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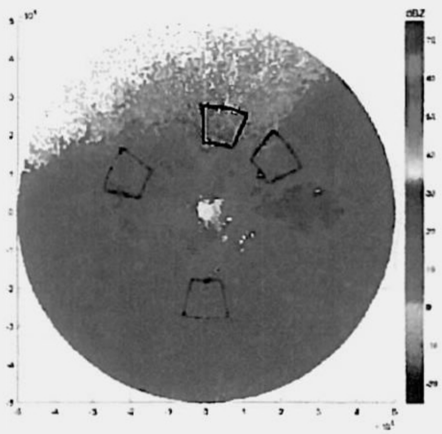
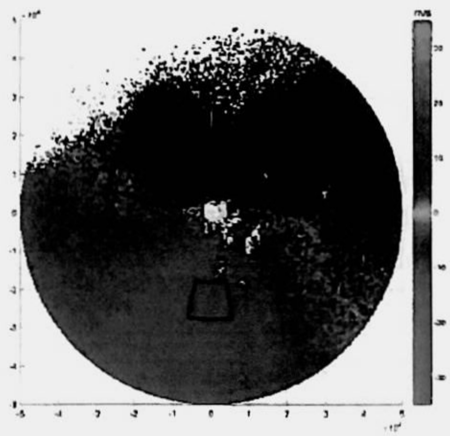
Assessment of Nocturnal Bird Migration Activity from Weather Radar Data for the Proposed Icebreaker Wind Energy Facility, Lake Erie, Ohio





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INTRODUCTION

This study examines NEXRAD weather radar data from Cleveland, Ohio and another radar station in Buffalo, New York for the purpose of assessing nocturnal bird and bat migration above the proposed site of the Icebreaker Wind Energy Facility in Lake Erie, and several comparison areas near Cleveland and Buffalo. The acronym NEXRAD represents "NEXt generation RADar", a network of approximately 160 Doppler radar stations maintained by the National Weather Service, and designed to monitor precipitation throughout the United States. NEXRAD data are stored and disseminated in two forms–as raw, high resolution Level II data, and as more highly processed, lower resolution Level III data. Level II products include reflectivity (a measure of the density of reflecting targets), radial velocity (the component of velocity either toward or away from the radar unit), and several other products (NOAA 2016). Most radar ornithological studies published to date have relied on analysis of reflectivity and radial velocity (e.g., Diehl et al. 2003, Gauthreaux and Belser 2003, Bonter et al. 2008, Buler and Dawson 2014, Farnsworth et al. 2016).

During operation, a radar unit sweeps horizontally through 360 degrees at each of several elevation angles (usually including 0.5°, 1.5°, 2.5°, 3.5°, and 4.5°) (NOAA 2016). The half-power beam width is approximately 0.95 degrees (Raghavan 2013), though energy return is greatest in the center of that beam. As of 2008, so-called "super resolution" Level II data for the lowest two elevations (0.5 degrees and 1.5 degrees) available from most NEXRAD stations have azimuthal resolution of 0.5 degrees and range resolution of 250 m (Torres and Curtis 2007). Thus, returned energy represents all targets within a section of a cone with 0.5 degrees "width" and "depth" of 250 m. Because of beam spread, the volume of this cone section increases with increasing range. From an analysis standpoint, the cone section represents the most fundamental sample unit for NEXRAD data. In the Methods section below, these cone sections are referred to as "pixels" of the polar coordinate system defined by radar azimuth and range.

Analysis of NEXRAD data for ornithological research depends on separating targets that are most likely to be birds (and/or bats) from other radar targets (Gauthreaux and Belser 1998). This data filtering process operates on the assumption that birds can fly opposing the wind or, if flying in the same direction as the wind, they can fly at greater than wind speed. Other targets will move with the wind (e.g., light precipitation or airborne dust) or only slightly faster than the wind (e.g., large swarms of insects). Thus, filtering out the slower-moving targets relies on independent measurements of wind speed and direction. Radiosonde wind data are obtained from weather balloons that are launched regularly from 92 stations in North America and the Pacific Islands (http://www.ua.nws.noaa.gov/). Many, though not all, radiosonde locations are coincident with NEXRAD stations. Data collected by instruments suspended from the balloon are radioed back to the station on the ground. At stations without radiosonde operations, winds at altitude must be estimated by other means, for example, from ground-based measurements (e.g., Archibald et al. 2016) or atmospheric wind models (e.g., Livingston 2008).

METHODS

Project Site, NEXRAD Stations, and Radar Sample Areas

The proposed Icebreaker Wind Facility will consist of six turbines (with a seventh alternate) in a single row, located approximately 14 km (9 miles) from the nearest point on the Lake Erie shoreline and 23 km (14 miles) from the KCLE NEXRAD station in Cleveland, Ohio (Figure 1). For the purpose of creating a reasonably sized sample area above the project, first, a boundary was defined as the 3.2 km (2 mile) buffer around the line segment connecting the turbines. The buffer was a racetrack-shaped polygon that provided range and azimuth limits for a NEXRAD sample area (Figure 2a), hereafter referred to as the Project Area. The Project Area was a wedge-shaped polygon with minimum range of 18 km, maximum range of 27.75 km, and arc limits spanning 25 degrees. Given the radar resolution for range (250 m) and azimuth (0.5°), the Project Area covered 39 range gates and 50 radar azimuths, or a total of 1950 pixels (= 39 × 50). The entire Project Area was above water (Figure 2a). Several comparison areas were created with the same size, range limits, and arc length as the Project Area. By design, these areas sampled air spaces at the same ranges so that, for fixed target sizes and densities within

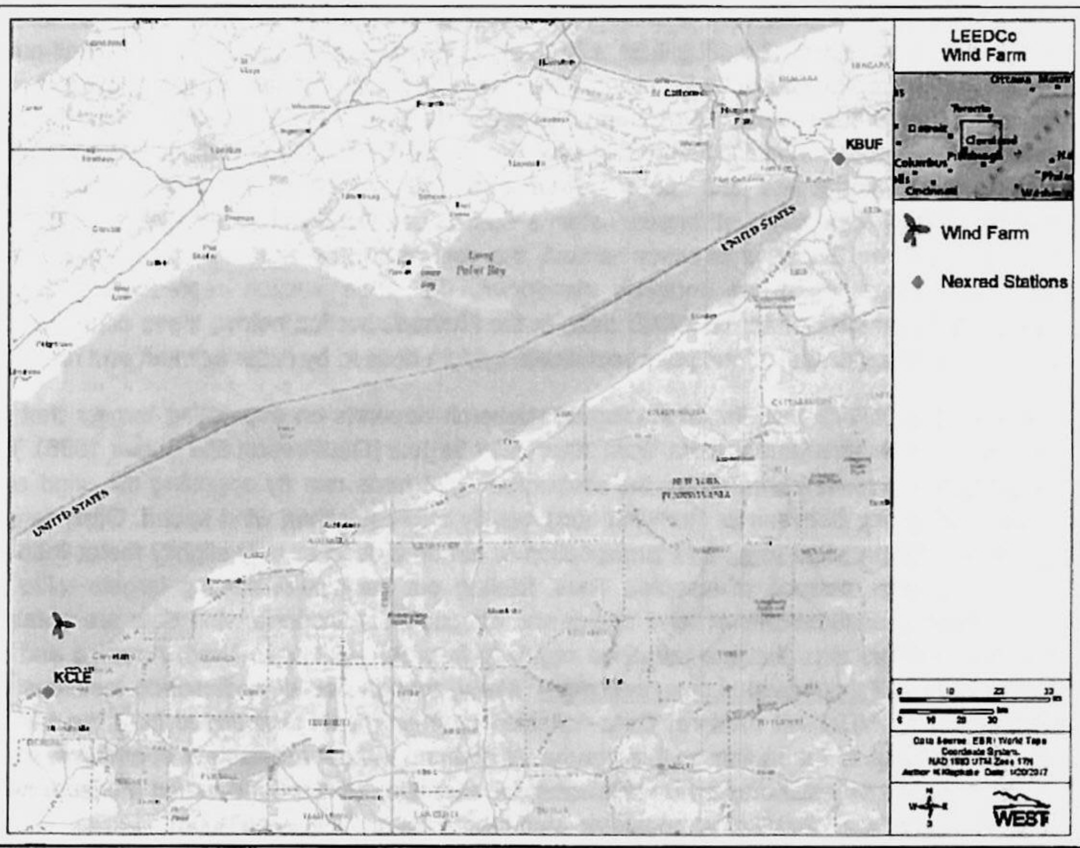
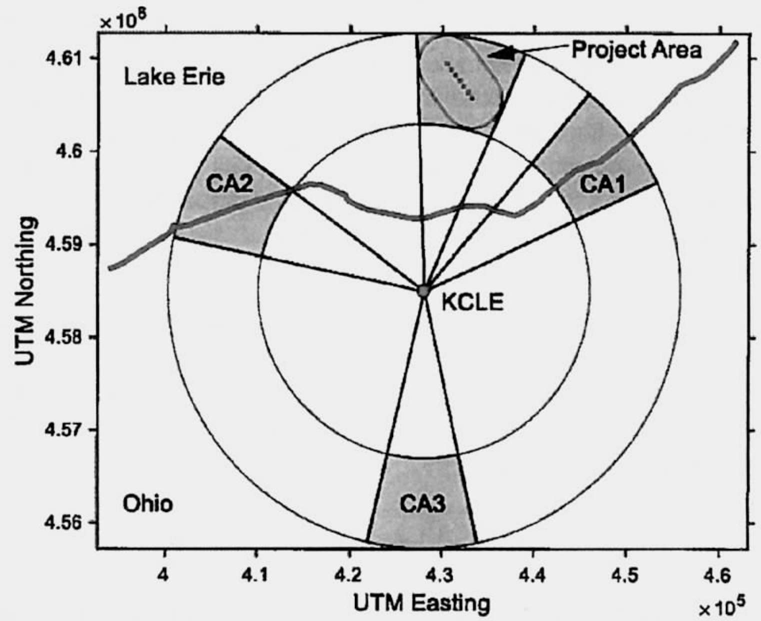


Figure 1. Location of the proposed Icebreaker Wind Energy Facility in Lake Erie, in relation to the KCLE NEXRAD station in Cleveland, OH and the KBUF station in Buffalo, NY.

(a)



(b)

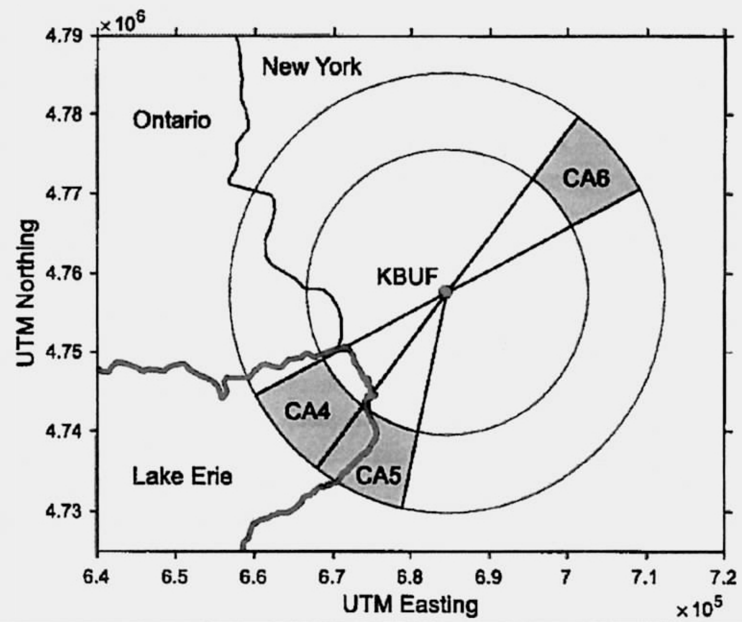


Figure 2. NEXRAD stations (red circles) and sample areas (gray shading), all at the same ranges (green circles) with same arc length (25 degrees) as the Project Area at (a) Cleveland (KCLE) and (b) Buffalo (KBUF). The Project Area in (a) shows the wind turbine locations (small blue circles) for the proposed Icebreaker Wind Energy Facility and bounding polygon (red line) used to define sample area dimensions.

each space, return energy would not differ. Furthermore, these areas sampled the same altitudes relative to the NEXRAD stations (though, altitude relative to ground or lake surface would vary somewhat). Three comparison areas were defined for KCLE (Figure 2). Comparison Areas 1 and 2 were situated above the Lake Erie shoreline such that approximately half of each area was above water and half was above land. Comparison Area 3 was located to the south of KCLE, entirely above land. Similarly, three comparison areas were defined for KBUF (Figure 2b). Comparison Area 4 was situated to the southwest of KBUF, entirely above water, though closer to the lake shore than the Project Area at KCLE. Comparison Area 5 was adjacent to Comparison Area 4, situated partly above water and partly above land, and Comparison Area 6 was entirely above land to the northeast of KBUF.

As described in the next section, only data from the lowest two radar elevations (0.5 degrees and 1.5 degrees) were retained for analysis. The height of the radar beam above the lake surface at the Project Area (i.e., the sample area shown in Figure 2a) was calculated accounting for radar height, earth curvature, and atmospheric refraction (Doviak and Zrnic 2006). In particular, beam height, H, was calculated as:

$$H = \sqrt{d^2 + \left(\frac{4}{3}r\right)^2 + 2d\frac{4}{3}r\sin(\theta)} + h_a - \frac{4}{3}r$$

where d = radar range (distance from the radar unit to the point of interest on the earth's surface), r = earth radius, θ = radar elevation, and h_a = height of the radar antenna relative to the point of interest. In addition to height of the beam center, the heights of the −3 dB (half-power) points were also calculated. As shown in Figure 3, the height of the center of the radar beam above the Project Area ranged from 257 to 366 m at the 0.5 degree elevation and from 574 to 847 m at the 1.5 degree elevation. Figure 3 also shows that at the 0.5 degree elevation the height of the lower −3 dB point ranged from 105 to 135 m above the Project Area. Thus, there was some overlap of the radar beam and the rotor-swept zone for the proposed turbines, which have a maximum blade tip height of 146 m. Figure 3 shows the area occupied by turbines (based on the proposed locations and height) as a semi-transparent gray rectangle, thus illustrating the overlap region. Table 1 provides more detail about radar beam height directly above the turbine locations. Note, for instance, that the lower −3 dB point ranged from 114.4 to 124.6 m directly above the turbine locations. Birds flying within the overlap region would likely be detected by the KCLE NEXRAD, though more detailed inference about target heights is not possible. Chilson et al. (2012) maintain that because birds are "bright" targets (relative to precipitation), a more appropriate characterization of beam width would be based on the −6 dB (quarter-power) points. That wider beam would imply greater overlap with the rotor-swept zone within the Project Area, i.e., detection of birds at lower heights (as well as at greater heights).

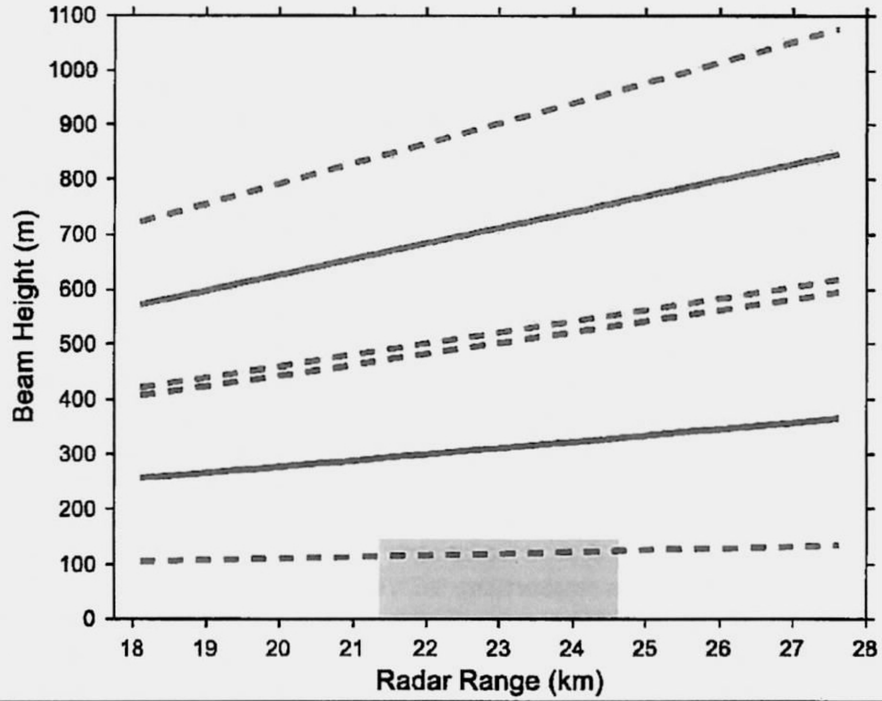


Figure 3. NEXRAD beam height relative to the lake surface, above the Project Area (X-axis limits) and, more specifically, above the wind turbines (gray shading). Solid lines indicate the beam centers, and dotted lines represent approximate beam boundaries of the 0.5⁰ (blue) and 1.5⁰ azimuth radar beams.

Table 1. Sampling heights of the radar beam from the KCLE station above the proposed Icebreaker Wind Energy Facility.

Radar Elevation	Position Within Beam	Beam Height (m) Near (21.36 km)	Far (24.63 km)
0.5°	Lower	114.4	124.6
	Center	291.9	329.2
	Upper	469.3	533.7
1.5°	Lower	487.2	554.4
	Center	664.6	758.9
	Upper	842.0	963.4

Heights are given for the nearest and farthest wind turbines from KCLE. "Lower" and "Upper" positions within the beam refer to the −3 dB (half-power) points for beam width of 0.95°. Beam heights account for land elevation and tower height at the KCLE site relative to the lake surface.

Data Selection, Downloading, and Pre-Processing

Level II NEXRAD data were downloaded from the database maintained by the National Centers for Environmental Information (NCEI) archival website (https://www.ncdc.noaa.gov/has/has.dsselect). Data were obtained from both the primary radar station (KCLE at Cleveland, OH) and the comparison station (KBUF at Buffalo, New York) for the nighttime hours during the spring and fall migratory periods, defined as April 1 – May 31 and August 20 – October 20, respectively. Fall data were obtained for the three years 2013 – 2015, and spring data were obtained for the years 2014 – 2016. While Fall 2016 data were available from KCLE, comparable data for the same period were not available from KBUF.

