Wind Turbines and Birds The Erie Shores Wind Farm Experience: Breeding Bird Surveys

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Introduction

In a recent article (James 2008) I provided information about some bird species nesting near wind turbines, where I had found nests for those species. In this article I will look more generally at bird populations in areas near wind turbines, as revealed by breeding bird surveys. In order to try to assess any potential effects of wind turbines on bird populations, it is usual to undertake a series of breeding bird point counts. While it would be ideal to count at or close to final turbine locations, both before and after turbines are installed and working, this has not always been possible. Breeding bird point counts were conducted in 2003 in the area proposed for the Erie Shores Wind Farm, 3 years before the turbines began operation. There were unanticipated delays in getting the wind farm in operation, and turbine locations were not yet established. While the point counts of 2003 provided quantitative information about the bird populations, most of the count points were not close enough to the final turbine positions in the large area initially under consideration, to be useful for comparison to counts after operations began.

During 2006 and 2007, once the 66 turbines of this wind farm were operating, point counts were conducted more focused on the turbines. Some woodlands and ravines were not readily accessible, without either trampling crops, or taking unacceptable amounts of time and effort to get near a turbine. There were also a few point counts done in 2006 that were not repeated because of

significant habitat/condition changes in the subsequent year. Additional details of the wind farm can be found in James (2008).

Post-construction point counts were conducted in three habitat types where possible: 1) In woodlands greater than 10 ha, and within 400 m of a turbine. Where woodlands were sufficiently large and close, counts were conducted in pairs, one within 100 m of a turbine (1 at 156 m), and the second about 250–300 m more distant (without getting closer than 100 m to the edge of the woodland). There were 20 counts in woodlands in both years, including 6 pairs of counts. 2) In wooded ravines that were at least close to 100 m across or wider, and within 400 m of a turbine. There were 7 counts in ravines, all more than 180 m from a turbine. 3) In agricultural fields that were large enough to establish two count points on laneways or roadways near a turbine, one point within 100 m of a turbine, and the second at least 300 m farther away (as far as possible without getting within 100 m of a significant change in habitat). In addition, any roadside count conducted in 2003 within 400 m of a turbine was added. There were 23 roadside counts comparable in both years, including 5 pairs of close and more distant counts.

Point counts were of 10 minutes duration, each sampled twice, at least a week apart, in reasonably good weather, between a half hour before sunrise and 10:30 h. The maximum number of any species recorded on any particular count was used. An effort was made to eliminate duplication, particularly with pairs of counts, but also from week to week at one location. In 2006, counts were done 29-31 May and 8-10 June; in 2007, on 27-30 May and 10-13 June.

Results – Woodland Counts

On woodland counts, 56 bird species were noted over the 2 years (Table 1). The number of species increased from 46 in the first year of operation to 54 in the second. In both years the most numerous species included: Great Crested Flycatcher, Red-eyed Vireo, House Wren, American Robin, Yellow Warbler, Northern Cardinal, Rose-breasted Grosbeak, Common Grackle and Baltimore Oriole. These are predominantly more characteristic of edges, openings and shrubby areas, reflecting the fragmented nature of the woodlands, and/or the removal of trees from wooded areas.

Species which might have been considered sensitive (eg. Wood Thrush) were as numerous as ever. The species with the most notable decline was Mourning Warbler, but this change was not likely the result of the turbines. Eight of 10 recorded in 2006 were >150 m from turbines, and 2 of 3 in 2007 were <150 m. The second year was much drier than the first and this may have affected some species. Other declines were modest and may have been only the result of normal variation. Species seen only once in any year but not the other could be random

Table 1. Bird species and numbers recorded in 2006 and 2007 on 20 woodland breeding bird point counts at Erie Shores Wind Farm.

