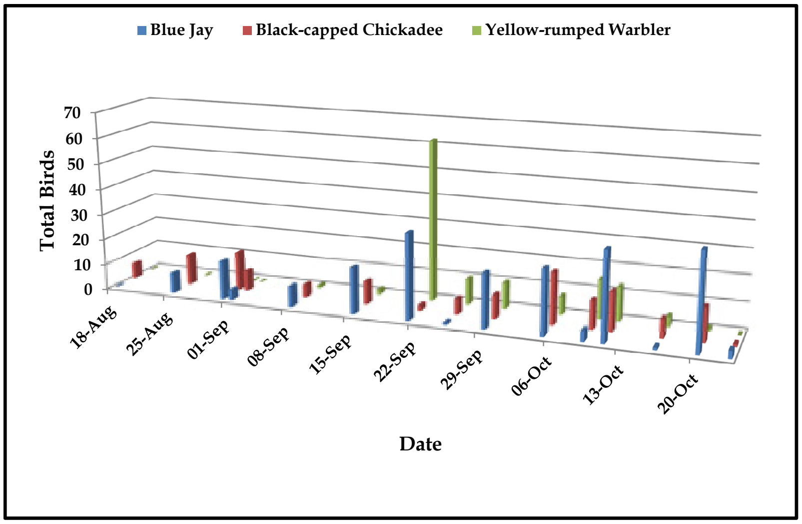
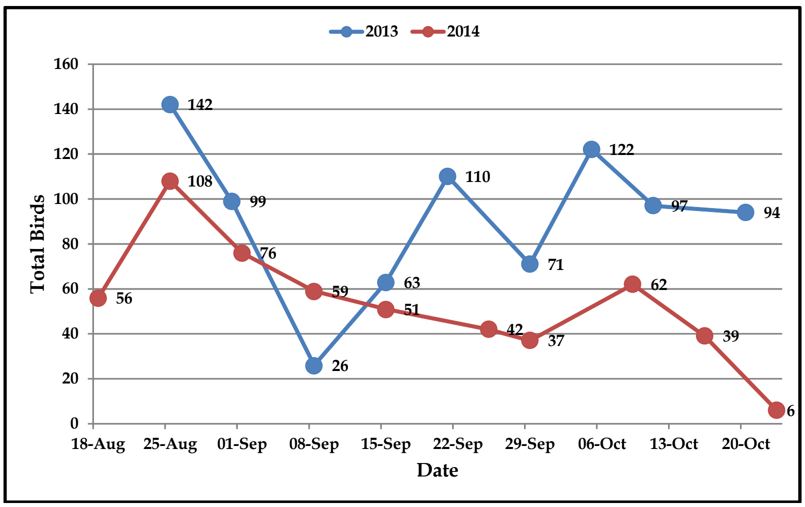


Figure 13. Comparison of Total Birds on Stop-over Transect during the Autumn in 2013 and 2014



present in the study area throughout the year, their high numbers on the transects indicated that many of these birds were migrants in stop-over. Blue Jays began increasing in mid-September and were at their highest level in the third week of October. Black-capped Chickadees peaked in the first week of October. A spike of Yellow-rumped Warblers occurred on September 21, 2013. Similar high numbers of this species did not occur in 2014. Indeed, through the autumn of 2014 only 34 Yellow-rumped Warblers were counted compared to 95 in 2013.

Lower counts of birds on the transects were true in general in 2014. Figure 13 compares the total birds on the stop-over transects in 2013 and 2014.

Discussion

The results of the stop-over surveys indicate that the numbers of birds present are similar to other upland areas of Nova Scotia in the autumn where wind energy facilities have been proposed or constructed. Based on other studies by the author using the same survey method, mean counts in high upland areas ranged between 48 to 79 birds per transect in the autumn compared to 72 at Fairmont.

Diurnal Passage

Diurnal passage describes the birds that are migrating over the study area during the day.