Each downloaded compressed file containing all data for an hour was decompressed into multiple files, each representing a separate radar scan at multiple elevations; typically, weather radars conduct 5 – 10 scans per hour. The NEXRAD data in these decompressed files were extracted from the native binary format using the Weather and Climate Toolkit, a Java program obtained from the NCEI (http://www.ncdc.noaa.gov/wct/). The Toolkit was used to export each file into NetCDF (Network Common Data Form) format (http://www.unidata.ucar.edu/software/netcdf/). NetCDF is a scientific data format that is machine independent and is readily imported by a variety of analysis software. Each NetCDF file contained all data from the native NEXRAD file in the original polar coordinate system (radar azimuth and range). NetCDF files were queried using Matlab, and only those files representing NEXRAD operation in Clear Air Mode (Volume Coverage Patterns 31 or 32) were retained for further processing and analysis. Files representing operation in Precipitation Mode, i.e., not in Clear Air Mode, were assumed to be dominated by precipitation and thus have little, if any, interpretable data indicative of bird migration. Other studies have excluded data due to precipitation (e.g., Farnsworth et al. 2016). Furthermore, Precipitation Mode data have lower resolution than data from Clear Air Mode, making analysis of biological targets more difficult (Diehl and Larkin 2005). Files were further filtered to retain only radar scans occurring between civil sunset (30 minutes after sunset) and civil sunrise (30 minutes before the following sunrise). This temporal filtering focused on the nocturnal period when migration is most intense (Diehl and Larkin 2005, Farnsworth et al. 2016), and also minimized contamination of scans due to sun strobes, which tend to occur near sunset and sunrise (Gauthreaux and Belser 2003).

All remaining NetCDF files were imported into Matlab and subset to retain "Super Resolution" reflectivity and radial velocity at 0.5 degree and 1.5 degree elevations; that is, all other Level II products and all higher elevations were discarded. Furthermore, data were subset to retain ranges less than 50 km. These subsetting steps led to greatly reduced file sizes and thus subsequently facilitated faster data processing and analysis. At the same time, 50 km range included substantial area beyond the Project site and similar comparison areas (described below) to facilitate visual pre-screening of radar scans.

Radar data were visually pre-screened in two stages to identify problems in radar scans. In the first stage, a technician viewed each scan at each elevation, displayed as a reflectivity-velocity pair, and flagged scans with potential problems such as precipitation (light precipitation may occur in Clear Air Mode), radar malfunction, or other anomalies. In the second stage, a more experienced person viewed those scans that had been flagged, and made a final determination regarding data acceptability. In particular, each sample area within each of the provisionally flagged scans was given a final flag if it was considered unacceptable, for example, because precipitation occurred within that area. In many cases, only one or two sample areas were flagged, while the remaining sample areas were considered acceptable. Flagged sample areas were not included in subsequent analysis. Other than pre-screening as described, all data were retained without regard to intensity of presumed migration (reflectivity values) or direction (inferred from radial velocity images); that is, there was no attempt made to pre-select occurrences of pronounced bird migration.

Target Filtering

Identification of likely bird migration required separation of targets based on estimated air speeds under the assumption that targets with relatively high air speed were birds (or bats) and those with air speeds closer to the wind were either completely passive (e.g., dust, smoke, or light precipitation) or weak fliers such as insects. An air speed threshold of 5 m/s (Buler and Dawson 2014) was used to separate these two target classes; i.e., targets with air speed greater than 5 m/s were interpreted as birds. Calculation of air speed required estimates of both target ground speed and wind speed. Target ground speeds were calculated from NEXRAD radial velocities, while wind speeds were based on vertical wind profiles from either radiosonde or modeled wind data.

NEXRAD radial velocity data does not provide a direct estimate of target ground velocity, except in those cases when targets are moving directly towards or away from the radar station. Under the assumption that target speed and direction are uniform across broad areas (typically, though not necessarily, at 360 degrees around the radar unit), they can be estimated using the "wind retrieval" techniques developed by meteorologists. The Velocity Azimuth Display (VAD) algorithm (Browning and Wexler 1968) provides one such approach. Regression is generally used to estimate mean velocities and also yields estimates of variability in radial velocity, though it is computationally intensive when radar scans number in hundreds to thousands. Liang and Wang (2009) describe a VAD technique that is simpler than regression, though it does not yield any estimate of variance.

Target ground velocity was calculated following Liang and Wang (2009) with the assumption that velocity was uniform around the circle at a given radar range (thus, uniform at a given height), but potentially varying at different ranges (heights). Letting θ_i represent radar azimuth (i = 1, ..., 720), $V_{\theta_{i,j}}$ represent radial velocity at the i^{th} azimuth and the j^{th} range (j = 1, ..., 39, for ranges within the sample areas), then the east-west and north-south velocity components at the j^{th} range were calculated, respectively, as:

$$u_j = \frac{-\sum_i V_{\theta_{i,j}} \cos(\theta_i)}{\sum_i \cos^2(\theta_i)}$$

$$v_j = \frac{-\sum_i V_{\theta_{i,j}} \sin(\theta_i)}{\sum_i \sin^2(\theta_i)}$$

Then, ground speed, $V_{j,g}$, and direction, $\phi_{j,g}$, were recovered, respectively, as:

$$V_{j,g} = \sqrt{u_j^2 + v_j^2}$$

$$\phi_{j,g} = \tan^{-1}(v_j/u_j)$$

In addition to their use in calculating target air speeds (see below), calculated ground directions were retained for subsequent analysis of migration direction.

Radiosonde data including wind speed and direction were obtained for KBUF from a website maintained by the University of Wyoming Department of Atmospheric Science (http://weather.uwyo.edu/upperair/sounding.html). These data were available at 12-hour intervals (at 00:00 and 12:00 UTC). For KCLE, no radiosonde data were available, so modeled vertical profile wind data were obtained from the Earth Systems Research Laboratory (ESRL, part of the National Oceanic and Atmospheric Administration) (http://www.esrl.noaa.gov/ psd/map/profile/). The modeled R1 Reanalysis data from ESRL are based on radiosonde and other measurements, and are available on a global 2.5 degree grid (latitude and longitude) at 6-hour intervals (00:00, 06:00, 12:00, and 18:00 UTC). For KCLE at 41.41° north, 81.86° west, the nearest model grid point was 42.50° north, 82.50° west.

Two-dimensional linear interpolation of vertical profile wind (whether radiosonde or modeled) was performed to estimate wind speed and direction across (1) time, to match the times at which radar scans were conducted, and (2) height, to match the calculated height of the radar beam at each range value within the sample areas. Interpolation was conducted separately for each night of radar data. Given the relatively coarse temporal resolution of the wind data, there were typically two to four sets of wind data spanning each night (before, during, and after the night's radar scans). Similarly, given the height resolution of the wind data and the relatively low heights of the radar beam within the sample areas, there were at most six height observations in each modeled wind dataset and at most 30 height observations in each radiosonde dataset. Interpolation was conducted for all radar beam heights within the sample areas at both the 0.5 degree and 1.5 degree radar beam elevations. Wind speed was interpolated directly. For wind direction, the cosine and sine transformations were calculated first, each transform was separately interpolated across time and height, and then directions were recovered as the arctangent transformation of the two components. Aside from the trigonometric transformations for direction, linear interpolation was not substantially more complicated than nearest-neighbor interpolation since both required calculation of numerous differences in both time and height.

Representing wind speed and direction at the j^{th} range (height) as $V_{j,w}$ and $\phi_{j,w}$, respectively, air speed, $V_{j,a}$ was calculated as:

$$V_{j,a} = \sqrt{V_{j,g}^2 + V_{j,w}^2 - 2V_{j,g}V_{j,w}\cos(\phi_{j,g} - \phi_{j,w})}$$

If target air speed at the j^{th} range was less than 5 m/s, then the corresponding reflectivity values within each sample area were set to missing values, i.e., those reflectivity values were excluded from further analysis. Otherwise, if target air speed exceeded 5 m/s, reflectivity values at that range were considered to be migrating birds and were retained for analysis.

In a final filtering step, each radar scan was evaluated and the data within each sample area were retained for analysis if at least 20 percent of the pixels had non-missing reflectivity values. Thus, certain sample areas within a scan might have been eliminated while the remaining sample areas from that scan were retained.

For subsequent analysis, reflectivity values were transformed from the logarithmic (*dBZ*) to the linear (*Z*) domain using the relationship:

$$Z = 10^{dBZ/10}$$

as in Diehl et al. (2003).

Analysis

Before any further processing, target direction data were averaged for each radar scan, at each beam elevation. Given the limited spatial resolution of both the VAD "wind retrieval" technique and the vertical profile wind data (whether from radiosonde or wind model), calculated target direction was the same for all sample areas at each radar station, though it might vary somewhat with beam elevation. Because direction is a circular variable, average direction, $\bar{\phi}$, was calculated as

$$\bar{\phi} = tan^{-1}(Y/X), \text{ where}$$

$$X = \sum_{i=1}^{n} \cos(\phi_i)/n \quad \text{and} \quad Y = \sum_{i=1}^{n} \sin(\phi_i)/n$$

where ϕ_i was the direction at range *i* (Batschelet, 1981). On the other hand, target reflectivity data were averaged separately for each sample area, at each radar elevation within each scan. That is, each sample area was represented by a single mean reflectivity value (for each scan and elevation); those mean values were treated as the observations in subsequent data summaries.

Target Direction

Summaries of target direction included the mean (calculated as above) by station, season, and elevation, or by station, season, year, and elevation. In addition, summaries included angular concentration, *r*, and standard deviation, *s*. Angular concentration (Batschelet, 1981) was calculated as

$$r = \sqrt{X^2 + Y^2}$$

where *X* and *Y* were the averages of the cosine and sine components of direction, respectively, as above. Angular concentration can vary between 0 (low concentration) and 1 (high concentration), with 0 occurring if directions are uniformly distributed on the circle, and 1 occurring if all directions are coincident. Angular standard deviation (Mardia 1972) was calculated as

$$s = \sqrt{-2\log_e(r)}$$

Ninety-five percent confidence intervals for mean direction were calculated using bootstrapping (Manly 2006). In particular, 1000 bootstrap samples were taken in which the data were sampled with replacement, the mean direction was calculated for each sample, and the lower and upper 95% confidence limits were calculated as the 2.5th and 97.5th percentiles, respectively.

Target Density

Radar reflectivity representing target density was averaged in various ways to make comparisons between sample areas or radar stations, by radar elevation, hour of the night, date, season, or year. In all cases, means and standard errors were calculated for graphical presentation. Serial correlation in reflectivity was not assessed, nor were standard errors corrected for such correlation. Reflectivity was not converted to bird density since such conversion is based on the important assumptions that target size is known and is uniform (Chilson and Adams 2014). Furthermore, conversion does not facilitate comparisons within this study.

RESULTS

After eliminating radar scans due to precipitation or other problems, 24,029 scans remained for analysis. In this case, a single scan refers to the data collected at both the 0.5 degree and 1.5 degree elevations, and a scan would have been retained for analysis if there were useable data in at least one of the sample areas at one elevation, though for most scans, there was useable data in all sample areas at both elevations. There were roughly equal numbers of scans at the two stations, 12,285 at KCLE and 11,744 at KBUF (Table 2). However, number of scans differed by season: 9,857 in the spring, and 14,172 in the fall. In part, the smaller number of scans in the spring was due to shorter nighttime periods in that season. Table 3 summarizes the number of scans with useable data by sample area and radar elevation as well as season and year. For instance, for the Project Area, in spring 2014, there were 1,525 scans at the 0.5 degree elevation and 1,458 scans at the 1.5 degree elevation.

Table 2. Number of radar scans by station, season, and year

Season	Year	KCLE	KBUF	Total
Spring	2014	1834	1974	
	2015	1551	1720	
	2016	1798	980	
	Total	5183	4674	9857
Fall	2013	2364	2323	
	2014	2235	2075	
	2015	2503	2672	
	Total	7102	7070	14172
Total		12285	11744	24029

Table 3. Number of scans with useable data by sample area, season, year, and radar elevation. Sample areas are designated as in Figure 2: PA = Project Area; CA = Comparison Area.

Season	Year	Elevation	KCLE				KBUF		
			PA	CA1	CA2	CA3	CA4	CA5	CA6
Spring	2014	0.5°	1525	1573	1558	1573	1667	1816	1688
		1.5°	1458	1614	1610	1638	1378	1429	1300
	2015	0.5°	1180	1344	1305	1337	1496	1542	1516
		1.5°	1075	1246	1189	1262	1414	1475	1451
	2016	0.5°	1433	1499	1490	1517	696	876	706
		1.5°	1378	1540	1510	1516	535	634	533
Fall	2013	0.5°	1980	1989	1989	1991	1615	1601	1617
		1.5°	1907	1983	1942	1989	1936	1932	1936
	2014	0.5°	2120	2122	2127	2126	1683	1668	1677
		1.5°	2090	2137	2127	2140	1821	1809	1817
	2015	0.5°	2161	2163	2163	2172	2514	2525	2511
		1.5°	2123	2139	2150	2156	2563	2575	2543

Migration Direction

Target directions are summarized in Figures 4 and 5, and Table 4. Rose plots show the distribution of all direction data by season and radar elevation for KCLE (Figure 4) and KBUF (Figure 5). The corresponding mean directions and associated 95 percent confidence limits are shown by red lines on each plot. In general, target directions were consistent with expected seasonal migration patterns. In the fall, target directions were toward the southwest at KCLE (Figure 4a, c) and toward the south or south-southeast at KBUF (Figure 5a, c). In the spring, target directions were predominantly toward the north-northeast at both stations (Figures 4b, 4d, 5b, 5d). In terms of general patterns and means, target directions were similar at both radar elevations within seasons at each station. However, at KBUF in the fall, mean fall directions did differ somewhat between the two radar elevations. In all cases, there was substantial variation in direction; most of the rose plots show that at KCLE there were targets moving in all directions, irrespective of season and radar elevation. At KBUF, the patterns were more complicated. For instance, in the fall, there were very few targets with northerly headings between 270 degrees and 45 degrees, but otherwise, headings showed fairly wide dispersion (Figure 5a, c).

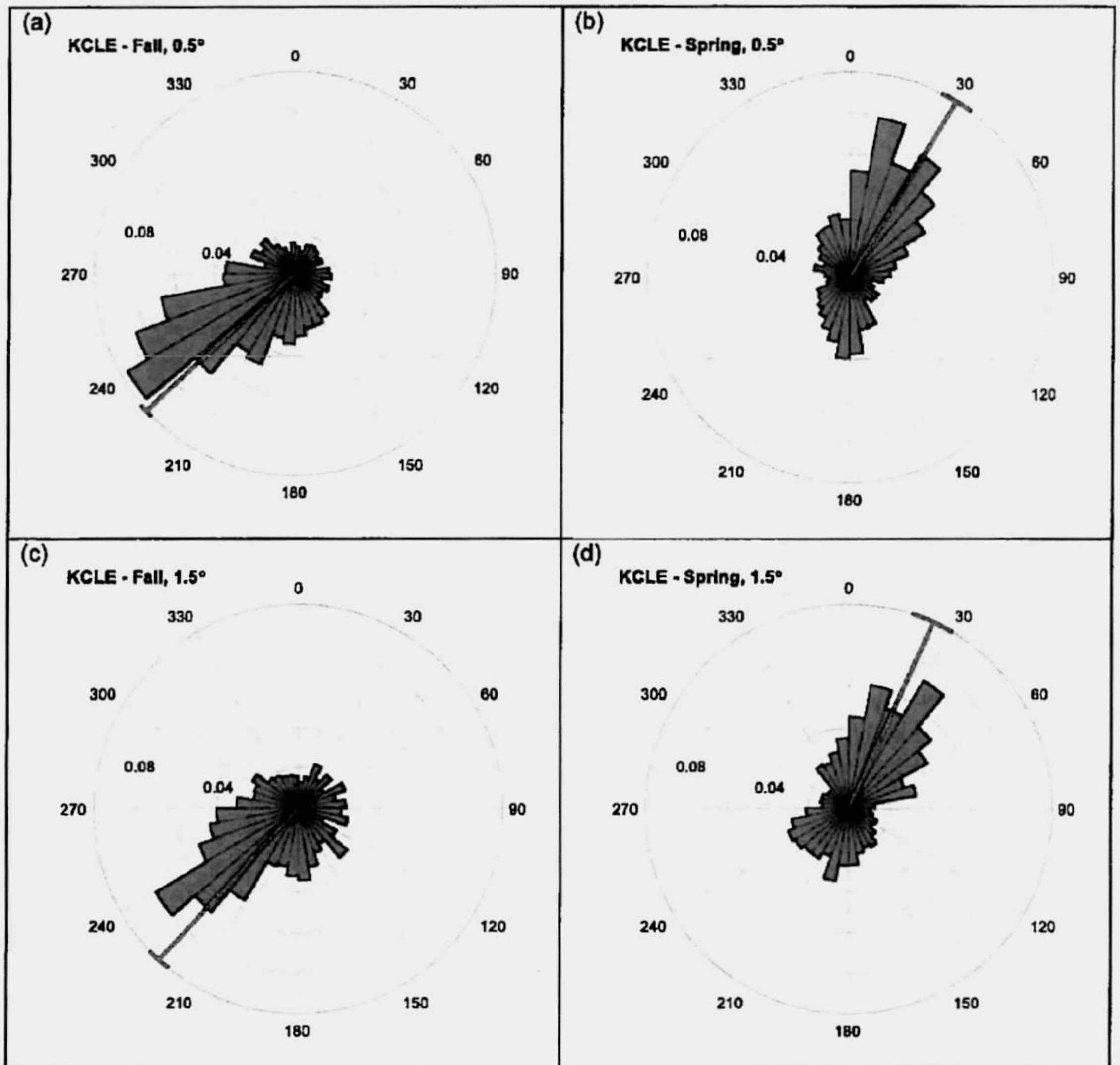


Figure 4. Rose plots showing target movement directions at KCLE at radar beam elevations of 0.5° (a and b) and 1.5° (c and d) in Fall (a and c) and Spring (b and d). Red lines indicate mean direction (radial segment) and 95% confidence interval (perpendicular "T" segment).