Species	in 2006	in 2007
Canada Goose *(Branta canadensis)*	1	18+?
Wood Duck *(Aix sponsa)*	1	
Wild Turkey *(Meleagris gallopavo)*	1	4
Green Heron *(Butorides virescens)*		1
Cooper's Hawk *(Accipiter cooperii)*		1
Killdeer *(Charadrius vociferus)*		1
American Woodcock *(Scolopax minor)*		1
Mourning Dove *(Zenaida macroura)*	3	6
Yellow-billed Cuckoo *(Coccyzus americanus)*	4	4
Black-billed Cuckoo (*C. erythropthalmus)*	2	1
Cuckoo sp?		1
Red-headed Woodpecker *(Melanerpes erythrocephalus)*	2	6
Downy Woodpecker *(Picoides pubescens)*	1	3
Hairy Woodpecker *(P. villosus)*	6	5
Northern Flicker *(Colaptes auratus)*	4	4
Pileated Woodpecker *(Dryocopus pileatus)*	2	1
Woodpecker sp?		1
Eastern Wood-Pewee *(Contopus virens)*	9	12
Least Flycatcher *(Empidonax minimus)*	4	1
Great Crested Flycatcher *(Myiarchus crinitus)*	19	16
Warbling Vireo *(Vireo gilvus)*	6	6
Red-eyed Vireo *(V. olivaceus)*	30	41
Blue Jay *(Cyanocitta cristata)*	11	9
American Crow *(Corvus brachyrhynchos)*	37	41
Bank Swallow *(Riparia riparia)*	4	8
Black-capped Chickadee *(Poecile atricapillus)*	3	2
White-breasted Nuthatch *(Sitta carolinensis)*	3	6
Carolina Wren *(Thyrothorus ludovicianus)*	1	1
House Wren *(Troglodytes aedon)*	16	18
Blue-gray Gnatcatcher *(Polioptila caerulea)*		2
Veery *(Catharus fuscescens)*	9	7
Swainson's Thrush *(C. ustulatus)*	1	1
Wood Thrush *(Hylocichla mustelina)*	8	13
American Robin *(Turdus migratorius)*	15	17
Gray Catbird *(Dumetella carolinensis)*	9	6
European Starling *(Sturnus vulgaris)*		3
Cedar Waxwing *(Bombycilla cedrorum)*	3	1

Species	in 2006	in 2007
Yellow Warbler (*Dendroica petechia*)	24	21
Black-throated Blue Warbler (*D. caerulescens*)	1	
Pine Warbler (*D. pinus*)		1
Black-and-white Warbler (*Mniotilta varia*)		2
American Redstart (*Setophaga ruticilla*)	8	8
Ovenbird (*Seiurus aurocapilla*)	3	2
Northern Waterthrush (*S. noveboracensis*)	1	
Mourning Warbler (*Oporornis philadelphia*)	10	3
Common Yellowthroat (*Geothlypis trichas*)	4	2
Eastern Towhee (*Pipilo erythrophthalmus*)	5	7
Chipping Sparrow (*Spizella passerina*)		2
Song Sparrow (*Melospiza melodia*)	7	12
Northern Cardinal (*Cardinalis cardinalis*)	17	29
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)	19	27
Indigo Bunting (*Passerina cyanea*)	5	5
Red-winged Blackbird (*Agelaius phoeniceus*)	6	5
Common Grackle (*Quiscalus quiscula*)	11	33
Brown-headed Cowbird (*Molothrus ater*)	9	12
Baltimore Oriole (*Icterus galbula*)	15	22
American Goldfinch (*Carduelis tristis*)	1	3

variation. Most species showed an increase, or remained the same. The number of geese in 2007 is uncertain as some were heard and not seen. The Swainson's Thrushes were no doubt late migrants, not expected to nest in the area.

Given the wide variation in point count data, it would be difficult to find any significance to an overall increase or decrease in numbers in any two years of data. However, a comparison of overall averages of species and individual numbers at least indicates the direction of changes. A comparison of average counts of species and individuals recorded on woodland point counts at Erie Shores is given in Table 2. The average counts, for both species and individuals, were higher in 2007 than the first year of operation of the turbines. Overall, there was no indication that woodland birds had been negatively impacted by the presence of the wind turbines.

Table 2. Average numbers of species and individuals recorded on 20 woodland point counts at Erie Shores Wind Farm in 2006 and 2007.

	2006	2007
Species – average/count	14.8	15.95
Individuals – average/count	18.1	23.2

Table 3. Average numbers of species and individuals on 6 pairs of close and more distant woodland point counts at Erie Shores Wind Farm in 2006 and 2007.

	2006	2007
At 6 counts close to turbines:		
Species – average/count	14.7	15.5
Individuals – average/count	18.3	20.8
At 6 more distant from turbines:		
Species – average/count	13.8	14.0
Individuals – average/count	18.1	18.3

A comparison of the 6 pairs of close and more distant counts in woodlands is given in Table 3. There was an increase in the averages of both numbers of species and numbers of individuals, whether closer or more distant from the turbines.

Wooded Ravine Counts

In the 7 wooded ravine counts, 43 species were noted over the 2 years (Table 4), with 32 species in the first year, and an increase to 39 species in the second year. In both years, the most numerous species were: Red-eyed Vireo, American Crow, American Robin, Yellow Warbler, Song Sparrow, Northern Cardinal, Red-winged Blackbird and Common Grackle. Again, most are species more characteristic of edges and shrubby areas rather than of deep woods. Most changes from year to year were relatively modest and seem likely to be random rather than influenced by turbines. The most notable change was for Blue Jay, but not surprising for a species that can be very quiet during the nesting season.