Methods

Formal diurnal passage study from a high elevation observation post was not part of the post-construction monitoring plan. However, systematic notes on diurnal passage were recorded while carrying out the stop-over transects. Birds that were clearly in diurnal passage were noted as well as their flight direction.

Results

A total of 88 birds were seen in diurnal passage, all but one during the autumn migration. Only 12 birds were seen in diurnal migration during the autumn of 2014 compared to 76 in 2013. Yellow-rumped Warbler composed 88% of total birds in diurnal migration in 2013 and 0% in 2014. Figures 14 and 15 show that the predominant flight direction of all birds, dominated by Yellow-rumped Warblers, was southwest and south. The peak in the Yellow-rumped Warbler passage in 2013 was September 21.

Figure 14. Heading of All Birds in Diurnal Passage in the Autumn, 2013-2014

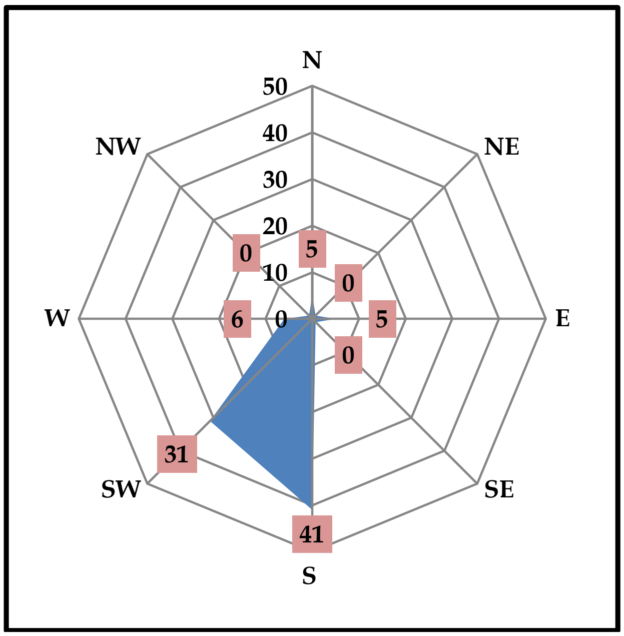
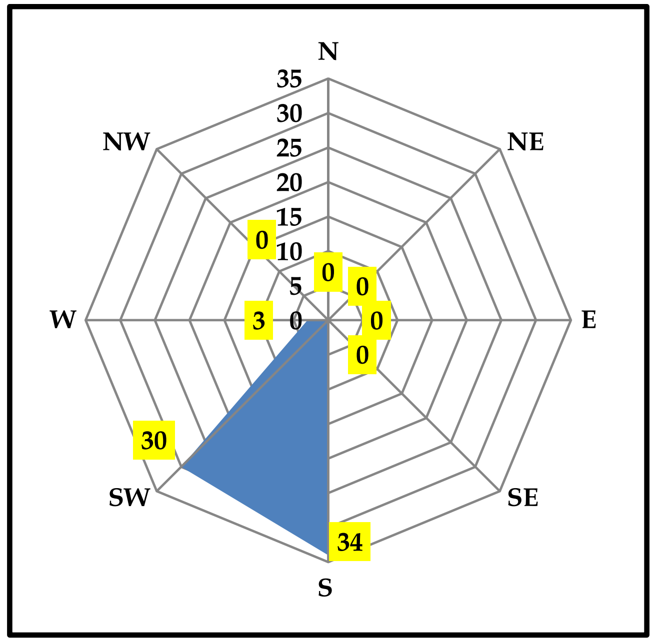


Figure 15. Heading of Yellow-rumped Warblers in Diurnal Passage in the Autumn, 2013



Discussion

The magnitude of diurnal passage at the Amherst Wind Farm is similar to other high upland areas of Nova Scotia where wind facilities have been proposed or constructed. At other locations surveyed by this author, using the same methods, the proportion of birds flying over the transect during the surveys ranged between 11 and 21 percent at three other sites. The percentage at Fairmont was also 21 percent. The number of birds noted as flying over the transect are a good indicator of the strength of diurnal passage.