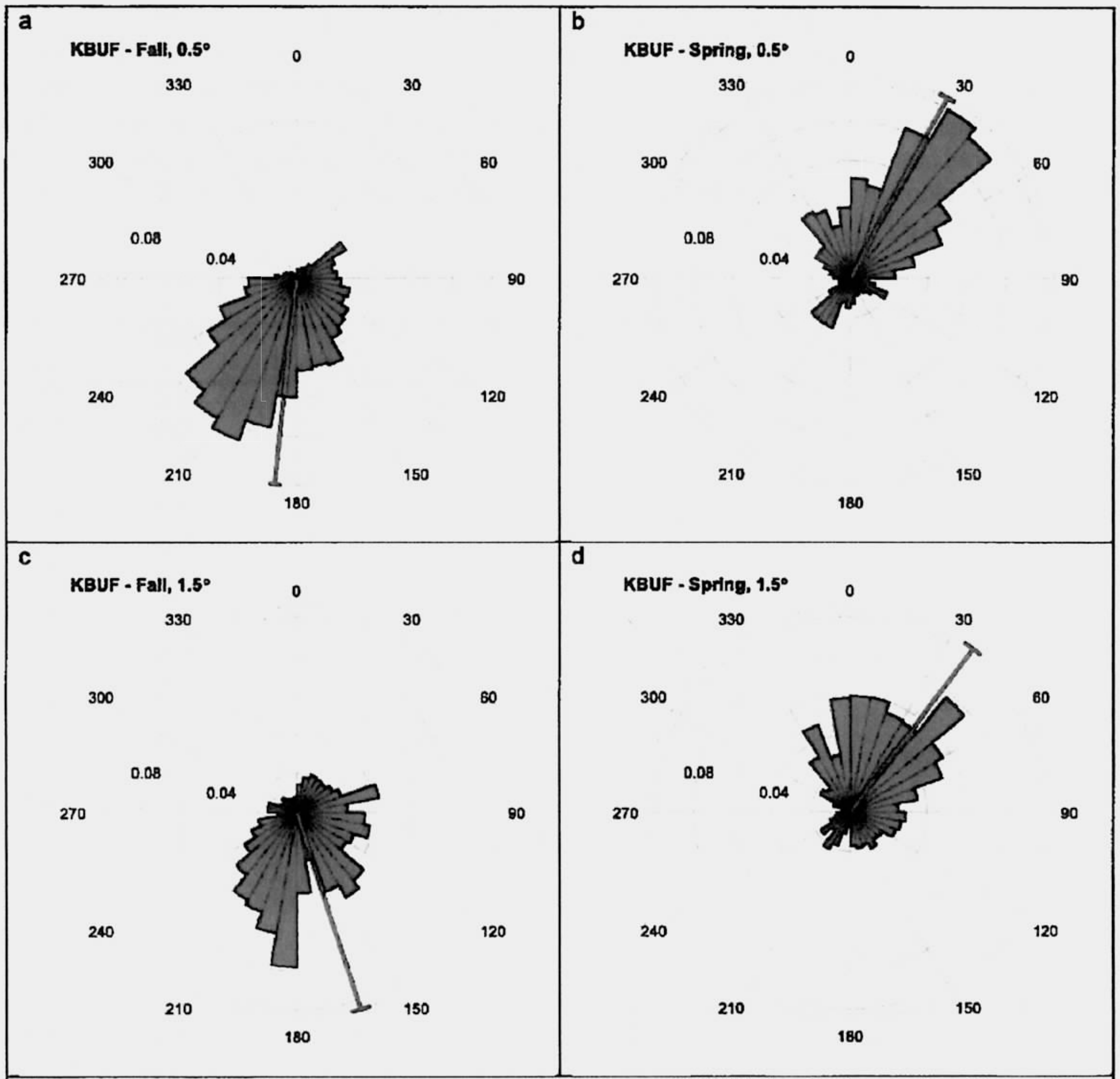


Figure 5. Rose plots showing target movement directions at KBUF at radar beam elevations of 0.5° (a and b) and 1.5° (c and d) in Fall (a and c) and Spring (b and d). Red lines indicate mean direction (radial segment) and 95% confidence interval (perpendicular "T" segment).

Table 4 provides statistical summaries (mean, concentration, and standard deviation) of direction by radar station, elevation, season, and year. For the most part, mean annual directions are consistent with the overall patterns in Figures 4 and 5. However, mean directions at KCLE in spring 2014 did not follow the expected pattern; that is, mean target headings were toward the southeast (154.5°) at the 0.5 degree elevation and toward the south-southwest (206.2°) at the 1.5 degree elevation. While there was also substantial variation in spring 2014 at KCLE; note that *r* was exceptionally low and, correspondingly, that *s* was high. More generally, target directions showed fairly high variability (low concentration); in most cases in Table 4, *r* was less than 0.5.

Table 4. Radar target direction summary: mean, concentration (*r*), and standard deviation (*s*) by station, season, year, and radar elevation.

			KCLE			KBUF		
Season	**Year**	**Elevation**	**Mean (°)**	***r***	***s* (°)**	**Mean (°)**	***r***	***s* (°)**
Spring	2014	0.5°	154.5	0.14	113.9	18.5	0.43	74.9
		1.5°	206.2	0.17	107.3	30.7	0.43	74.0
	2015	0.5°	14.1	0.41	76.3	43.3	0.54	63.7
		1.5°	14.9	0.40	77.3	49.1	0.46	71.7
	2016	0.5°	29.6	0.35	83.1	12.7	0.32	86.1
		1.5°	34.9	0.31	87.3	14.1	0.27	93.0
	All Years	0.5°	31.2	0.21	100.7	28.5	0.43	74.1
		1.5°	24.2	0.16	110.4	37.3	0.40	77.1
Fall	2013	0.5°	244.0	0.33	85.8	187.5	0.61	57.1
		1.5°	248.6	0.22	99.5	159.6	0.27	92.4
	2014	0.5°	219.2	0.49	68.4	199.5	0.68	50.5
		1.5°	217.1	0.38	79.6	175.3	0.36	82.3
	2015	0.5°	225.5	0.38	79.3	170.5	0.43	74.7
		1.5°	209.4	0.22	99.1	155.2	0.44	73.6
	All Years	0.5°	227.6	0.40	78.0	186.1	0.54	63.8
		1.5°	222.8	0.27	93.2	161.8	0.36	81.9

Migration Intensity

Migration intensity as represented by mean reflectivity varied among the seven sample areas at the two radar stations (Table 5, Figure 6). Overall mean reflectivity, averaged across season, year, and radar elevation, was lowest at the Project Area at KCLE (Figure 6a). Reflectivity was approximately twice as high at the two sample areas at KCLE overlapping the lakeshore (Comparison Areas 1 and 2) and somewhat greater at the inland sample area (Comparison Area 4). Mean reflectivity was highest at the two nearshore sample areas at KBUF (Comparison Areas 4 and 5), approximately eight times greater than mean reflectivity at the Project Area. At the inland KBUF sample area (Comparison Area 6), reflectivity was much lower than at the other two KBUF sample areas, though it was approximately 1.5 times greater than at the Project Area.

Table 5. Reflectivity by sample area (PA = Project Area, CA = Comparison Area). Each cell contains mean (top) and standard error (bottom) of reflectivity. (See also Figure 6.)

		KCLE				KBUF		
		PA	**CA1**	**CA2**	**CA3**	**CA4**	**CA5**	**CA6**
Overall		7.85 0.09	18.33 0.28	18.12 0.19	22.39 0.37	62.09 2.18	65.07 1.85	12.73 0.18
Elevation	0.5°	11.14 0.16	26.69 0.53	27.85 0.33	32.91 0.70	116.85 4.28	120.31 3.59	18.14 0.31
	1.5°	4.44 0.09	9.95 0.15	8.30 0.14	11.84 0.17	7.18 0.14	8.86 0.20	7.25 0.16
Season	Spring	6.44 0.13	16.13 0.58	16.11 0.28	20.63 0.76	65.71 3.66	56.14 2.64	6.89 0.15
	Fall	8.77 0.13	19.88 0.25	19.51 0.26	23.62 0.32	59.94 2.71	70.81 2.53	16.21 0.27
Year	2013 – 2014	6.02 0.12	15.55 0.33	14.42 0.29	19.22 0.47	116.69 5.38	103.15 4.36	13.07 0.29
	2014 – 2015	9.58 0.20	20.31 0.35	20.82 0.36	21.66 0.42	58.88 3.39	75.74 3.25	12.49 0.31
	2015 – 2016	8.05 0.16	19.21 0.68	19.23 0.34	26.16 0.87	8.25 0.22	15.55 0.59	12.63 0.34

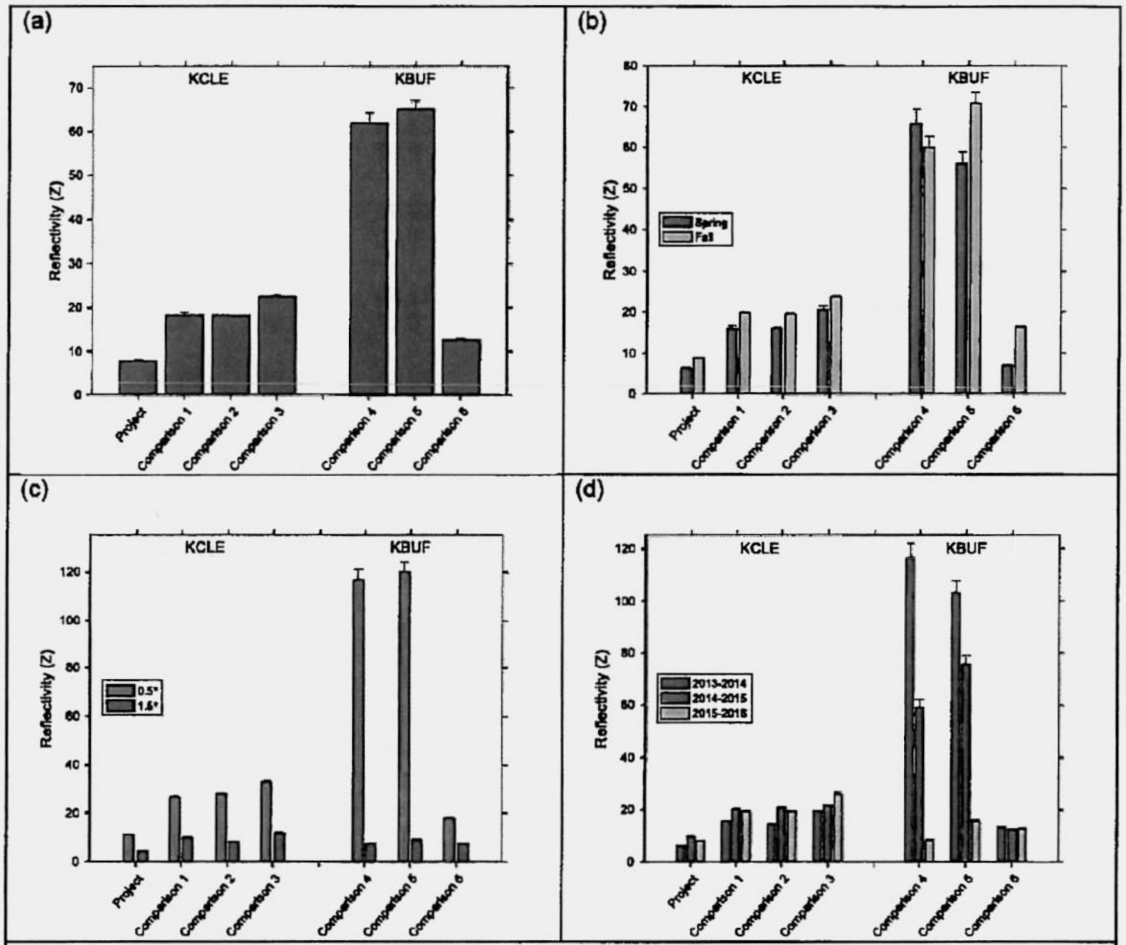


Figure 6. Mean reflectivity (bar heights) plus 1 standard error (error bars) at the seven sample areas:
(a) degrees overall – averaged across season, year, and elevation
(b) by season – averaged across year and elevation
(c) by elevation – averaged across season and year
(d) by year – averaged across season and elevation.

Reflectivity showed moderate seasonal variation at each of the sample areas, and was generally higher in the fall than in the spring, except at Comparison Area 4, where reflectivity was greater in the spring (Table 5, Figure 6b). For the seasonal analysis, reflectivity was averaged across year and radar elevation.

At each sample area there was substantial difference in mean reflectivity depending on radar elevation (reflectivity averaged across year and season) (Table 5, Figure 6c). In particular, reflectivity was at least twice as great at the 0.5 degree elevation as at the 1.5 degree elevation, though at Comparison Areas 4 and 5, the differences were particularly pronounced. That is, target densities were much greater at lower heights above the lake or land surface. In general, the differences among the sample areas seen in Figure 6a are due to reflectivity differences at the lower radar elevation (Figure 6c). At the greater radar elevation, the differences in reflectivity among the sample areas are relatively small.

For most of the sample areas, there was little to moderate annual variation in mean reflectivity (averaged across season and radar elevation) (Table 5, Figure 6d). Here, a year was arbitrarily defined as a fall season and the succeeding spring season, e.g., fall 2013 through spring 2014, such that there were three years of data. Interestingly, the annual variation in reflectivity was substantial at Comparison Areas 4 and 5; it can be seen that the high overall reflectivity at these two areas was due to exceptionally high values in 2013-2014, and 2014-2015. In contrast, mean reflectivity in 2015-2016 at these two areas was similar to values at the other sample areas.

Mean reflectivity varied by time of night, as defined by an hour after civil sunset, at both KCLE and KBUF, in both fall and spring (Figure 7). At KCLE, reflectivity increased each hour until five hours after civil sunset, and thereafter decreased hourly in both seasons (Figure 7a, b). At KBUF, the hourly pattern varied with season. In the fall, there was little if any initial increase, though reflectivity decreased from four hours after civil sunset until daylight (Figure 7c). In the spring, reflectivity increased until about seven hours after civil sunset, changed little for the next few hours, and then decreased substantially in the last hour before daylight (Figure 7d).

Reflectivity varied substantially by date throughout each season (Figures 8-11). No clear patterns are evident in the fall (panel a in Figures 7-10). In the spring, there is little activity throughout April compared to May, particularly at the Project Area (Figure 8b) and Comparison Area 2 (Figure 9b).

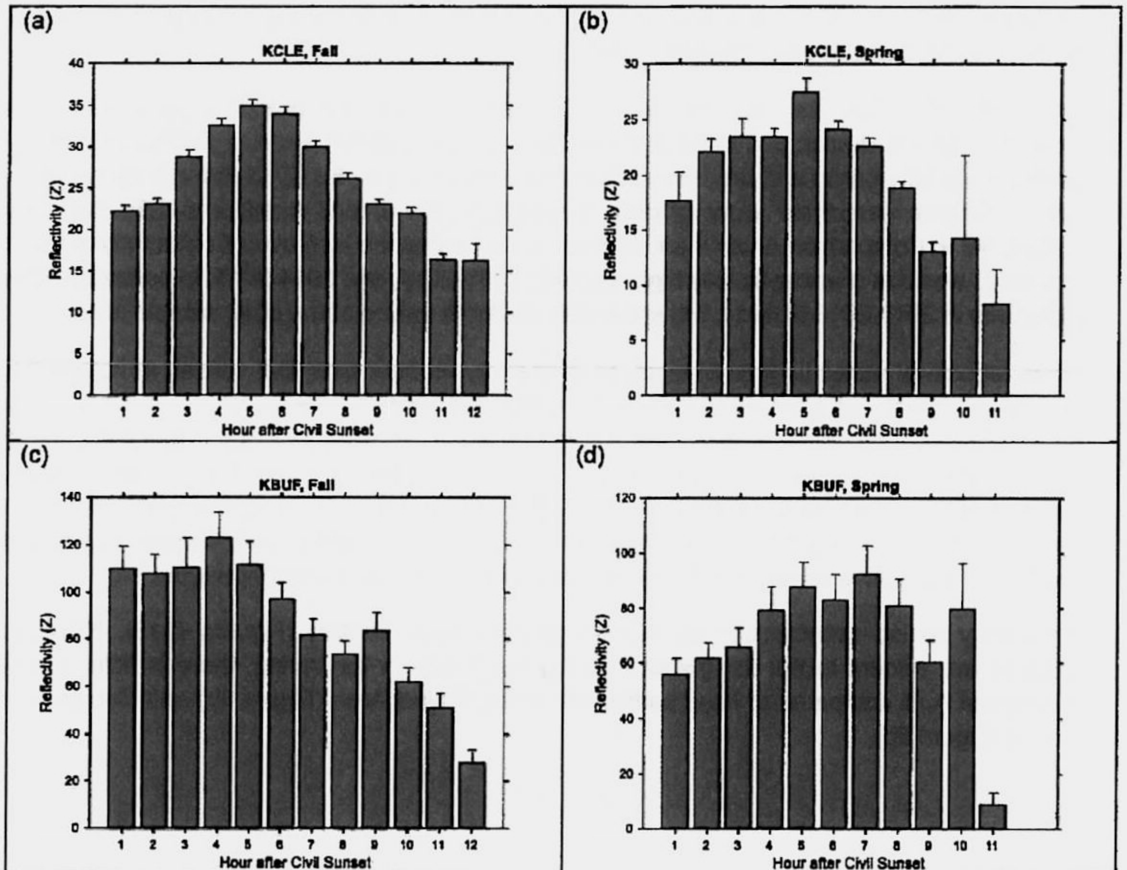


Figure 7. Mean reflectivity (bar heights) plus 1 standard error (error bars) by hour after civil sunset at KCLE and KBUF
(a) KCLE in fall
(b) KCLE in spring
(c) KBUF in fall
(d) KBUF in spring
All plots represent 0.5° elevation averaged across year and sample area. Note different Y-axis scaling in each plot.