As with woodlands, a comparison of the average numbers of species and individuals per count, indicates increases in all averages during the second year of operations (Table 5). Again, a negative impact is not indicated.

Table 4. Bird species and numbers recorded in 2006 and 2007 on 7 wooded ravine point counts at Erie Shores Wind Farm.

Species	in 2006	in 2007
Canada Goose		4
Mallard *(Anas platyrhynchos)*	1	1
Wild Turkey	1	2
Turkey Vulture *(Cathartes aura)*		1
Red-tailed Hawk *(Buteo jamaicensis)*		1
Rock Pigeon *(Columba livia)*	1	1
Mourning Dove	1	6
Yellow-billed Cuckoo	3	1
Belted Kingfisher *(Megaceryle alcyon)*		1
Downy Woodpecker	2	3
Northern Flicker		1
Pileated Woodpecker		1
Woodpecker sp?		1
Great Crested Flycatcher	2	6
Eastern Kingbird *(Tyrannus tyrannus)*	1	
Yellow-throated Vireo *(Vireo flavifrons)*		1
Warbling Vireo		1
Red-eyed Vireo	12	11
Blue Jay	8	3

Species	in 2006	in 2007
American Crow	9	17
Bank Swallow	1	6
Black-capped Chickadee	2	1
House Wren	3	3
Veery		1
American Robin	5	7
Gray Catbird	5	5
Cedar Waxwing	2	
Yellow Warbler	5	6
American Redstart	1	2
Mourning Warbler	1	
Common Yellowthroat	4	2
Scarlet Tanager *(Piranga olivacea)*		1
Eastern Towhee	1	
Chipping Sparrow	1	2
Song Sparrow	9	9
Northern Cardinal	7	9
Rose-breasted Grosbeak	1	3
Indigo Bunting	3	5
Red-winged Blackbird	12	10
Common Grackle	5	12
Brown-headed Cowbird	7	5
Baltimore Oriole	4	5
American Goldfinch	2	1

Table 5. Average numbers of species and individuals recorded on 7 wooded ravine point counts at Erie Shores Wind Farm in 2006 and 2007.

	2006	2007
Species – average/count	13.6	16.9
Individuals – average/count	17.6	22.7

Roadside Counts

Over 2 years there were 62 species recorded on the 23 roadside point counts, 55 species each year (Table 6). The most numerous species both years were: gulls (mainly, if not entirely, Ring-billed Gull *Larus delawarensis*), Mourning Dove, Bank Swallow, Horned Lark, American Robin, European Starling, Red-winged Blackbird, Common Grackle and Brown-headed Cowbird. There is nothing particularly notable about any of the differences in species present one year but not the other. Most such birds were either rare locally (e.g. Orchard Oriole or House Sparrow) or not roadside birds at all (e.g. Veery or Ovenbird). The Bald Eagle nest was not active in 2007 by the summer (see James 2008), and the single Cliff Swallow colony near a count was not active in 2007.

The largest changes were in a few flocking species that might be expected to show considerable variation from year to year. The flocking species were also the least accurately counted. Some gulls may have been out of sight behind vegetation or variable topography. Rapidly milling Bank Swallows were estimated once or twice during the count period as accurately as possible, but with birds coming and going down over the shore bluffs, the actual number in view over the count area may have been higher than seen at any shorter interval. Numbers in rapidly moving flocks of starlings or blackbirds could only be estimated.

Table 6. Bird species and numbers recorded in 2006 and 2007 on 23 roadside point counts at Erie Shores Wind Farm.