Morning flights of Yellow-rumped Warblers are not unusual in the highland areas of Nova Scotia in the autumn. The absence of Yellow-rumped Warblers in 2014 could be due to the absence of the observer on the days it occurred.

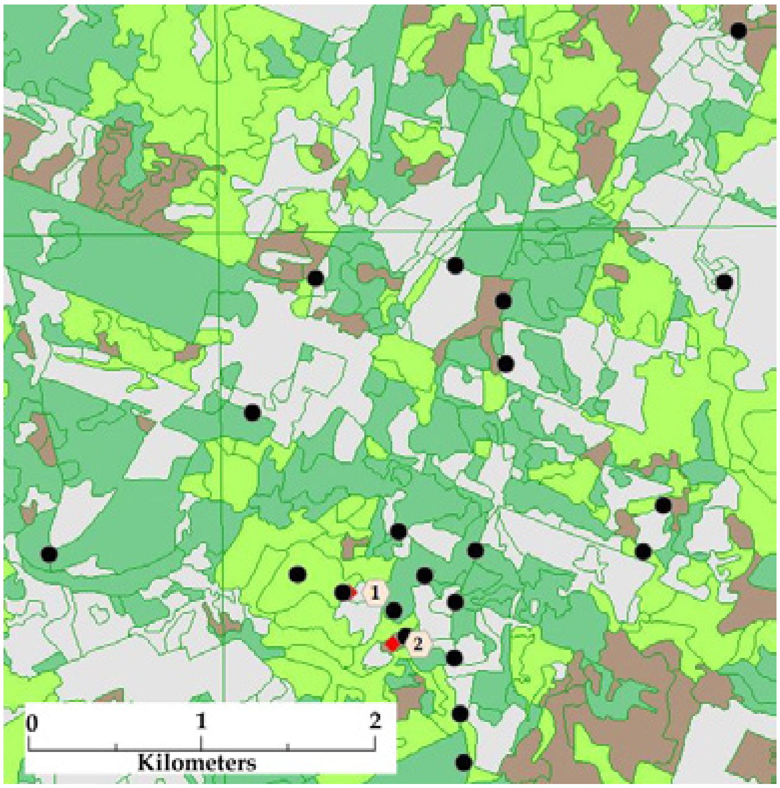
Breeding Birds

The analysis of breeding birds is divided into two categories. Early breeding birds are those that start their nesting activities before or in the early phases of spring migration. Peak breeding birds consists largely of Neotropical migrants that start their nesting activities in late May and June.

Methods

Early breeding birds are surveyed during the stop-over transects. Species that begin their nesting activities before or during the first week of May are considered early breeders in this study.

Figure 16. Location of Peak Breeding Point Counts 2013



Peak breeding birds are surveyed by means of point counts. All birds seen or heard during a ten-minute period at a point count station are recorded in the following distance categories from the observer: <50 meters, 50-100 meters, >100 meters, flying overhead. The location of the 21 peak breeding point counts is shown in Figure 16.

Results

Table 7 lists the early breeding birds and their mean number seen on the four surveys conducted in the last week of April and the first week of May. The most common early breeding bird is the American Robin.

Table 7: Mean Number of Early Breeding Birds on the Transect during last week of April and the First Week of May, 2013-2014

Species	Mean
American Robin	12.75
Black-capped Chickadee	4.50
American Crow	4.00
Blue Jay	3.25
Song Sparrow	2.75
Dark-eyed Junco	2.75
Ruffed Grouse	1.75
Northern Flicker	1.75
Hairy Woodpecker	1.00
American Black Duck	0.50
Downy Woodpecker	0.50
Pileated Woodpecker	0.50
Gray Jay	0.25
Common Grackle	0.25

Table 8 lists the total number, mean, and frequency of the forty most common bird species surveyed during the peak breeding point counts. The nine most common species, detected on at least one third of the point counts, are American Robin, Red-eyed Vireo, White-throated Sparrow, American Crow, Black-throated Green Warbler, Alder Flycatcher, Magnolia Warbler, Ovenbird, and Northern Parula.