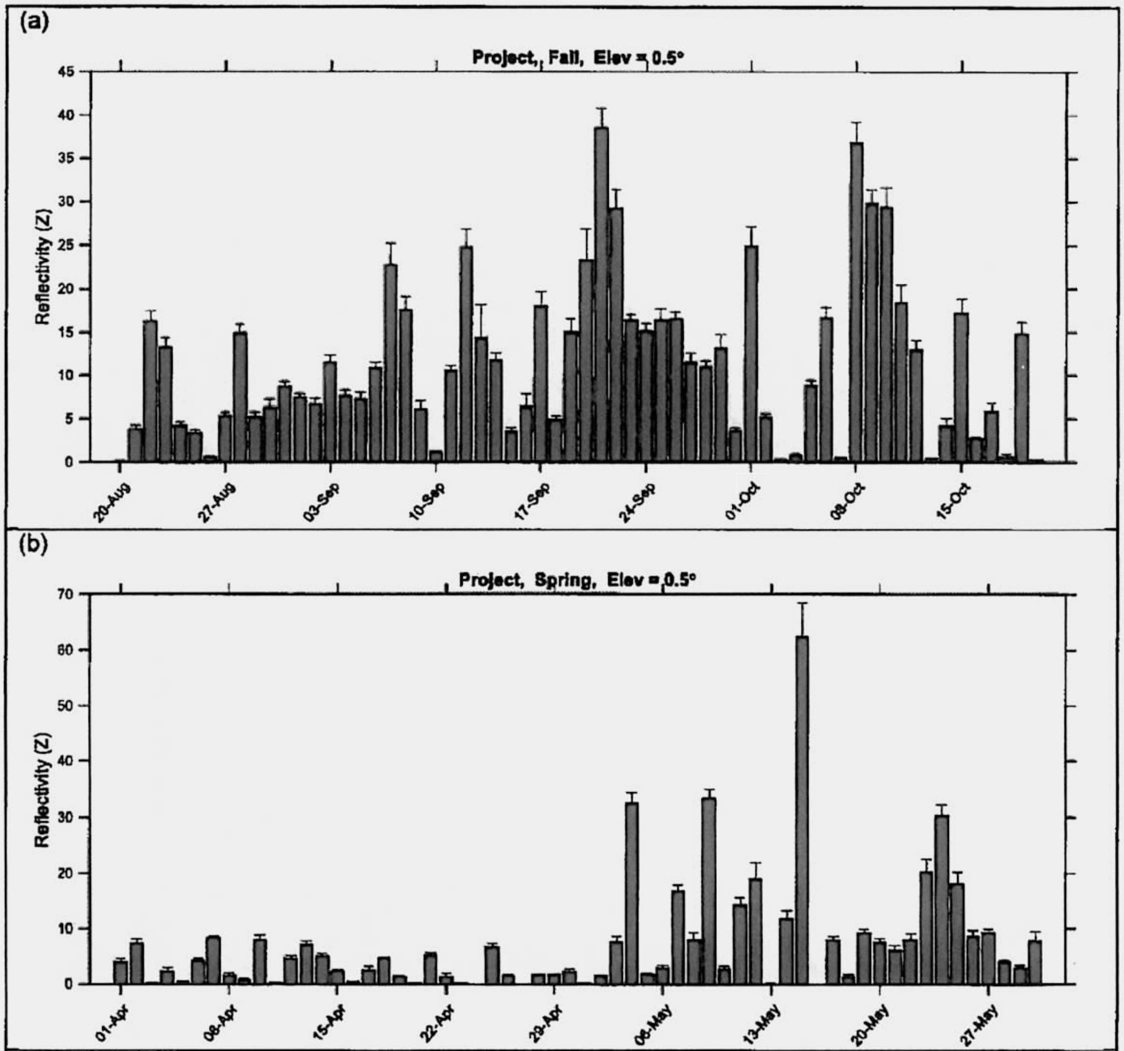
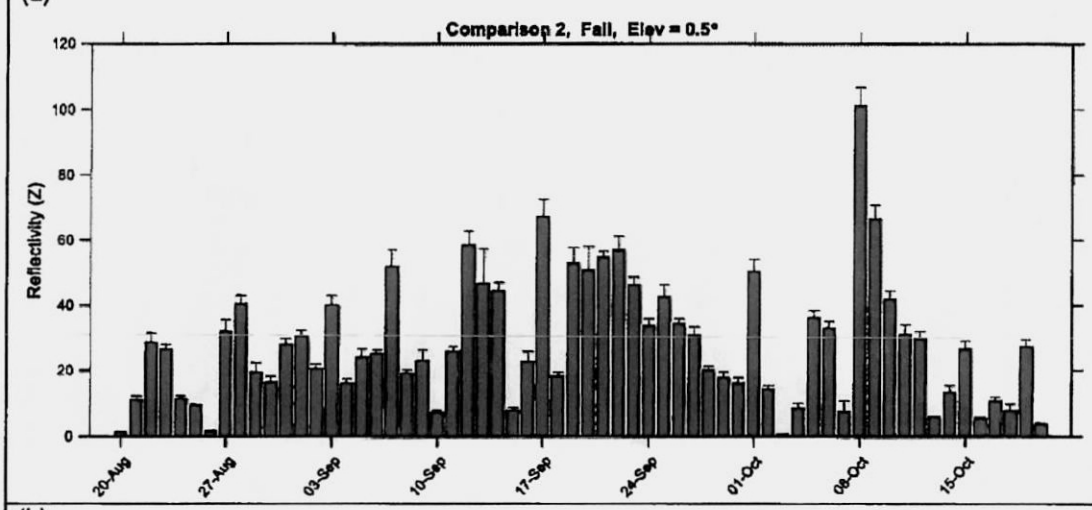


Figure 8. Mean reflectivity by day at the Project Area (KCLE) in (a) fall and (b) spring. Both plots represent 0.5° elevation averaged across year. Note different Y-axis scaling in each plot.

(a)



(b)

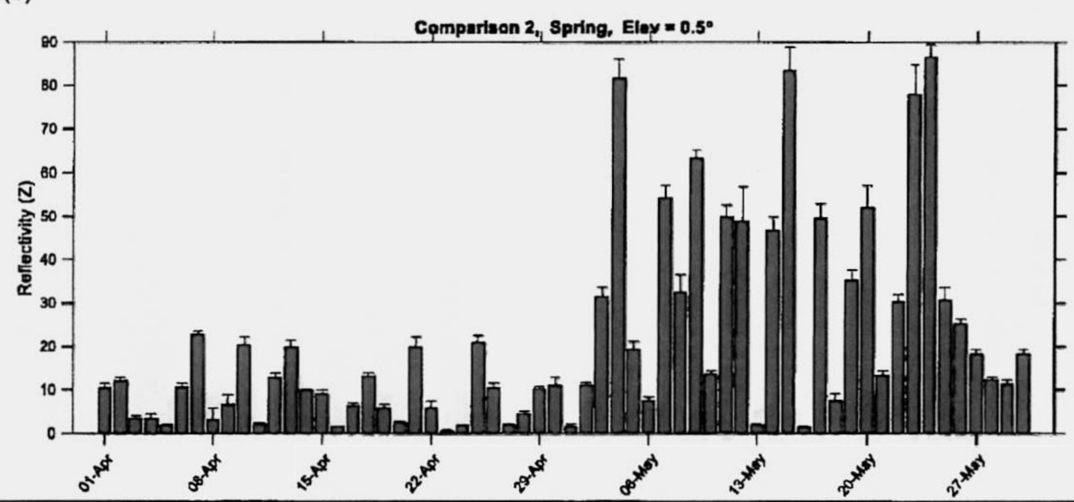


Figure 9. Mean reflectivity by day at Comparison Area 2 (KCLE) in (a) fall and (b) spring. Both plots represent 0.5° elevation averaged across year. Note different Y-axis scaling in each plot.

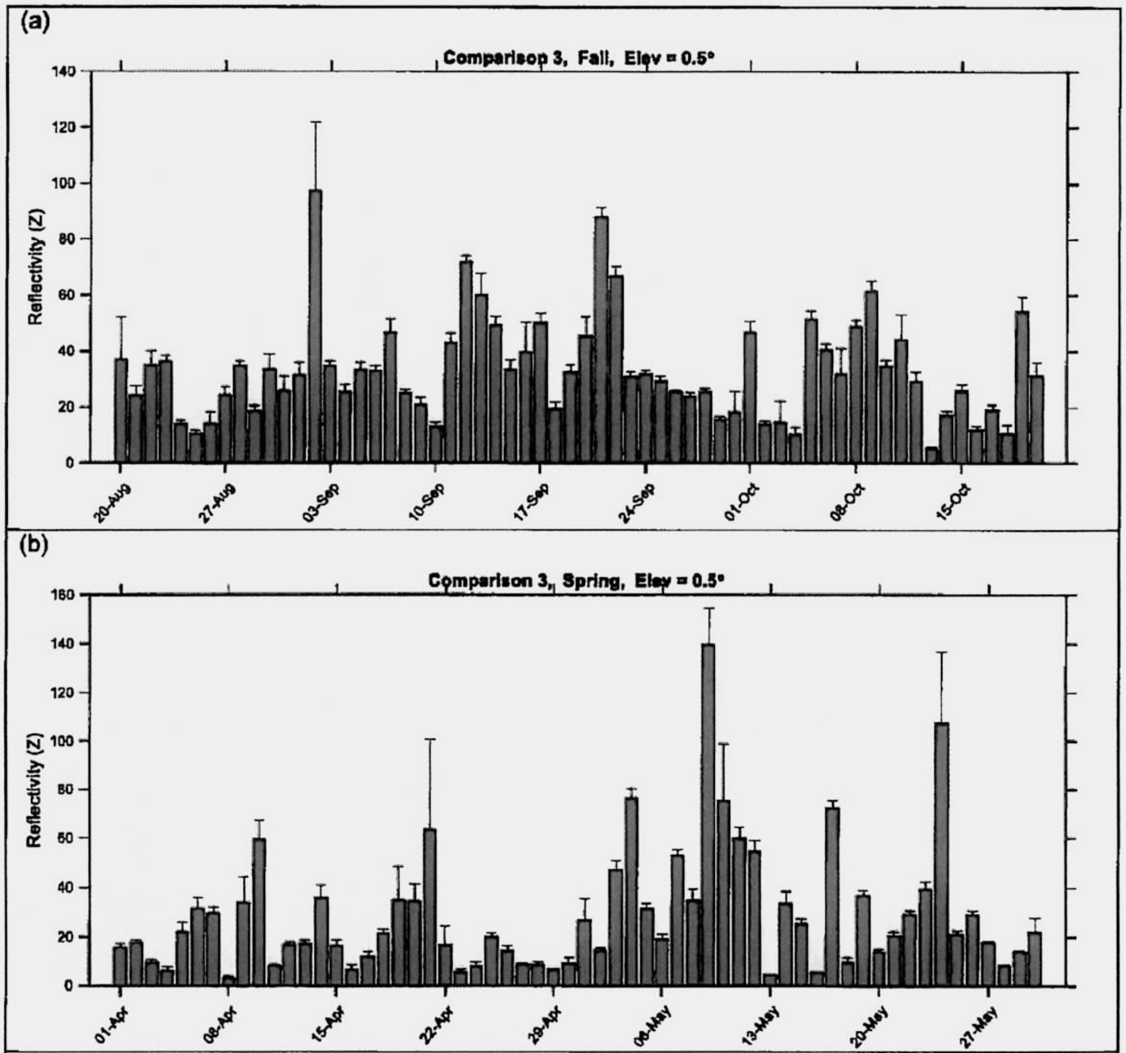


Figure 10. Mean reflectivity by day at Comparison Area 3 (KCLE) in (a) fall and (b) spring. Both plots represent 0.5° elevation averaged across year. Note different Y-axis scaling in each plot.

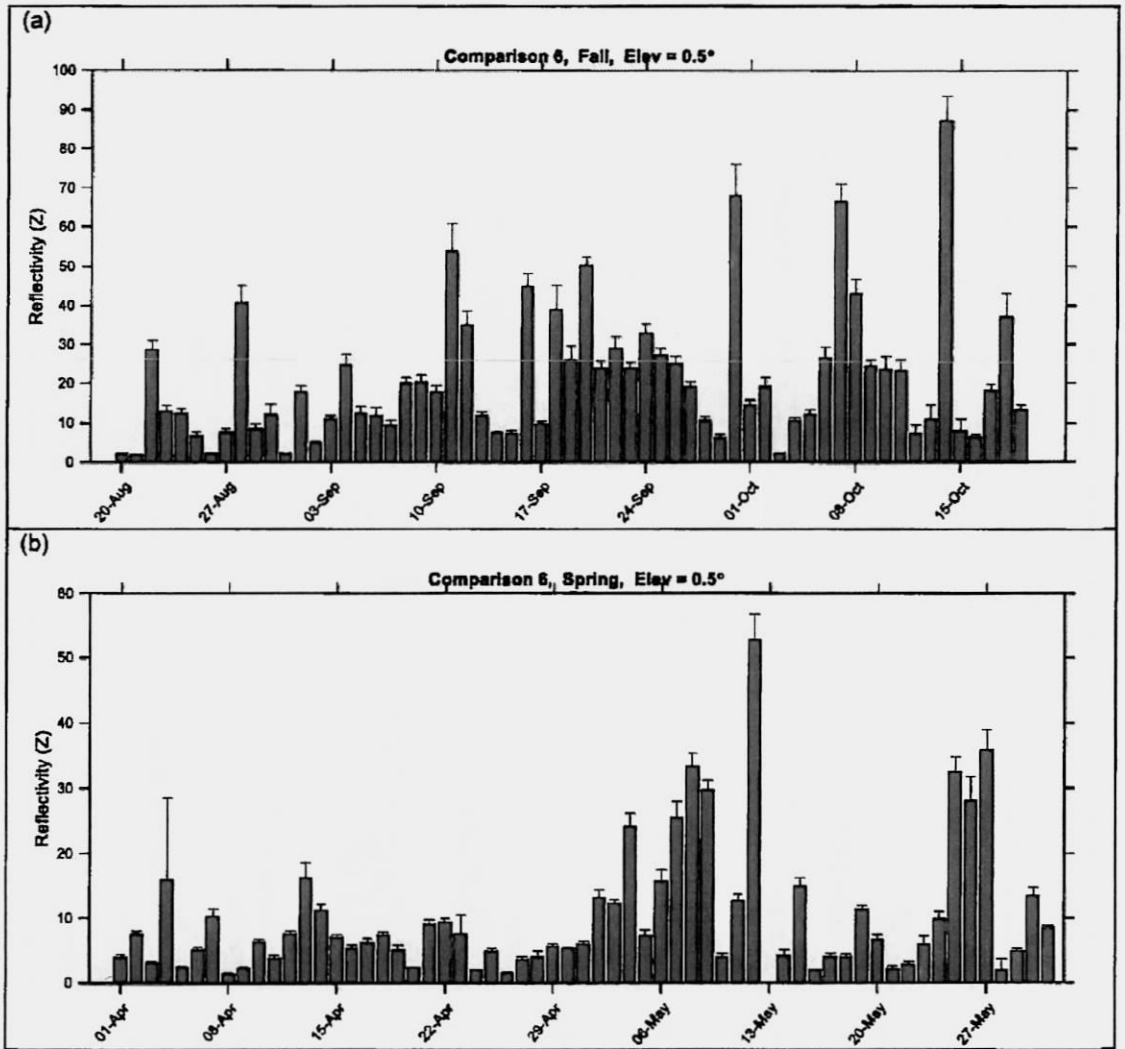


Figure 11. Mean reflectivity by day at Comparison Area 6 (KBUF) in (a) fall and (b) spring.
Both plots represent 0.5° elevation averaged across year.
Note different Y-axis scaling in each plot.

DISCUSSION

Caveats

The methods used here make at least two important assumptions. First, wind speed and direction from both radiosonde and wind models are assumed to be uniform over large spatial and temporal scales. That is, the wind is assumed to be constant over the region scanned by the radar for a relatively long period (up to 12 hours). Spatial and temporal variation in wind patterns will lead to errors in velocity filtering, which is intended to separate birds from slower-moving targets. Second, movement characteristics of radar targets (i.e., speed and direction) are treated as effectively uniform over large regions. Finer scale variation in target direction, velocity, or density will be obscured in this processing.

There are several other important limitations to this analysis. It cannot distinguish individual targets, nor can it distinguish birds from bats, nor any other target that might move faster than measured wind speed. Furthermore, the velocity filter is a fairly crude tool. For instance, slow-moving targets, such as birds soaring on the wind, will be automatically removed. Also, NEXRAD cannot detect targets that are close to the ground, except at very close range. In the case of KCLE, most near range data will necessarily be over land, or close to shore over Lake Erie.

Summary and Conclusion

Results from this analysis show that overall migration intensity inferred from mean reflectivity was lowest above the Project Area among all seven sample areas (Figure 6a). That relationship was also true when reflectivity was averaged by season (Figure 6b), radar elevation (Figure 6c), and year (Figure 6d). That is, migration intensity was lower at the Project Area than at all of the comparison sample areas in both spring and fall, at radar elevations of both 0.5 degrees and 1.5 degrees, and in all three years. Though, notably, migration at Comparison Area 6 in the spring was only slightly greater than at the Project Area in the same season (Figure 6b), and migration at Comparison Area 4 in 2015-2016 was only slightly greater than at the Project Area in the same year (Figure 6d).

At the KCLE station in Cleveland, the inland sample area, Comparison Area 3, had the greatest overall migration intensity, while the two areas above the shoreline, Comparison Areas 1 and 2, had migration that was intermediate to the inland and offshore areas (Figure 6a). Again, these patterns held true by season, radar elevation, and year (Figures 6b, 6c, 6d).

At the KBUF station in Buffalo, Comparison Areas 4 and 5, which were completely and partly above water, respectively, had much greater migration than any of the other sample areas (Figure 6). While this held true for both seasons, at the lower radar elevation, and for two of the three years of the study, it was not true at the 1.5 degree radar elevation nor in the last year (2015-2016). In those conditions, migration was generally greater in the other Comparison Areas. Thus, for the most part, the relative migration intensity at over-water and inland sites at KBUF was the reverse of the spatial pattern at KCLE. While the reason for these differences is not clear, it is noteworthy that Comparison Areas 4 and 5 at KBUF are situated at a very narrow section of Lake Erie at the eastern end of the Lake. Comparison Area 4 is entirely above water, but close to land on three sides (Figure 2b). The distance from south to north shore at this narrow end of the lake is less than 10 km.