Species	in 2006	in 2007
Canada Goose	4	84
Mallard	2	19
Ring-necked Pheasant *(Phasianus colchicus)*		1
Wild Turkey	2	1
Great Blue Heron *(Ardea herodias)*	1	1
Turkey Vulture	1	20
Bald Eagle *(Haliaeetus leucocephalus)*	2	
Red-tailed Hawk	1	1
American Kestrel *(Falco sparverius)*	1	1
Killdeer	20	26
Spotted Sandpiper *(Actitis macularius)*	3	
Gull sp?	155	108
Rock Pigeon	9	5
Mourning Dove	25	38
Black-billed Cuckoo	1	1
Red-headed Woodpecker	1	2
Downy Woodpecker		2
Northern Flicker	5	4
Pileated Woodpecker		1
Eastern Wood-Pewee	1	1
Great Crested Flycatcher	2	3
Eastern Kingbird	4	9
Warbling Vireo	9	11
Red-eyed Vireo	10	8
Blue Jay	1	6
American Crow	47	39
Horned Lark *(Eremophila alpestris)*	28	34
Purple Martin *(Progne subis)*	4	2
Tree Swallow *(Tachycineta bicolor)*	1	2
Bank Swallow	200	234
Cliff Swallow *(Petrochelidon pyrrhonota)*	4	
Barn Swallow *(Hirundo rustica)*	14	30
White-breasted Nuthatch		1
House Wren	8	5
Eastern Bluebird *(Sialia sialis)*		1
Veery	1	
Wood Thrush		1
American Robin	47	56
Gray Catbird	1	1
Brown Thrasher *(Toxostoma rufum)*	4	6
European Starling	98	140
Cedar Waxwing	4	2
Yellow Warbler	15	15
Ovenbird	1	
Common Yellowthroat	1	
Field Sparrow *(Spizella pusilla)*	1	1
Chipping Sparrow	11	20
Vesper Sparrow *(Pooecetes gramineus)*	10	10
Savannah Sparrow *(Passerculus sandwichensis)*	4	9
Song Sparrow	31	30
Northern Cardinal	12	15
Rose-breasted Grosbeak	3	1

Species	in 2006	in 2007
Indigo Bunting	4	3
Bobolink *(Dolichonyx oryzivorus)*	5	3
Red-winged Blackbird	67	101
Eastern Meadowlark *(Sturnella magna)*	4	1
Common Grackle	104	131
Brown-headed Cowbird	23	56
Orchard Oriole *(Icterus spurius)*	1	
Baltimore Oriole	12	17
American Goldfinch	10	11
House Sparrow *(Passer domesticus)*		1

A comparison of the average counts of individuals or species (Table 7) indicates an increase in both in the second year of operation. While some of the increase could be attributed to flocking species, there were also higher numbers of some common species such as Mourning Dove, Horned Lark and Barn Swallow. There may have been some influence of more birds moving into newly created habitat, areas where there were few if any present the first year. These would include Killdeer along the laneways, or Savannah Sparrow and Vesper Sparrow into the few available grassy areas. Many of the species were not in the fields per se, but around buildings or in wooded areas, often at some considerable distance from the count point or a turbine. This would suggest that overall numbers of birds in the area were generally higher in the second year. Some differences may have been the result of random changes in weather or in timing of the counts.

Table 7. Average numbers of species and individuals recorded on 23 roadside point counts at Erie Shores Wind Farm in 2006 and 2007.

	2006	2007
Species – average/count	16.4	17.6
Individuals – average/count	45.2	57.9

A comparison of the 5 pairs of roadside counts at close and more distant points within the same fields is given in Table 8. The only decrease the second year is a marginal drop in the average number of species at the closest points. But the numbers of individuals at these same points increased considerably. It would be difficult to argue that the turbines had any negative impact at the closer count points.

Table 8. Average numbers of species and individuals on 5 pairs of close and more distant roadside point counts at Erie Shores Wind Farm in 2006 and 2007.

	2006	2007
At 5 counts closer to turbines		
Species – average/count	16.4	16.2
Individuals – average/count	36.2	48.6
At 5 counts more distant from turbines		
Species – average/count	16.6	16.8
Individuals – average/count	43.4	50.2

Discussion and Conclusions

The turbines at Erie Shores Wind Farm are widely spaced (300 m to several kilometres between them), and the rotors are well above the vegetation (more than 41 m above ground at the lowest), some are out in farm crops 100 m or more from the nearest trees or shrubs. Nesting birds in the area were not deterred from using available habitat, even under the extent of the blades (James 2008). It should not be surprising then, that over the two years following the commencement of turbine operation, there was no decline in census numbers. It was common to observe birds foraging in vegetation and on the ground close to turbines, and in no hurry to move away. Available habitat, often only small patches among more extensive farm fields, was used, and birds were often seen in farm crops close to turbine towers. While the increases during the second year of operations may represent only random fluctuations in populations, they clearly indicate that breeding birds were not avoiding the wind turbines.