An analysis was conducted comparing the count of birds within 1 kilometer of the Fairmont Wind Farm turbines and the counts greater than 1 kilometer from the turbines. This breaks down to 11 point counts within 1 kilometer and 10 point counts beyond kilometer. There was no significant statistical differences in the means of the total birds and total species within or beyond 1 kilometer. The means were 14.32 and 14.55 birds within and beyond 1 kilometer and 9.36 and 8.65 species within and beyond 1 kilometer. On a species by species basis,

Table 8: Total Number, Mean, and Frequency of Peak Breeding Birds, 2013-2014

Species	Total	Mean	Frequency	Rank
American Robin	72	1.71	83.3	1
Red-eyed Vireo	68	1.62	81.0	2
White-throated Sparrow	41	.98	50.0	3
Amercan Crow	36	.86	45.2	4
Black-throated Green Warbler	31	.74	45.2	5
Alder Flycatcher	30	.71	42.9	6
Magnolia Warbler	29	.69	42.9	7
Ovenbird	33	.79	40.5	8
Northern Parula	18	.43	35.7	9
Song Sparrow	27	.64	31.0	10
Dark-eyed Junco	19	.45	31.0	11
American Goldfinch	20	.48	28.6	12
Black-capped Chickadee	15	.36	28.6	13
Common Yellowthroat	13	.31	28.6	14
Hermit Thrush	13	.31	26.2	15
Mourning Warbler	13	.31	26.2	16
Blue Jay	10	.24	21.4	17
Ruby-crowned Kinglet	10	.24	21.4	18
Swainson's Thrush	9	.21	19.0	19
American Redstart	9	.21	16.7	20
Blue-headed Vireo	6	.14	14.3	21
Northern Flicker	7	.17	11.9	22
Mourning Dove	5	.12	11.9	23
Chestnut-sided Warbler	5	.12	11.9	24
Hairy Woodpecker	5	.12	9.5	25
Nashville Warbler	5	.12	9.5	26
Cedar Waxwing	4	.10	7.1	27
Least Flycatcher	3	.07	7.1	28
Common Raven	3	.07	7.1	29
Black-and-White Warbler	3	.07	7.1	30
Purple Finch	3	.07	7.1	31
European Starling	19	.45	4.8	32
Yellow-rumped Warbler	3	.07	4.8	33
Yellow-bellied Sapsucker	2	.05	4.8	34
Yellow Warbler	2	.05	4.8	35
Lincoln Sparrow	2	.05	4.8	36
Rose-breasted Grosbeak	2	.05	4.8	37
Pileated Woodpecker	2	.05	2.4	38
Great Blue Heron	1	.02	2.4	39
Barred Owl	1	.02	2.4	40

Table 9: Species with Statistically Significant Differences in Abundance Relative to Distance from Wind Turbine

Species	Mean @ <1 km	Mean @ >1 km	p
American Crow	0.41	1.35	0.004
Swainson's Thrush	0.36	0.05	0.026
American Robin	1.36	2.10	0.041
American Redstart	0.00	0.45	0.009
Mourning Warbler	0.50	0.10	0.017
White-throated Sparrow	1.64	0.25	0.000
Dark-eyed Junco	0.77	0.10	0.002

however, there were some statistically significant differences. Swainson's Thrush, Mourning Warbler, White-throated Sparrow, and Dark-eyed Junco were more abundant within 1 kilometer of a turbine. The latter three species typically take advantage of disturbed forest areas. Species that were more abundant in the area beyond 1 kilometer from a turbine were American Crow, American Robin, and American Redstart. These species favour agricultural land or more mature forests.