Livingston (2008) conducted a study at KCLE for the proposed Icebreaker Wind Energy Facility. The methods in that earlier study differed from those of the current study in that the earlier study focused on a single sample area above the proposed project and, for that area, used data from the 0.5 degree radar elevation only. No other sample areas at that elevation were examined. Data from the 1.5 degree radar elevation were analyzed, though that analysis included the entire radar sweep, that is, a much larger area over both water and land. Thus, unambiguous comparisons of migration intensities over land and water, and, similarly, comparisons of migration intensities at the two radar elevations are difficult with the Livingston (2008) analysis. That said, the range of migration intensities over both seasons is comparable to values in this study. For instance, if bird densities in the upper panels of Figures 4 and 5 of Livingston (2008) are back-converted to reflectivity (*Z*), then it can be seen that on most nights of both spring and fall, mean reflectivity was less than 20 Z. Furthermore, on most of the remaining nights, mean reflectivity was in the range 20-40 Z. Those results are consistent with nightly variation seen in this study (Figure 8). Also, as in this study, fall migration intensity was generally greater than spring in Livingston (2008) (compare the upper panels of Figure 4 and 5, spring and fall, respectively, in Livingston, 2008).

Diehl et al. (2003) analyzed bird migration in the Great Lakes region using NEXRAD data from three stations (including KCLE and KBUF), and found that bird densities over land were generally greater than over water, consistent with results from KCLE in this study (Table 5 and Figure 6). Diehl et al. (2003) attributed this pattern in relative migration density to lake avoidance. That is, while large numbers of birds flew over the Great Lakes, even larger numbers remained over land during migration in both seasons.

Such avoidance behavior might account for the particularly high migration intensities seen at KBUF in two of the three years of this study. Bird migrating around the east end of Lake Erie might have chosen to cross this narrow section of water where land was nearby in three directions. Notably, while Diehl et al. found higher densities over land than over Lake Erie at both KBUF and KCLE, the difference at KBUF was small and not statistically significant.

In comparing seasonal patterns of migration, Diehl et al. observed that fall densities at KBUF were greater than spring densities over both land and water, though at KCLE densities were greater in spring than in fall. In this longer, three-year study, densities were generally greater in the fall than in the spring at both stations, though these seasonal differences were generally small (Figure 6b).

Results from this study suggest that bird/turbine collision risk for the proposed offshore project is lower than it would be for a similar project located near shore or onshore in the Cleveland area. Furthermore, based on variation in migration intensity, annual variation in risk and seasonal variation, with somewhat higher risk in fall, would be expected. Differences in migration intensity with radar elevation indicate that, at the Project Area, there are more than twice as many birds at the lower 0.5 degree elevation (Figure 6c). While the airspace sampled at this elevation does overlap with the rotor-swept zone, the extent of overlap is small (Figure 3), thus the migrant bird activity detected by this lower beam primarily comes from altitudes immediately above the rotor swept zone of the turbines. Given the limitations of NEXRAD resolution, it is not possible to determine the precise flight altitudes of birds within the radar beam.

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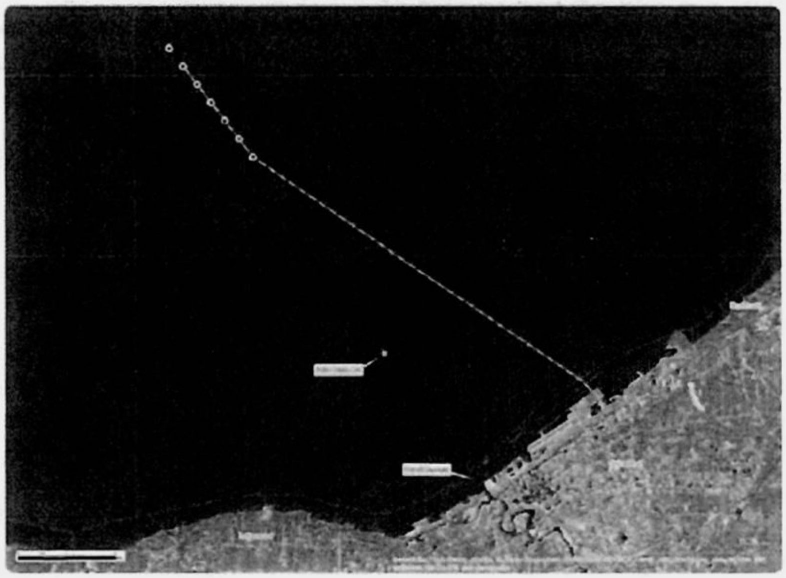
Icebreaker Survey Protocol Matrix

Monitoring Method				Monitoring Objectives (X = primary value, (x) = secondary value)							Monitoring Design			
General type	Specific system	Location	Platform	Bat Collision	Bird Collision	Displacement	Behavioral Attraction/ Avoidance	Exposure	Species specific data?	Comment	Season	Frequency	Duration	# units
Bat Nets: aerial net/mesh with cameras	Experiment-al (TBD) Limited (e.g. 25 m) radius net/grid for carcass capture, combined with density-weighted area correction	Project site	Turbine(s)	X					Partial	needs to be developed, along with methods for data collection and bias correction	March 15-Nov 15 (ODNR bat season)	continuous, daily photos w game cameras	continuous	3
THUNK: acoustic/vibrational collision detection with cameras	Experi-mental (OSU)	Project site	Turbine(s)	X	X				Partial	Species ID depends on camera components functioning. Not demon-strated in presentation	year-round	continuous	continuous	3
Identiflight Stationary video monitoring	Identiflight (RES-Boulder Imaging)	Project site	Turbine(s)	(x)	(x)		(x)	X	Yes	Designed for diurnal exposure monitoring, collisions and nocturnal would be experimental	year-round	continuous	continuous	2
Aerial High-resolution Imaging Survey	APEM	Project site	Fixed wing plane fly at 600m			X			Yes	Surveys safer and data quality superior to live-observer surveys	Oct 15 - May 15 (ODNR baseline season)	Twice per month (ODNR protocol	1-2 hours	1
Aerial High-resolution Imaging Survey	Hi-Def, Inc - BRI	Project site	Fixed wing plane fly at 600m			X			Yes	Surveys safer and data quality superior to live-observer surveys	Oct 15 - May 15 (ODNR baseline season)	Twice per month (ODNR protocol	1-2 hours	1

Monitoring Method				Monitoring Objectives (X = primary value, (x) = secondary value)							Monitoring Design			
General type	Specific system	Location	Platform	Bat Collision	Bird Collision	Displacement	Behavioral Attraction/ Avoidance	Exposure	Species specific data?	Comment	Season	Frequency	Duration	# units
Aerial Live Observer Survey		Project site	Fixed wing plane fly at 75m			X			Yes	Surveys more hazardous and data quality inferior to imaging surveys (birds disturbed, limited ID, imprecise sample area)	Oct 15 - May 15 (ODNR baseline season)	Twice per month (ODNR protocol	1-2 hours	1
Marine Radar	Detect Merlin (S band in both vertical and horizontal)	3 miles offshore, 5 miles from site	Crib (yr1, turbine yrs 2,3)				(x)	X	No	Detect says can't do it on a boat; Need approval from CLE water dept.; distance from site	Apr 15-May 31, Aug 15-Oct 31 (ODNR songbird migr season)	5 nights/week (ODNR protocol)	continuous	1
Marine Radar	DHI Scanter 5000	3 miles offshore, 5 miles from site	Crib (yr1, turbine yrs 2,3)				(x)	X	No	Would probably need approval from water dept.	Apr 15-May 31, Aug 15-Oct 31 (ODNR songbird migr season)	5 nights/week (ODNR protocol)	continuous	1
Marine Radar	DHI Furuno solid state (horiz) and x band (vert)	Project site	Boat (yr 1 only)					X	No	Boat based radar will have lower data quality; clutter issues; at the site	Apr 15-May 31, Aug 15-Oct 31 (ODNR songbird migr season)	5 nights/week, weather dependent (ODNR protocol)	2 hours/night	1
Marine Radar	Accipiter PS1-8A (X-band, with ability to rotate horiz and vert)	Project site	Boat (yr 1 only)					X	No	Boat based radar pros and cons (see above); provider says it can go on buoy	Apr 15-May 31, Aug 15-Oct 31 (ODNR songbird migr season)	5 nights/week weather dependent(ODNR protocol)	2 hours/night	1

Monitoring Method				Monitoring Objectives (X = primary value, (x) = secondary value)							Monitoring Design			
General type	Specific system	Location	Platform	Bat Collision	Bird Collision	Displacement	Behavioral Attraction/ Avoidance	Exposure	Species specific data?	Comment	Season	Frequency	Duration	# units
Marine Radar	Accipiter PS1-8A (X-band, with ability to rotate horiz and vert)	3 miles offshore, 5 miles from site	Crib (yr1, turbine yrs 2,3)				(x)	X	No	Crib pros and cons	Apr 15-May 31, Aug 15-Oct 31 (ODNR songbird migr season)	5 nights/week (ODNR protocol)	continuous	1
Marine Radar	SRC SR Hawk	3 miles offshore, 5 miles from site	Crib (yr 1, turbine yrs 2, 3)				(x)	X	No	Crib pros and cons	Apr 15-May 31, Aug 15-Oct 31 (ODNR songbird migr season)	5 nights/week (ODNR protocol)	continuous	1
NEXRAD Radar		Project site and comparison sites	KCLE and KBUF Weather Stations					X	No	limited info on target altitude	Apr 15-May 31, Aug 15-Oct 31 (ODNR songbird migr season)	flexible, extensive	continuous	N/A
Bird Acoustics	WA Songmeter SM4	Project site	Buoy (yr1), turbine (yrs 2, 3)					X	Partial		Apr 15-May 31, Aug 15-Oct 31 (ODNR songbird migr season)	continuous	nocturnal	2
Bat Acoustics	WA SM4Bat	Project site	Buoy (yr1), turbine (yrs 2, 3)					X	Partial		March 15-Nov 15 (ODNR bat season)	continuous	nocturnal	2
Stationary Live Observer		Project site	Turbine(s)		(x)		X	X	Yes		Apr 15-Nov 15 (based on suitable weather)	weekly	4 hours	4 people

ICEBREAKER WIND:
SUMMARY OF RISKS
TO BIRDS AND BATS



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WEST Inc.

EXECUTIVE SUMMARY

The Lake Erie Energy Development Corporation (LEEDCo) has proposed the Icebreaker Wind project, a small, demonstration 6-turbine, 20.7-megawatt (MW) offshore wind energy facility eight to 10 miles (13 to 21 kilometers [km]) from the shore of Cleveland, Ohio. WEST has completed a review and summary of baseline data and other publicly available data on bird and bat use and other information of the Project's environment for the purpose or evaluating the level of risk posed by the proposed project to birds and bats. The overall conclusion of this analysis is that the Project poses low risk of adverse impacts to birds and bats. This conclusion stems largely from two principal observations: 1) the Project is small in scale, consisting of six turbines; 2) the level of use of this area by birds and bats is low compared to bird and bat use of terrestrial or nearshore environments.

The potential for *displacement* effects, defined as the transformation of the Project area from suitable habitat to less suitable habitat by virtue of Project construction or operation, was evaluated by examining data on the use of the Project site and other offshore environments in the central Lake Erie basin by birds and bats for activities other than transit, in the context of technical literature on the subject. Our analysis indicated that the risk of displacement effects is likely low for Icebreaker Wind. This is because baseline data have shown that the use of the Project area as a habitat for anything other than migratory transit by any bird species is minimal or negligible. In a baseline aerial survey effort conducted by the Ohio Department of Natural Resources over a large portion of Lake Erie, including the Project site, between 2009 and 2011, only six species of waterbirds were documented within the vicinity of the Project area at densities that can be considered above negligible or occasional. Three of these species were gulls (Bonaparte's Gull, Ring-billed/Herring Gull), with averages roughly between one and five individual birds observed in the Project area and vicinity per survey during the baseline survey effort. For the other three species, (Horned Grebe, Common Loon, and Red-breasted Merganser), averages of roughly one individual or fewer were observed within the Project area and vicinity per survey during the baseline survey effort. At such low densities, statistically significant displacement effects would not likely be detectable with a realistic survey effort. For the same reason, there is not a reasonable likelihood that any such effects could be biologically significant for any species.

The potential for behavioral *avoidance or attraction* effects was evaluated by examining post-construction monitoring results of other offshore wind energy facilities, and by reviewing technical literature on this subject. Behavioral avoidance is defined as the avoidance of the Project by bird or bat species that would otherwise use the Project area strictly for transit. Behavioral attraction is defined as attraction to the Project area by bird or bat species that would otherwise utilize the area less frequently or not at all. The conclusion of our analysis is that Icebreaker Wind does have the potential to generate both behavioral avoidance and attraction effects in some groups of birds or bats. Although the passage rates of migrating birds through the Project area are expected to be lower than on land, along the shore of Lake Erie, or in near-shore waters, some migrating birds and bats from a variety of taxa are likely to migrate through the Project area on a regular basis. After construction some migrating birds and bats may detect the presence of the facility and fly around it. In such cases, the additional energy expenditure of this avoidance behavior is expected to be negligible, as has been demonstrated at offshore wind projects in Europe. Therefore, the potential for adverse effects from this behavior is likely negligible. Other birds and bats flying in the vicinity of the Project area may be attracted to the facility. This is not likely to occur in nocturnal migrant birds, as the Project will utilize flashing red aviation obstruction lights, which do not attract nocturnal migrants or other birds. Attraction effects are more likely to occur with some diurnal waterbirds such as gulls and cormorants, as has been demonstrated in Europe, and may also occur with additional taxa, including bats.

The potential for *collision* effects was evaluated by examining data on the use of the Project site and other offshore environments in the central Lake Erie basin by birds and bats, including merely for transit, contextualized with information on taxon-specific wind-turbine collision susceptibility patterns from technical literature and publicly available post-construction monitoring reports from other wind energy facilities. The overall conclusion of our analysis was that total fatality levels of birds and bats are expected to be lower for Icebreaker Wind than for land-based wind energy facilities in the region. Previous risk analyses and correspondence with the US Fish and Wildlife Service has indicated that no federally listed bird or bat species are likely to be affected. The Project is not likely to generate population-level effects for any species. These conclusions are based primarily on the low use of offshore environments within the central Lake Erie basin by birds and bats, as well as the small size of the Project, and are also influenced by known patterns of taxon-specific collision susceptibility and species' geographic ranges.

No eagles or other raptors regularly forage 8-10 miles offshore, minimizing exposure to collision risk in this group of birds. A small number of eagles and other raptors may be exposed to collision risk if they encounter the Project while migrating across Lake Erie; however, eagles and other raptors tend to avoid migrating over large water bodies such as Lake Erie, and no raptors were documented within 10 miles of the Project area during a 2-year baseline survey effort. Therefore, we conclude that collision risk is low for eagles and other raptors.

For waterfowl and other waterbirds, baseline aerial survey data have shown that the spatial utilization pattern of such birds is largely restricted to the first three to six miles (five to 10 km) from shore in the central/southern Lake Erie basin, with minimal or negligible density of waterfowl and other waterbirds in the vicinity of the proposed Project area. Furthermore, available evidence from both offshore and onshore wind energy facilities indicates that wind turbine collision susceptibility is generally low for these bird types. Certain waterbird species, notably Double-crested Cormorants and several species of gulls, may experience higher levels of exposure to potential collision risk if they are attracted to the Project subsequent to construction, but collision susceptibility is generally regarded to be low for these bird types, hence overall risk is low. Additional insight into the potential for such effects can only be gained from post-construction observations.

For bats, the likely per megawatt bat fatality rate at Icebreaker Wind must be predicted with caution due to the well-known complexity of the relationship between pre-construction bat acoustic activity rates and post-construction bat fatality rates at land-based wind energy facilities in the Midwest and nation-wide. Although bats are primarily terrestrial animals, some species are likely to cross Lake Erie and the Project area on a regular basis, particularly as they are migrating, and the extent to which bats may be attracted to the Project's turbines as they are migrating across the Lake is not well-known and cannot be determined through additional baseline data gathering. The overall bat collision risk is low for Icebreaker Wind, nonetheless, because even if the Project results in fatality rates that are toward the upper end of the distribution of per megawatt bat fatality rates at regional land-based wind projects, the small size of the Project limits the total (facility-wide) bat fatality rate to one that would be moderate, at worst, in relation to land-based wind energy projects in the Great Lakes region.

Nocturnally migrating songbirds and similar birds may be exposed to collisions with Icebreaker Wind's turbines as they migrate across Lake Erie in spring and fall, though the terrestrial habitats of bird species in this category naturally restricts potential collision exposure to migratory flights. As a group, nocturnally migrating songbirds and similar birds exhibit low general susceptibility to collisions with wind turbines. Furthermore, a region-wide analysis of NEXRAD radar data performed by an independent research team of government and academic scientists demonstrated that the density of songbird migration over the central Lake Erie basin was less than one half of what it was over terrestrial environments within the region. Several recent studies employing marine radars in shoreline environments have demonstrated relatively high densities of nocturnal migrant birds along the shorelines of Lake Erie and Lake Ontario, reinforcing our understanding of the tendency of such migrants to concentrate along coastlines and avoid flying over large water bodies, such as Lake Erie, if possible. On the basis of this information, and also in light of the small size of the Project, we conclude that the collision risk for nocturnally migrating songbirds and similar birds is low.

The relationship between pre-construction bird and bat use, or "exposure" data and post-construction collision fatality at wind energy facilities is known to be complex. However, the baseline information on bird and bat abundance in the offshore environment of the central Lake Erie basin can be compared with publicly available, bias-corrected bird and bat fatality rates for land-based wind energy facilities in the Great Lakes region. We applied such comparisons to make rough, quantitative predictions of the collision fatality rates that Icebreaker Wind is likely to generate for bats and birds. Such comparisons indicate that bat fatality rates are most likely to be on the order of one to four bats/MW/year, which would lead to roughly 21 to 83 total bat fatalities/year for the facility. We note that bat fatality rates could be as high as 20-30 bats/MW/year if there is a substantial behavioral attraction effect, but the small size of the Project limits the magnitude of this risk to a moderate level in relation to other regional wind energy facilities even under this worst case scenario. For birds, fatality rates are most likely to be on the order of one or two birds/MW/year, or 21 to 42 total birds/year for the facility. At these levels, the collision fatalities caused by Project Icebreaker do not have a reasonable likelihood of generating a population-level impact for any species of bird or bat, particularly as these fatalities are not likely to affect any listed species, and will be distributed among many species, further lessening the impact on any one species.