Studies at other wind farms have generally experienced similar results. European studies have generally considered mortality to be insignificant, but that displacement is potentially a more serious problem, and have focused more on this aspect of turbines. At 2 large turbines in Sweden, surveys over 3 years before and after operations began, found no indication of any effect on species diversity or abundance (Karlsson 1983). At 6 small wind farms along or near the coast in the Netherlands, the disturbance effect on breeding habitat of birds was negligible (Winkelman 1985). Two years of studies at 11 sites in Germany, indicated no effect on breeding birds (Vauk 1990). Studies over 8 years at an 18 turbine wind park (Oosterbierum) in the Netherlands, indicated no effect on breeding populations of Eurasian Oystercatcher (*Haematopus ostralegus*), Northern Lapwing (*Vanellus vanellus*), Black-tailed Godwit (*Limosa limosa*) and Common Redshank (*Tringa totanus*) (Winkelman 1992). There were no significant changes in upland breeding bird populations before or after construction of a wind farm (Bryn Titli) in Wales, either within the wind farm, or between the wind farm and an adjacent control site (Phillips 1994). There was no evidence of any disturbance effect on breeding waders at high density in close proximity to a large wind farm in coastal habitat in Gotland, Sweden. Densities of breeding waders were similar in the same habitat nearby without turbines (Percival 1998).

A study of nesting birds at Tarifa, Spain, found higher densities in the wind farm than in two other similar adjacent sites. The mean productivity of nests (number of fledglings per nest) was similar for all areas (Janss 2000). Seven years of breeding bird surveys before, during and after construction at Windy Standard wind farm in Britain, indicated no demonstrable effects on bird species

(cited in Langston and Pullan 2002). A study of 10 upland wind farms in Britain, comparing breeding bird distributions at wind farms with reference to control sites and random points, indicated no significantly lower densities in wind farms, and no apparent avoidance of larger vs. smaller turbines (cited in Langston and Pullan 2002).

In Belgium, a breeding peninsula for terns and plovers was constructed in 2000, in the outer port, at Zeebrugge. Despite there being 25 small- to medium-sized turbines standing in the vicinity of the peninsula, the site was very successful in attracting terns, with numbers increasing to 2791 pairs by 2007. Some terns were nesting as close as 30 m from the turbines, many at 100 m away or beyond (Stienen *et al.* 2008).

Where some declines have been indicated for one or more species, the loss usually has been attributed to human disturbance, rather than the turbines themselves. At a large facility in Washington and Oregon (Stateline), U.S.A., grassland birds combined had very similar overall use estimates pre- and post-construction (very slight increase). Any impact to individual species was largely attributed to direct habitat loss, and temporary disturbance by people and vehicles using laneways between turbines (Erickson *et al.* 2004). At a small installation of 3 turbines in the Orkney Islands, Scotland, comparing a plot that included the turbines and a control plot 2 km away over 8 years following construction, indicated no significant change in annual use by ducks, Red Grouse (*Lagopus lagopus*), waders, skuas/gulls and small passerines. The only noted decline was 3 of 5 pairs of Red-throated Loon (*Gavia stellata*), apparently the result of human disturbance (the loons were present in the morning when workers arrived) (Meek *et al.* 1993). At a large wind farm in Minnesota (Buffalo Ridge) in grasslands, bird densities were lower closer to the turbines (within 40 m, and between 80 and 180 m, than farther away). However, human distrubance was indicated to have been the probable cause of the lower densities. The turbines were also much shorter than at Erie Shores (37 m towers and 33 m diameter rotors), and noise, movement or closer spacing may also have contributed to the decline in breeding birds close to turbines (Leddy *et al.* 1999).

A decline in the number of breeding waders within 300 m of a single large turbine in Denmark (Tjaereborg) was reported by Pederson and Poulsen (1991). The cause is unclear, and since this is contradictory to other studies of waders already cited (Winkelman 1992, Percival 1998, Meek *et al.* 1993) it suggests perhaps human disturbance may have been the main factor.

In a very different habitat, high elevation forest in the Green Mountains of Vermont (Searsburg), breeding bird studies indicated that overall, within a 50 m radius of the turbines, the number of species increased slightly after construction. Here, however, the forest-dwelling

species, such as Swainson's Thrush and Red-eyed Vireo, declined, and species of edges and openings, such as American Robin and Blue Jay, increased (Kerlinger 2000). Such changes might be expected where habitat is altered substantially (local forest removal). But such effects should be minimal in grassland and farmland where surrounding habitat remains the same (or is restored to the same), apart from constructed laneways.

Where habitat changes are minimal, bird populations are likely to be relatively unaffected. The disturbance caused by vehicles and people on laneways and at turbines may be temporary. Once turbines are in operation and necessary adjustments made, visits for routine maintenance are few. Any species that may have been displaced by people may well move back into available habitat once disturbance declines. Birds can quickly habituate to a structure that operates much the same every day. Farming activities on the land are typically much more of a disturbance in an agricultural setting than routine maintenance activities, or the turbines themselves. For most small birds any potential danger remains well above normal activities. For any that venture high enough to be near turbine blades, they would be well aware of the presence of the turbine and able to see and avoid the blades. The small amount of noise from the turbines is insufficient to deter birds from living in close proximity.

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