During the conduct of the point count peak breeding surveys in 2014, a sound meter was used to measure ambient noise at the time of the point count. At the conclusion of each count, the mean noise level for 1 minute was recorded. Mean noise levels for 21 point counts ranged from 43.9 to 77.2 decibels. The mean of the mean noise levels at each count was 58.2 within 1 kilometer of a turbine and 62.6 beyond 1 kilometer from a turbine. Figure 17 plots the mean noise level against the total birds at each point count. The plot shows that there is weak relationship between counts and background noise (r^2=0.083).

In contrast, wind speed at the time of the point count had the largest effect on the total number of birds on any particular point count as shown in a univariate general linear model (see Table 10). Counts were highest with wind speeds less

Figure 17. Relationship of Ambient Noise to Total Birds at Point Counts

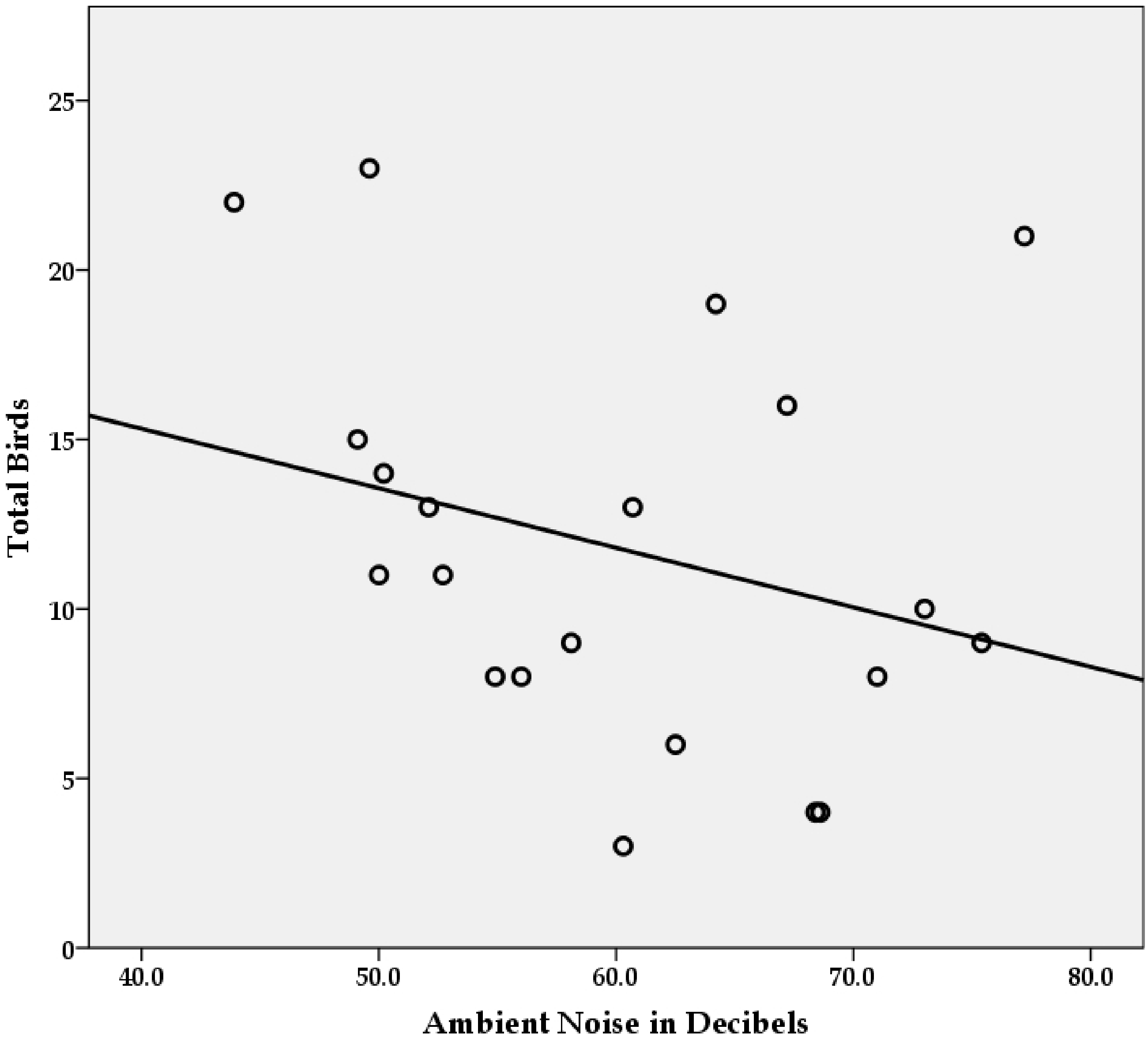


Table 10: Factors Having a Significant Impact on Total Birds at Point Count

Dependent Variable: Total Birds at Point Count							
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	Hypothesis	6336.642	1	6336.642	43.380	.001	.895
	Error	746.329	5.109	146.072[a]			
Habitat	Hypothesis	310.962	5	62.192	2.701	.039	.303
	Error	713.757	31	23.024[b]			
WindSpeed	Hypothesis	775.465	5	155.093	6.736	.000	.521
	Error	713.757	31	23.024[b]			

than 20 km/hour. Habitat had a small yet significant effect, with counts highest in agricultural and residential areas.

Discussion

The breeding data suggest that the Fairmont Wind Farm has had little effect on the total number of birds nesting in the area. What appears to have changed is the species composition, with a greater abundance of birds preferring disturbed habitats.

Species of Conservation Concern

A species of conservation concern is one for which a determination has been made by the Nova Scotia Department of Natural Resources (NSDNR), Government of Canada through the Species at Risk Act (SARA), or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) that its population is at risk. Table 11 lists the species of conservation concern seen within or close to the boundaries of the Fairmont Wind Farm. Table 11 gives both the conservation status of the species and an annotation about its presence in the study area. No SARA or COSEWIC listed species were recorded in the study area.