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INTRODUCTION

This document presents an analysis of the nature, intensity, and likelihood of risks to birds and bats posed by the development of Icebreaker Wind (also known as the "Project" or "Icebreaker"). Icebreaker is a small-scale wind demonstration project (a six-turbine 20.7-megawatt [MW] facility) that would be located in Lake Erie eight to 10 miles (13 to 21 kilometers [km]) offshore of Cleveland, Ohio. The Project is being developed by the Lake Erie Energy Development Corporation (LEEDCo) and Icebreaker Windpower Inc., a subsidiary of Fred. Olsen Renewables USA. One of the key advantages of developing commercial wind energy facilities in the offshore environment is that bird and bat risks are generally regarded to be lower than on land, as all bats and most birds are generally terrestrial animals (Schuster et al. 2015). Nonetheless, there is still a great deal of uncertainty regarding the potential for offshore wind energy to create adverse impacts on birds and bats, owing partially to the newness of offshore wind energy relative to land-based wind energy development, particularly in the US, and also to the inherent difficulties in gathering data on wildlife risks and impacts in the offshore environment. This uncertainty is one of the primary reasons for constructing a small demonstration project such as Icebreaker Wind as the first offshore wind energy development in the Great Lakes. As such, Icebreaker will be able to serve as a platform for gathering information that will be useful for decision-making regarding future development in the region.

Beginning in 2008, LEEDCo conducted a variety of Project-specific bird and bat baseline studies for the purpose of providing information on the risks posed to birds and bats by the proposed Project to support the risk determinations and permitting processes required by state and federal authorities (Geo-Marine, Inc 2008; Svedlow et al. 2012). These baseline studies have been supplemented by several systematic expert reviews of bird and bat risk issues associated with the Project, in which Project-specific data have been interpreted in the context of available data from independently performed field studies, publicly available databases, and technical literature (Kerlinger and Guarnaccia 2013, Kerlinger 2016). The need for this additional summary stems from the availability of new information germane to bird and bat risk considerations that has arisen or been identified subsequent to the Project's most recent application for a Certificate of Environmental Compatibility and Public Need to the Ohio Power Siting Board in 2014.

The intent of the current analysis is to present an updated synthesis of available information relevant to the consideration of bird and bat risks posed by the Project. All of the information presented in the baseline studies and previous risk analyses for Icebreaker is not fully recapitulated in this document, but all of the available information germane to each risk-related topic has been incorporated into the current analysis, with particular sources of information weighted according to their relevance with regard to addressing the risk-related questions. The analysis is organized by effect type, and then by taxon (for collision effects).

DISPLACEMENT EFFECTS

The potential for generating a displacement effect, defined as the transformation of an area from being suitable habitat to being unsuitable habitat for one or more wildlife species, is an important wildlife risk consideration for some land-based and offshore wind energy facilities (Drewitt and Langston 2006, Strickland et al. 2011). In wind-wildlife literature, such effects are most often associated with wildlife species that are known or hypothesized to avoid occupying areas in which tall structures, or significant anthropogenic activity/disturbance is present. For land-based wind farms in the US, displacement effects have received the most attention in relation to grassland and shrub-steppe obligate species (e.g., Greater and Lesser Prairie-Chickens [*Tympanuchus cupido* and *T. pallidicinctus*], Sage Grouse [*Centrocercus urophasianus*], Grasshopper Sparrow [*Ammodramus savannarrm*]; Strickland et al. 2011, LeBeau et al .2016). In the offshore realm, displacement effects have been hypothesized or examined primarily in certain species of waterfowl and other waterbirds (e.g., loons, alcids) that are known to forage regularly in marine areas where offshore wind facilities have been proposed or installed (Petersen and Fox 2007, Walls et al. 2013). Displacement effects are considered herein in the sense most commonly applied in wind-wildlife literature, referring only to use or avoidance of foraging, roosting, breeding, or wintering habitats. The use or avoidance of areas that are occupied by wildlife species strictly for transit is considered separately below under "behavioral avoidance."

In the case of Icebreaker Wind, there is minimal potential for displacement effects, as there is minimal to negligible utilization of the Project area by any bird or bat species for anything other than transit. This pattern was documented through an aerial baseline survey effort conducted over a two year period (2009-2010 and 2010-2011) by the Ohio Department of Natural Resources (ODNR) over a large portion of the south-central Lake Erie basin, including the Project area (Norris and Lott 2011). This survey effort consisted of weekly, low-altitude (ca. 76 meter [m; 248 foot (ft)]) flights during fall (mid-October through mid-December) and spring (mid-March through mid-May) seasons, with expert observers gathering bird observations from aboard a small twin-engine fixed-wing aircraft flying at a speed of roughly 120 knots (138 miles [222 km] per hour). The 2-year survey effort resulted in a total of 24,395 miles of flight along the transect pattern shown in Figure 1, during which a total of 725,785 individual bird observations was collected, representing at least 51 bird species.

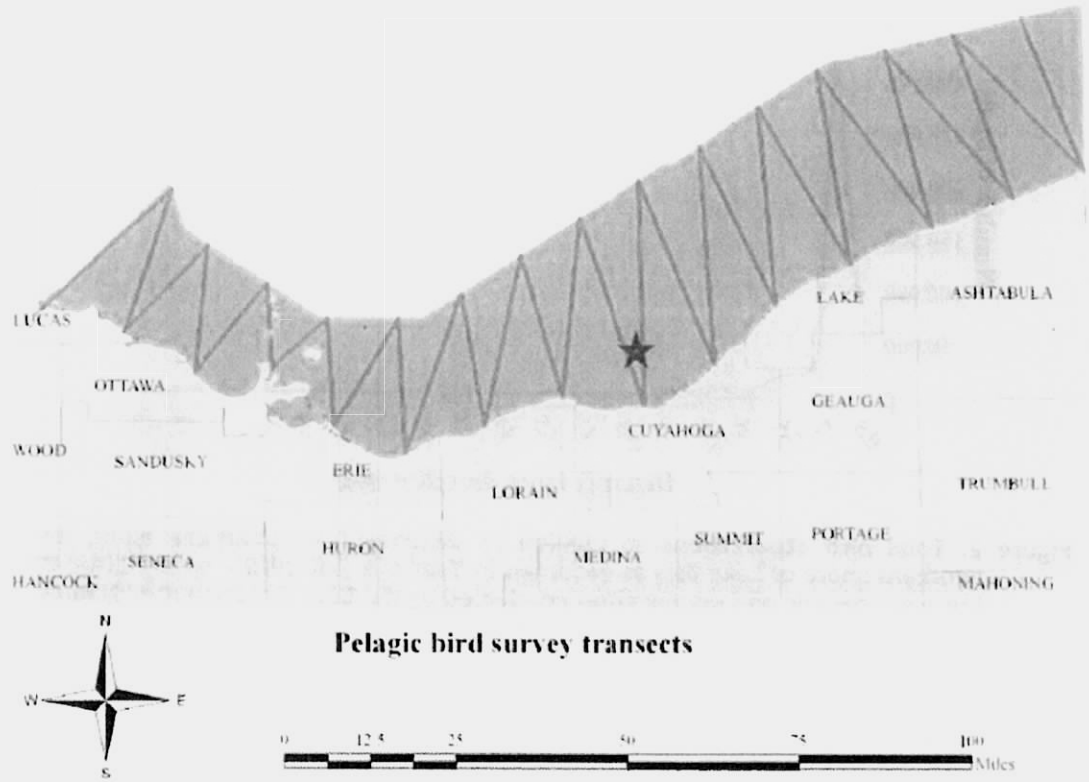

Figure 1. Aerial flight transect pattern flown during the Norris and Lott (2011) pelagic bird surveys in Lake Erie during 2009-2011. The approximate proposed location of Icebreaker Wind is shown by the blue star (Figure reproduced from Norris and Lott 2011).

In order for Icebreaker Wind to have the potential to generate a displacement effect, the Project area must be utilized by wildlife species prior to the construction of the facility. Data from both years of the ODNR survey effort indicate that the abundance of birds was negligible (Year 1) or minimal (Year 2) at distances between eight and 10 miles from shore, corresponding to the zone in which the Project has been proposed (Figures 2 and 3). Examination of species-specific and spatially-explicit patterns in the ODNR survey data (Norris and Lott 2011 appendix C) indicated that the only species that may occur in the vicinity of the Project area on a somewhat consistent basis are Red-breasted Merganser (*Mergus serrator*), Common Loon (*Gavia immer*), Horned Grebe (*Podiceps auritus*), Bonaparte's Gull (*Chroicocephalus philadelphia*), and Ring-billed/Herring Gull (*Larus delawarensis*/*L. argentatus*; Norris and Lott 2011). For the merganser, loon, and grebe, the density of birds in the vicinity of the Project area documented by Norris and Lott (2011) was roughly one bird per survey or lower. For the gulls, the density may have been as high as five birds per survey. At such low densities, a statistically significant displacement effect resulting from the presence of the Project would be difficult to detect. For the same reason, there is no reasonable likelihood that such an effect would be biologically significant for any species.

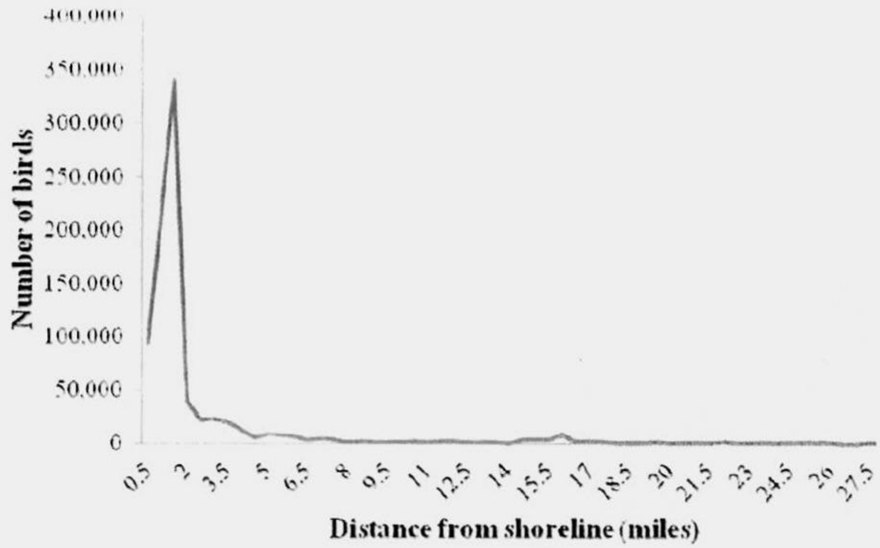

Figure 2. Total bird observations in relation to distance from shoreline along the southern shore of Lake Erie as recorded in Year one (fall 2009 – spring 2010) of the aerial pelagic bird survey effort conducted by the Ohio Department of Natural Resources. (Figure reproduced from Norris and Lott 2011).

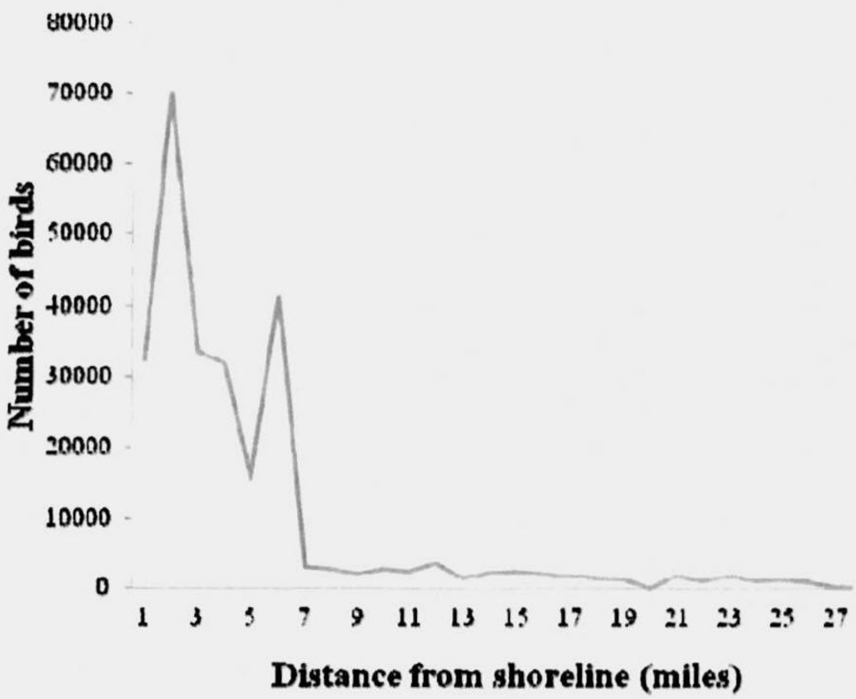

Figure 3. Total bird observations in relation to distance from shoreline along the southern shore of Lake Erie as recorded in Year two (fall 2010 – spring 2011) of the aerial pelagic bird survey effort conducted by the Ohio Department of Natural Resources (Figure reproduced from Norris and Lott 2011).

BEHAVIORAL AVOIDANCE/ATTRACTION EFFECTS

Behavioral avoidance effects are defined herein as the avoidance of a constructed facility by wildlife species whose only utilization of the Project area would be strictly for transit (i.e. passing through on migratory or "commuting" flights). Avoidance of the Project area by species that might otherwise use the area as foraging or roosting habitat is considered separately in this analysis as a displacement effect (see previous section). Behavioral avoidance of a wind facility by a bird or bat may have a beneficial effect, as it will generally reduce collision risk, but it may also generate an adverse effect in the form of increased energy expenditure required to fly around a turbine or the facility.

In the case of Icebreaker Wind, the potential for adverse effects on wildlife from behavioral avoidance is negligible, as the additional energetic expenditure required for migrating birds or bats to fly around the Project will be negligible. This conclusion is based on the findings of Masden et al. (2009), who found that the additional energetic expenditure required for migrating birds to circumvent the Nysted Offshore Wind Energy Facility in the Danish Baltic Sea was negligible in relation to the overall energetic cost of their migratory journey. The Project will occupy a relatively small above-water footprint, consisting of a linear array of six turbines and measuring roughly two miles (three km) in length, substantially smaller than the dimensions of the facility studied by Masden et al. (2009). In addition, the Project's turbines would be spaced at approximately 600 meter intervals, providing space for birds to fly between turbines.

Icebreaker Wind has a high likelihood of generating attraction effects in some species of birds and/or bats, as above water structures in general, and offshore wind turbines in particular, are known to attract certain species for whom such structures may represent places to perch and roost. The phenomenon of bats' potential attraction to wind turbines is still poorly understood, but recent studies have indicated that some bats may be attracted to wind turbines under some circumstances (McAlexander 2013, Cryan et al. 2014). Krijgsveld et al. (2011) demonstrated attraction of cormorants and gulls to the structures of the Egmond aan Zee Offshore Wind Energy Facility in the Netherlands. Several species of gulls and one species of cormorant occur regularly on Lake Erie, and may be similarly attracted to the structures of Icebreaker. Similar to behavioral avoidance, behavioral attraction to offshore wind turbines may have both beneficial and adverse effects on flying wildlife. Beneficial effects may include increased availability of roosting and/or foraging sites in an otherwise inhospitable or unfavorable environment. Adverse effects may include increased exposure to collision risk. One feature relevant to the likelihood of attracting flying wildlife is that flashing red aviation obstruction lighting will be installed on the nacelles of the turbines for Project Icebreaker. Such lighting does not appear to attract nocturnally migrating birds (Kerlinger et al. 2010, Gehring et al. 2012); hence, the Project is not likely to attract substantial numbers of such birds.

COLLISION EFFECTS

It is well-known that some birds and bats can experience mortality or injury due to collisions or near-collisions with wind turbines (Strickland et al. 2011, Schuster et al. 2015). Bird and bat collision fatality rates at land-based wind energy facilities have been particularly well-studied in North America, where intensive and systematic carcass searching studies have been accompanied by sophisticated methods for adjusting the raw data to account for biases caused by limited carcass detectability and carcass removal by scavengers. For birds, recent reviews of bias-corrected fatality rate estimates have indicated a fairly consistent pattern, with an overall average US rate of roughly four to five birds killed per MW of installed wind capacity per year (4.11 birds/MW/year reported by Loss et al. 2013). For bats, there is a greater degree of variation in fatality rates across land-based wind energy facilities, and overall fatality rates are generally higher than they are for birds (Arnett et al. 2013).

Beyond simple rates, one of the most important patterns that has emerged from bird and bat collision fatality studies at land-based wind energy studies to date is that collision susceptibility is highly taxon- or guild-specific for both birds and bats (Strickland et al. 2011, Arnett et al. 2013, Schuster et al. 2015). For many bird species, susceptibility appears to be most closely related to species' overall abundance, and the amount of time a species spends flying within rotor swept altitudes, with an additional influence of behavioral and morphological factors (Strickland et al. 2011). The majority of bird fatalities at land-based wind energy facilities in North America are nocturnal migrants (many songbirds and similar species), and some of the fatalities presumably occur during their high-altitude nocturnal migratory flights, particularly when storms or ascent/descent bring the birds below their normal migratory cruising altitudes (300-500 m [984-1,640 ft]) and into the rotor swept altitudes of commercial wind turbine rotors (Strickland et al. 2011). Certain common birds of agricultural habitats that exhibit tendencies to engage in high altitude flights, and certain widespread and abundant vulture and raptor species, are also commonly found among bird fatalities at land-based wind energy facilities (Strickland et al. 2011). Other birds, particularly species with a high degree of aerial maneuverability, such as swallows and swifts, are rarely encountered as fatalities at wind energy facilities even though they may be very abundant, and may spend a substantial amount of time flying within rotor-swept altitudes (Strickland et al. 2011). Birds that are rare, or that rarely fly within rotor swept altitudes, tend to be rarely encountered as wind-turbine fatalities (Strickland et al. 2011).

For bats, the pattern of collision susceptibility at land-based wind energy facilities in North America is also highly species-specific, but the underlying reasons that drive the pattern are less well-understood than they are for birds. Three species of migratory, tree-roosting insectivorous bats in the family Vespertilionidae (Eastern Red Bat [*Lasiurus borealis*], Silver-haired Bat [*Lasionycteris noctivagans*], and Hoary Bat [*Lasiurus cinereus*]) are among the most commonly found bats in North American wind farm fatality studies, comprising 78% of bat fatalities at US wind energy facilities (Arnett and Baerwald 2013). In these species, most fatalities occur during late summer and fall, typically late July through late September, a period that corresponds to fall migration and initiation of mating activities (Fleming and Eby 2003, Cryan and Barclay 2009). By contrast, many other species, particularly bats in the genus *Myotis*, are found as wind turbine collision fatalities much more rarely, for reasons not yet fully understood (Arnett et al. 2008, 2010, 2013).