Table 11: Annotated List of Species of Conservation Concern Seen in Study Area

Species	Status in Nova Scotia	Annotation
Common Loon	May be at Risk	Flying over stop-over transect on September 25, 2014
Yellow-bellied Flycatcher	Sensitive	1 seen 3.7 km from the closest turbine in peak breeding in 2013
Gray Jay	Sensitive	1 seen on stop-over transect on May 5, 2014
Boreal Chickadee	Sensitive	4 seen on stop-over transect in spring of 2013. 5 seen on stop-over transect in spring of 2014. 1 on peak breeding point count in 2014, 678 meters from nearest turbine
Golden-crowned Kinglet	Sensitive	5 seen on stop-over transect in spring and 21 in the autumn if 2013. 7 recorded on stop-over transect in 2014
Ruby-crowned Kinglet	Sensitive	28 on stop-over transect in spring and 13 in the autumn of 2013. 7 on 6 point counts in peak breeding ranging from 81 to 1600 meters from a turbine and a mean distance of 598 meters in 2013. 10 on stop-over transect in the spring and 1 in the autumn of 2014. 1 on 2 peak breeding point counts in 2014, 678 and 1600 meters from nearest turbine
Bay-breasted Warbler	Sensitive	1 on stop-over transect September 25, 2014
Blackpoll Warbler	Sensitive	1 on stop-over transect September 8 and 15, 2014
Rose-breasted Grosbeak	Sensitive	2 seen on stop-over transect on 31 August. 1 seen on two point counts during peak breeding , 1900 and 1700 meters from the closest turbine

Conclusion

Two years of post-construction studies indicate that the avifauna of the Fairmont Wind Farm is similar to other upland areas of Nova Scotia where wind energy facilities have been constructed. This is true for breeding birds and birds in stop-over. Diurnal passage observations indicate significant numbers of Yellow-rumped Warblers in 2013 but not in 2014. Data suggest that a few bird species preferring a disturbed forest habitat increased after construction while a couple species preferring a mature forest decreased.

Bat mortality as a result of collisions at the wind farm is very small, and bird mortality is below the national average.

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