In the offshore realm, the carcass-searching field study methodologies that have advanced our scientific understanding of bird and bat fatality rates at land-based wind energy facilities are generally unavailable. Direct monitoring of bird and bat fatalities has rarely been attempted at European offshore wind energy facilities to date. In one of the first and best known attempts, Mark Desholm and colleagues developed the Thermal Animal Detection System (TADS), and deployed it at the Nysted Offshore Wind Energy Facility in the Danish Baltic Sea. In vertical (collision) viewing mode, the system's infrared monitoring field of view covered roughly one third of the rotor of a single turbine, and it was deployed in this way for intensive monitoring periods during the peak period of spring and fall sea duck migration over a three year period (2004-2006; Desholm 2006). In spite of the fact that this facility is located within a major flight corridor for migrating sea ducks, with an estimated 235,136 Common Eiders (*Somateria mollissima*) passing by in the vicinity of the wind farm each autumn, no sea duck collisions were recorded during this monitoring effort in 1,086 hours of direct observation in collision-viewing mode (Desholm 2006). Only one collision event of any kind was recorded during this monitoring effort, a collision of a single small bird or bat (Desholm 2006). Perhaps influenced by this result, avian impact studies at European offshore wind energy facilities in recent years have focused on collision risk modeling efforts, in which bird passage rates are combined with collision avoidance rates to "predict" collision fatality rates (Cook et al. 2014). To date, no offshore wind energy facilities in Europe or elsewhere have reported bird or bat fatality rates generated from direct observations of bird or bat collisions with operating offshore wind turbines, though there are a variety of emerging remote sensing systems that show varying degrees of potential for producing such data in the future (see reviews by Collier et al. 2011, Sinclair et al. 2015).

Although empirical validation of predicted collision fatality rates has not yet been attained for an offshore wind energy facility, information on the turbine collision/avoidance probabilities for various bird taxa from European offshore wind studies, combined with known bird and bat fatality patterns from land-based wind energy facilities in North America, provides a reasonable foundation for assessing the levels of collision risk likely to be experienced by various bird and bat taxa from Icebreaker Wind. In the sections that follow, collision risk is reviewed for four separate categories of birds and bats, representing the bird and bat types of the highest potential interest with regard to potential collision risk from Icebreaker. In these discussions, the overall risk evaluations (e.g. "high" "moderate" "low") refer to how the range of potential fatality rates likely to be generated by Icebreaker Wind compares to fatality rates that have been documented at typical land-based wind energy facilities in the region.

We note that low collision risk for any ESA-listed species of birds or bats was established in earlier risk analyses for the Project (Guarnaccia and Kerlinger 2013, Kerlinger and Guarnaccia 2013), and was acknowledged by the USFWS (2014). For this reason, the discussion of risk to ESA-listed species is not repeated in the present analysis.

Eagles and Other Raptors

The level of collision risk for eagles or any other species of raptor at Icebreaker Wind is low, primarily because no species of eagle or other raptor regularly utilizes offshore environments eight to 10 miles from shore. Although Bald Eagles (*Haliaeetus leucocephalus*) and Osprey (*Pandion haliaetus*) regularly forage over water for fish, both of these species are typically restricted to areas within several miles of shore (Buehler 2000, Poole et al. 2016). This general pattern was evidenced specifically for the Project site and vicinity by the boat-based avian baseline surveys conducted in nearshore waters near the Project site during 2010 (Svedlow et al. 2012) and the aerial avian baseline surveys conducted in 2009-2011 by the ODNR (Norris and Lott 2011), neither of which resulted in any observations of any raptors within 10 miles of the Project area.

The potential for Bald Eagles or other raptors to be exposed to any risk of collision with Icebreaker's turbines is therefore almost exclusively limited to migratory transits of these species across Lake Erie (but see also waterfowl and ice discussion in the next section). Bald Eagles and a variety of other migratory raptor species may occasionally cross the open water of Lake Erie during migration. Nonetheless, such crossings are expected to be uncommon in the vicinity of Icebreaker Wind, as raptor migration in general (Kuvlesky et al. 2007), and specifically within the Great Lakes region (Hawk Migration Association of North America [HMANA] 2016) tends to be heavily concentrated along shorelines and at narrows and peninsulas due to the tendency of raptors to avoid migrating over large water bodies (Kerlinger 1989).

To the extent that a small amount of exposure of Bald Eagles and other raptors to potential collision risk at Project Icebreaker does exist, given the small project size, and offshore location, risk is anticipated to be low. In a recent review, Pagel et al. (2013) reported that a total of six Bald Eagle fatalities are known to have occurred over a 16-year period from 1997-2012 for all land-based wind energy facilities within the contiguous United States. To date, there are far fewer publicly available records of Bald Eagle fatalities or injuries at wind energy facilities than there are for Golden Eagles, which are rare in the Great Lakes region. According to Pagel et al. (2013), there were 85 eagle fatalities at wind energy facilities throughout the U.S. between 1997 and 2012 (excluding eagle fatalities at the Altamont Pass Wind Resource Area in California). Of these 85 mortalities, 79 were Golden Eagles and 6 were Bald Eagles (Pagel et al. 2013).

Waterfowl and Other Waterbirds

The level of collision risk for waterfowl, or other water-affiliated bird species at Icebreaker Wind is low, overall, with some variation among waterbird taxa. Several species of gulls (Ring-billed Gull, Herring Gull, Bonaparte's Gull) are the only bird species shown by baseline studies to utilize the Project area and vicinity at densities generally greater than one bird observed per survey (Norris and Lott 2011). Several additional gull species (e.g. Glaucous Gull [*Larus hyperboreus*], Iceland Gull [*L. glaucoides*], Great Black-backed Gull [*L. marinus*]) likely use the Project area, albeit on an occasional basis (Norris and Lott 2011, eBird 2016). The general behavioral patterns of gulls can lead to higher exposure to potential wind turbine collision risk, as gulls tend to spend a large fraction of time flying, and a substantial fraction of their flight activity may occur within the rotor swept altitudes of wind turbines (Winiarksi et al. 2012). However, gulls are very agile and acrobatic flyers, and possess a high degree of visual acuity, giving them a relatively high degree of aerial maneuverability and a relatively low level of susceptibility to collisions with wind turbines (Cook et al. 2014). For this reason, current practice in avian collision risk modeling for offshore wind facilities in Europe is to assign very high collision avoidance probabilities to gull species (e.g., 0.995 total avoidance probability recommended for Herring Gull and Great Black-backed Gull, Cook et al. 2014). Therefore, although some gull collisions with Icebreaker's turbines may be expected, particularly if gull species exhibit behavioral attraction to the Project (see Behavioral Avoidance/Attraction section), the general level of collision risk for this group is low, and there is no reasonable likelihood that it could affect the populations of any gull species.

In the case of waterfowl and similar species (loons, grebes, coots, cormorants), collision risk is low, both because of low levels of exposure, and also because of low wind-turbine collision susceptibility. Baseline data have shown that only a small number of species in this category utilize the Project area on a regular basis, and in all cases the density of such birds was generally below one bird observed in the vicinity of the Project area per survey (Norris and Lott 2011; and Displacement section). One possible exception to this pattern is Double-crested Cormorant (*Phalacrocorax auritus*), which may experience somewhat higher exposure to collision risk at Icebreaker if it is attracted to the Project's turbines once built, as was observed for Great Cormorants (*P. carbo*) at the Egmond aan Zee Offshore Wind Energy Facility in the Netherlands (Krijgsveld et al. 2011; see Behavioral Avoidance/Attraction section). Although protected by the Migratory Bird Treaty Act, it should be noted that Double-crested Cormorants have been actively managed as a pest species in recent years in the Great Lakes region, as this species' recent population growth is believed to have negatively impacted fish populations (USFWS 2003); hence some collision risk for this species from Icebreaker Wind does not represent a significant concern from a biological or conservation perspective.

Another possible exception to the overall pattern of low exposure could occur if high concentrations of waterfowl and/or similar waterbirds are attracted to ice-free refuges around the Project's turbines. It was recently hypothesized that such refuges could form during extreme ice-over events on Lake Erie by the US Fish and Wildlife Service (USFWS 2016). The USFWS (2016) extended this hypothesized effect to possibly include Bald Eagles as well, noting that eagles could also be attracted to ice free refuges in order to prey on waterfowl, fish, or carrion. In order to examine this possibility, we conducted a systematic analysis of Lake Erie ice formation patterns and movement dynamics, focused on identifying the likelihood that the Project's turbine towers could generate ice-free refuges that would attract concentrations of birds, potentially exposing them to increased collision risk. This analysis was facilitated by the effort that LEEDCo has dedicated to understanding the dynamics of ice formation and movement on Lake Erie as they relate to engineering aspects of the Project.

The overall finding of the analysis of ice-related bird risk is that this risk is low, since open areas will still exist closer to shore even during extreme ice cover events, while at other times when the ice is more open and mobile, there will be a predominance of alternative open areas closer to shore and scattered throughout the offshore ice cover. One factor that influences this conclusion is that extreme ice-over events capable of causing a general scarcity of open water as far as eight to 10 miles offshore in Lake Erie are rare. Table 1 shows the number of days during which ice cover on Lake Erie exceeded 96% dating back to 1973. There were a total of 41 such days over this 44-year period (Table 1).

Table 1. Number of days per year that ice cover exceeded 96% on Lake Erie from 1973 to 2016, according to the US National Oceanographic and Atmospheric Administration's (NOAA) Great Lakes Environmental Research Laboratory (J. Wang, NOAA Great Lakes ice climatologist, pers. comm., November 7, 2016).

	Decade				
Year	1970	1980	1990	2000	2010
0		0	0	0	0
1		0	0	0	0
2		5	0	0	0
3	0	0	0	0	0
4	0	0	5	0	1
5	0	0	0	0	10
6	0	0	6	0	0
7	5	0	1	0	
8	6	0	0	0	
9	2	0	0	0	

Figure 4 shows the mean winter-time ice cover percentage in Lake Erie over the same period. These ice cover patterns indicate that extreme ice-over events, where open water areas may become relatively scarce, are generally rare in Lake Erie.

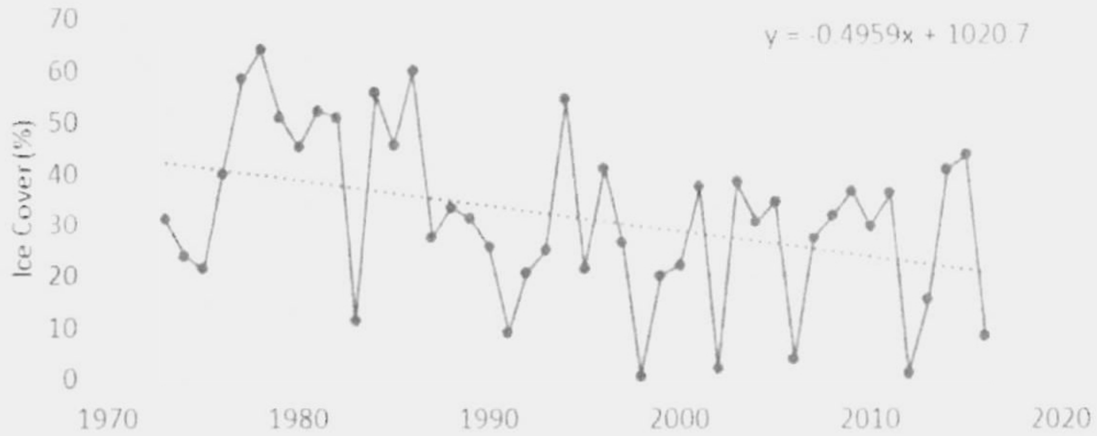

Figure 4. Mean annual winter ice cover on Lake Erie from 1973 to 2016, according to the US National Oceanographic and Atmospheric Administration (NOAA)/Great Lakes Environmental Research Laboratory (GLER; adapted from Wang et al. 2012, and J. Wang, NOAA Great Lakes ice climatologist, pers. comm., November 7, 2016).

The other factor indicating that the risk of bird-attracting ice-free refuges forming exclusively around Icebreaker Wind's turbines is low derives from the ice dynamics of Lake Erie and the Project. Icebreaker's turbine towers will measure seven m (23 ft) in diameter at the ice cone-surface interface. When ice moves past these turbine tower cones, it will fill in rapidly, since the design will cause broken ice chunks to flow around the towers and float in the wake, rather than pile up at the leading edges where the moving ice is contacting the towers (D. Dickins, pers. comm.). Ice pile-ups at the leading edge that could leave the wake relatively clear would only occur with much broader structures in shallower water where the ice could ground on the Lake bottom, such as is known to occur at the Cleveland water intake crib, which is 110' wide and does not have an ice cone (D. Dickins, pers. comm.). Therefore, ice-free wakes that may be created by the Project's turbines under rare circumstances are small, and will fill in rapidly. indicating that there is a minimal chance that they will attract birds.

There is a further fundamental physical consideration that supports the conclusion of low ice-related bird risk. Wakes can only form when ice is moving, and ice can only move when there is open water into which for it to move. Therefore, Icebreaker's turbine towers can only generate broken ice wakes under conditions in which other, larger areas of open water are available nearby; hence, the wakes are not likely to attract substantial numbers of birds. If ice is not moving, for example when extreme cold conditions are combined with calm winds, then Icebreaker's turbine towers will not generate wakes (D. Dickins, pers. comm.).

The image shown in Figure 5 illustrates the availability of ice-free areas on March 6, 2014, which was the day with the maximum ice coverage on Lake Erie that winter, which was the coldest in four decades. Even in this extreme case, large areas of open water are visible throughout most portions of the Lake. Areas of open water during such events may include areas where ice has been blown away from shore by the prevailing winds, cracks, leads, and polynyas created by the movement of ice, and open areas created by warm water outfalls, such as the Avon Lake Power Plant, located roughly 12 miles west of Cleveland (Figure 5). At least five additional outfalls are located along the Cleveland lakefront.

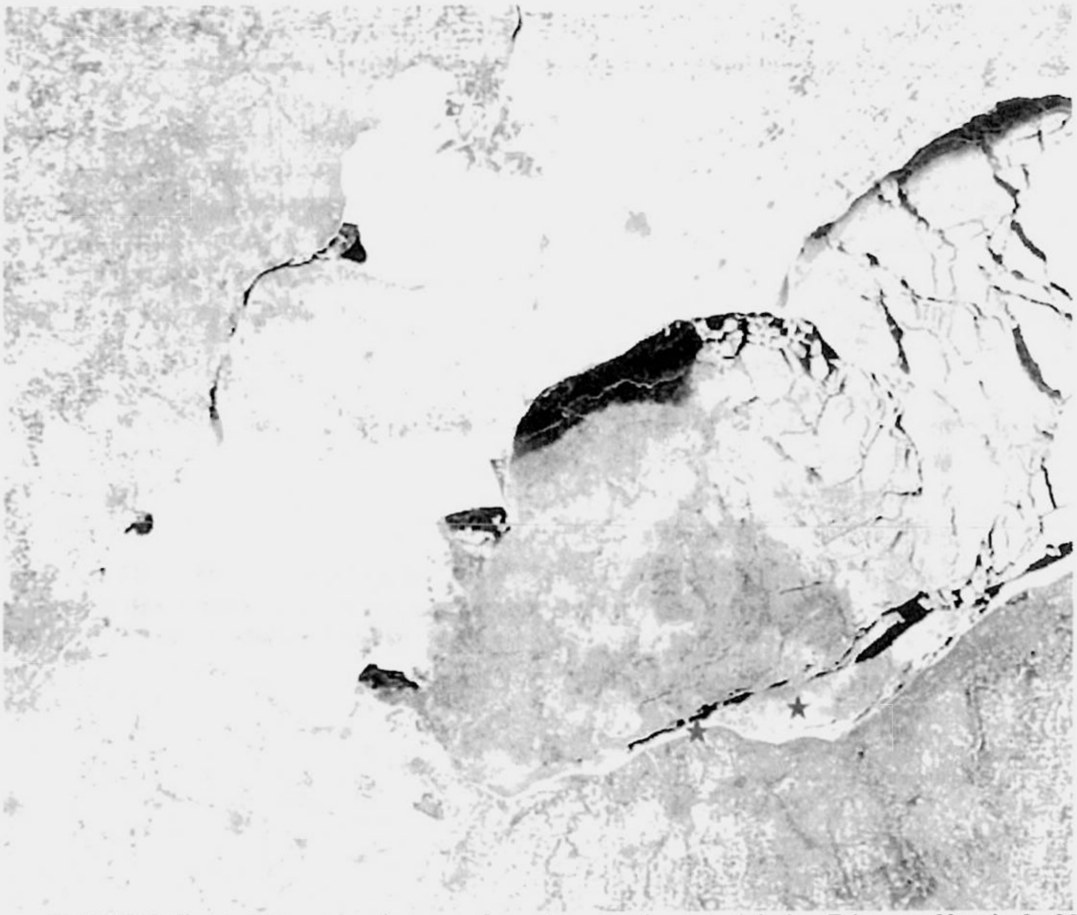

Figure 5. MODIS Terra true color image of western and central Lake Erie, on March 6, 2014, corresponding to the day with maximum ice coverage recorded in 2014 of 96.5% (Source: J. Wang - NOAA/GLERL). 2014 was an exceptionally severe winter, ranked as the coldest on record for the Great Lakes region since 1978/79 (Source: M. Herring - NOAA Boulder). In spite of the extensive ice cover in the central part of the Lake, there are numerous openings and fractures (dark blue areas) scattered throughout the offshore ice sheet as well as extensive shore-following leads with open water between Cleveland and the proposed location of Icebreaker Wind (approximate location shown with a blue star). The location of the Avon Power Plant, a coal-fired power plant that normally produces an ice-free refuge along the Lake Erie shore due to warm water outfall, is shown by the red star. Image courtesy of NASA, processed by the Space and Engineering Center, University of Wisconsin-Madison.

As a final consideration regarding waterfowl collision risk, it is important to note that European studies have demonstrated a strong tendency for flying ducks to avoid offshore wind facilities and turbines (Desholm and Kahlert 2005, Pettersson 2005, Desholm 2006, Larsen and Guillemette 2007, Masden et al. 2009). Furthermore, a variety of studies at land-based wind energy facilities in the US sited near waterfowl concentration areas have also demonstrated low wind-turbine collision susceptibility in waterfowl (Derby et al. 2009, 2010b, Jain 2005, Niemuth et al. 2013). For these reasons, waterfowl are expected to have a low probability of colliding with Icebreaker's turbines, even on the rare occasions when they may be exposed to such risk.

Bats

The level of collision risk for bats at Icebreaker Wind is low. This conclusion stems largely from the small size of the Project, which confers a correspondingly low scale to the possible level of overall bat collision fatality that the Project may generate. Furthermore, the exposure of bats to potential collision risk at the Project is also low, as indicated by the level of acoustic bat activity recorded offshore in the central Lake Erie basin during the baseline study. We recognize that the relationship between exposure and fatality rate is complex and must be interpreted with caution. The relatively low level of bat acoustical activity recorded at offshore studies to date (Ahlén et al. 2009, Pelletier et al. 2013, Boezaart and Edmonson 2014) is consistent with the basic observation that bats are primarily terrestrial animals. In the case of Icebreaker, bats' use of the Project site is expected to be restricted to migratory transits. In contrast to other primarily terrestrial groups with somewhat parallel predictions, such as raptors and songbirds, there is a higher level of residual uncertainty in this prediction for bats, as bats' utilization of Great Lakes offshore environment, and the phenomena associated with potential bat attraction to turbines, are not well understood (McAlexander 2013, Cryan et al. 2014, Schuster et al. 2015). Because this residual uncertainty stems primarily from the possibility of a behavioral attraction effect, we note that it can only be resolved with post-construction observations.

The most informative source of information on the level of bat activity likely to occur at Icebreaker Wind is the bat acoustic study conducted by Tetra Tech in 2010, as part of Icebreaker's wildlife baseline data gathering effort (Svedlow et al. 2012). In this effort, Anabat™ SD-1 (Titley Scientific™, Columbia, Massachusetts) ultrasound detectors were deployed at four land-based locations along the central Lake Erie shore to gather data on land-based bat activity, and four identical detectors were deployed on the Cleveland water intake crib, located roughly three miles offshore of Cleveland in Lake Erie, to gather data on offshore compared with onshore bat acoustic activity in the central Lake Erie basin. Ultrasound acoustic recordings were gathered at these locations during the entire spring and summer/fall migratory periods, the two periods during which most bat collision fatality occurs at Midwestern wind energy facilities (Arnett et al. 2008). Two of the crib-based offshore detectors were located on the crib's crow's nest, roughly 35 m (115 ft) above the surface of the water, and two of the detectors were elevated to a height of approximately 50 m (164 ft) above the water's surface on the guy wires of the crib's meteorological tower. During the spring 2010 deployment (April 1 through May 31, 2010), a total of 244 detector-nights of data were gathered at the onshore locations, and a total of 232 detector-nights of offshore data were gathered at the crib. During the summer/fall 2010 deployment (June 1 through November 10, 2010), a total of 616 detector-nights of data were gathered at the onshore locations, and a total of 482 detector-nights of offshore data were gathered at the crib. The levels of bat acoustic activity recorded over the course of this effort are shown in Table 2.

Table 2. Bat call rates, expressed as the number of calls recorded per detector-night, at onshore versus offshore locations in the central Lake Erie basin, as recorded during the baseline bat acoustic study conducted for Icebreaker Wind (Svedlow et al. 2012, see text for additional explanation).

Location	Spring Call Rate	Summer/Fall Call Rate
Onshore	4.95	51.1
Offshore	0.353	5.28

The Icebreaker Wind bat baseline acoustic study demonstrated that the bat activity level was roughly 10 times greater on land than offshore during both the spring and summer/fall study periods. We note that this comparison may overestimate the level of bat activity likely to occur at the Project site, as the location used to represent the offshore environment in this case, the Cleveland water intake crib, is located roughly three miles from shore, whereas the Project site is located between eight and 10 miles from shore where the abundance of bats is likely to be lower. Boezaart and Edmonson (2014) documented bat acoustic activity at a Great Lakes offshore location even further from shore in Lake Michigan (roughly 30 miles [48 km] from shore). Their study resulted in the detection of some bat calls attributable to several of the most common and widespread migratory bats in the region; however, the study only reported data on bat calls that were unambiguously identified to the species level, and many bat calls cannot be unambiguously identified using state-of-the-art call classification methods; hence, bat acoustic activity rates reported by Boezaart and Edmonson (2014) are not directly comparable to those reported by Svedlow et al. (2012).

Further insight into how the offshore bat acoustic activity data gathered at the Cleveland water intake crib by Svedlow et al. (2012) compare to onshore bat acoustic activity patterns can be gained by comparing the overall rate recorded by Svedlow et al. (2012) to rates recorded during baseline bat acoustic studies conducted for land-based wind energy projects within the region. Figure 6 illustrates such a comparison, showing Svedlow et al.'s (2012) summer/fall offshore bat acoustic data in relation to comparable data from 14 studies conducted at land-based wind energy projects in the Great Lakes region, representing all such studies for which data comparable to the Icebreaker offshore bat acoustic data are publicly available. References and date ranges for the data gathering efforts of these studies are presented in Table 3.

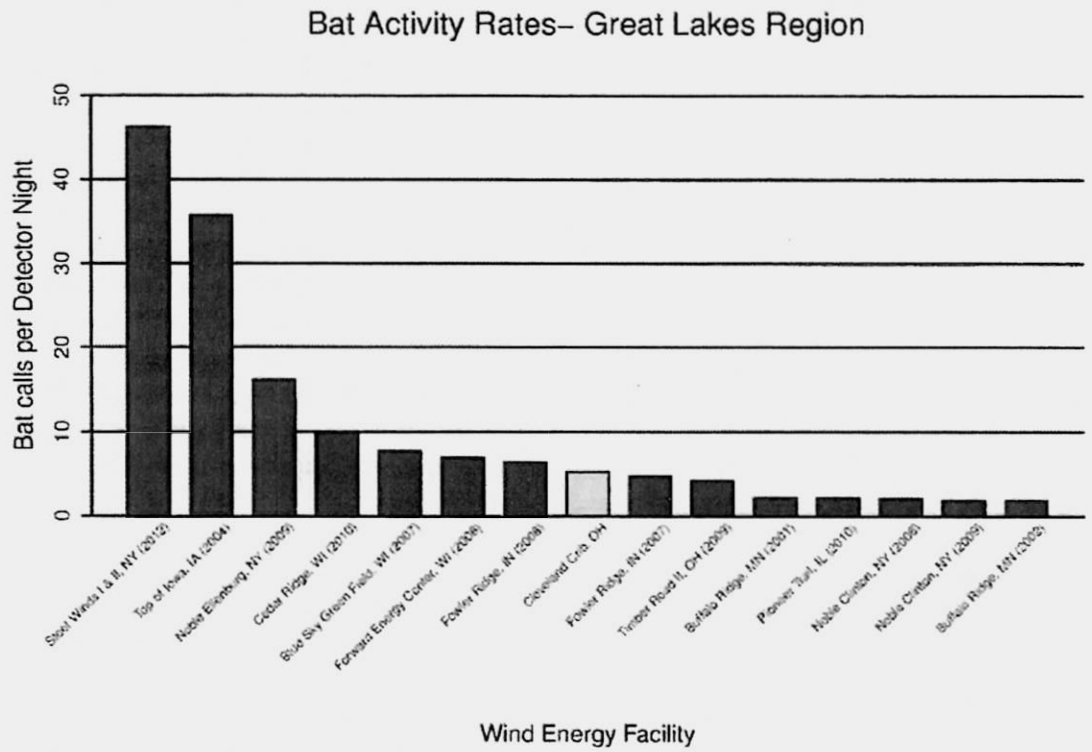

Figure 6. Bat acoustic data during the summer/fall season, expressed in terms of bat calls per detector-night, recorded three miles offshore of Cleveland in Lake Erie at the Cleveland water intake crib (yellow bar labeled "Cleveland Crib", data from Svedlow et al., 2012), in relation to comparable data gathered during 14 baseline studies conducted at land-based wind energy project areas in the Great Lakes region, representing all such projects for which comparable data are publicly available.

Table 3. Data sources and bat acoustic data recording date ranges for the bat acoustic studies whose data are illustrated in Figure 6.

Study	Reference	Date Range
Blue Sky Green Field (2007)	Gruver et al. 2009	7/24/07-10/29/07
Buffalo Ridge (Phase II; 2001/Lake Benton I)	Johnson et al. 2004	6/15/01-9/15/01
Buffalo Ridge (Phase II; 2002/Lake Benton I)	Johnson et al. 2004	6/15/02-9/15/02
Cedar Ridge (2010)	BHE Environmental 2011	7/16/07-9/30/07
Cleveland Crib (2010)	Svedlow et al. 2012	6/02/10-11/10/10
Forward Energy Center (2008)	Grodsky and Drake 2011	8/5/08-11/08/08
Fowler Wind Farm (2007)	Gruver et al. 2007	8/15/07-10/19/07
Fowler Wind Farm (2008)	Carder et. al. 2010	7/17/08-10/15/08
Noble Clinton (2008)	Jain et al. 2009a	8/8/08-09/31/08
Noble Clinton (2009)	Jain et al. 2010a	8/1/09-09/31/09
Noble Ellenburg (2009)	Jain et al. 2010b	8/16/09-09/15/09
Pioneer Trail (2011)	Stantec Ltd. 2011b	7/16/10-10/31/10
Steel Winds I & II (2012)	Stantec Ltd. 2013	5/10/12-11/5/12
Timber Road II (2009)	Good et al. 2010	3/19/09-11/16/09
Top of Iowa (2004)	Jain 2005	5/26/04-9/24/04

Bat acoustic activity is the most commonly gathered form of baseline bat data gathered during the development of wind energy facilities in North America, and is widely regarded as the best indicator of bat exposure to collision risk that can be gathered during the development phase of wind energy projects (Strickland et al. 2011, USFWS 2012). Nonetheless, it is important to note that bat acoustic activity is an imperfect predictor of bat collision risk, as bat acoustic activity is not equivalent to bat abundance (Strickland et al. 2011). Furthermore, the relationship between pre-construction bat acoustic activity levels and bat fatality levels recorded at wind energy facilities subsequent to construction is complex and variable (Hein et al. 2013). For this reason, it is also useful to examine bat fatality rates that have been documented at land-based wind energy facilities in the Great Lakes region in order to generate a more quantitative, if rough, prediction of the level of bat fatality likely to be caused by the operation of Icebreaker Wind. Figure 7 illustrates 55 bias-corrected bat fatality rates that have been produced at land-based wind energy facilities in the Great Lakes region, representing all such studies for which bias-corrected bat fatality rate estimates are publicly available. Reference information for these studies is presented in Table 4. Figure 7 illustrates a distribution of bat fatality rates similar to that presented in an earlier analysis for all of North America by Strickland et al. (2011), with bat fatality rates ranging from roughly 1 to over 30 bats/MW/year.

Given the observation that the bat acoustic activity levels recorded offshore in the central Lake Erie basin were on the low end of the range for land-based wind projects in the region with comparable data (Figure 6), the most parsimonious prediction that can be made regarding the level of bat fatality likely to be generated by Icebreaker is that it will be toward the lower end of the distribution of bat fatality rates recorded at land-based wind energy projects in the region, on the order of 1-4 bats/MW/year (Figure 7). However, given the complexity of the relationship between pre-construction bat activity and post-construction bat fatality rates at land-based wind energy facilities in the US (Hein et al. 2013), and the possibility that bats migrating over Lake Erie may be attracted to the Project's turbines, increasing collision risk, the most precise prediction that is warranted by existing information in this case is that the bat fatality rate at Icebreaker Wind is likely to fall somewhere within the distribution shown in Figure 7, ranging from one to 30 bats/MW/year. Within this range, the overall level of bat fatality likely to be generated by the Project is still moderate, at worst, in relation to land-based wind energy projects in the Great Lakes region, due to the Project's small size.

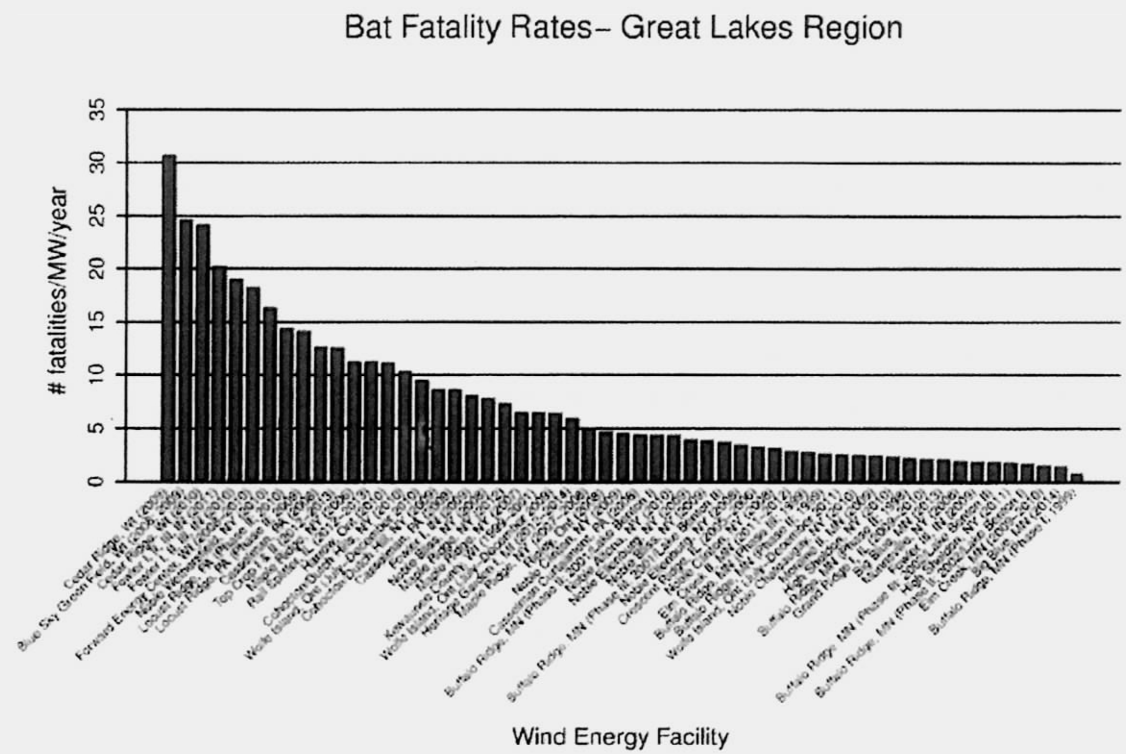

Figure 7. Bias-corrected bat fatality rates, expressed in terms of bat fatalities/megawatt of installed wind energy capacity/year, recorded in 55 studies from land-based wind energy projects in the Great Lakes region, representing all such projects for which comparable data are publicly available.

Table 4. Data sources for the bat fatality rate studies whose data are illustrated in Figure 7.

Facility and Study Year(s)	Report Reference
Big Blue, MN (2013)	Fagen Engineering 2014
Big Blue, MN (2014)	Fagen Engineering 2015
Blue Sky Green Field, WI (2008; 2009)	Gruver et al. 2009
Buffalo Ridge, MN (Phase I; 1999)	Johnson et al 2000
Buffalo Ridge, MN (Phase II; 1998)	Johnson et al. 2000
Buffalo Ridge, MN (Phase II, 1999)	Johnson et al 2000
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 1999)	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	Johnson et al. 2000
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	Johnson et al. 2004
Casselman, PA (2008)	Arnett et al. 2009a
Casselman, PA (2009)	Arnett et al. 2010
Casselman Curtailment, PA (2008)	Arnett et al. 2009b
Cedar Ridge, WI (2009)	BHE Environmental 2010
Cedar Ridge, WI (2010)	BHE Environmental 2011
Cohocton/Dutch Hill, NY (2009)	Stantec 2010a
Cohocton/Dutch Hills, NY (2010)	Stantec 2011c
Crescent Ridge, IL (2005-2006)	Kerlinger et al. 2007
Elm Creek, MN (2009-2010)	Derby et al. 2010a
Elm Creek II, MN (2011-2012)	Derby et al. 2012
Forward Energy Center, WI (2008-2010)	Grodsky and Drake 2011
Fowler I, IN (2009)	Johnson et al. 2010a
Fowler I, II, III, IN (2010)	Good et al. 2011
Fowler I, II, III, IN (2011)	Good et al. 2012
Fowler III, IN (2009)	Johnson et al. 2010b
Grand Ridge I, IL (2009-2010)	Derby et al. 2010b
Harrow, Ont (2010)	NRSI 2011
Heritage Garden I, MI (2012-2014)	Kerlinger et al. 2014
High Sheldon, NY (2010)	Tidhar et al. 2012a
High Sheldon, NY (2011)	Tidhar et al. 2012b
Kewaunee County, WI (1999-2001)	Howe et al. 2002
Locust Ridge, PA (Phase II; 2009)	Arnett et al. 2011
Locust Ridge, PA (Phase II; 2010)	Arnett et al. 2011
Maple Ridge, NY (2006)	Jain et al. 2007
Maple Ridge, NY (2007)	Jain et al. 2009b
Maple Ridge, NY (2007-2008)	Jain et al. 2009c
Maple Ridge, NY (2012)	Tidhar et al. 2013
Moraine II, MN (2009)	Derby et al. 2010c
Munnsville, NY (2008)	Stantec 2009
Noble Altona, NY (2010)	Jain et al. 2011a
Noble Bliss, NY (2008)	Jain et al.2009d
Noble Bliss, NY (2009)	Jain et al. 2010c
Noble Chateaugay, NY (2010)	Jain et al. 2011b
Noble Clinton, NY (2008)	Jain et al. 2009e
Noble Clinton, NY (2009)	Jain et al. 2010a
Noble Ellenburg, NY (2008)	Jain et al. 2009f
Noble Ellenburg, NY (2009)	Jain et al. 2010b
Noble Wethersfield, NY (2010)	Jain et al. 2011c
Rail Splitter, IL (2012-2013)	Good et al. 2013a
Ripley, Ont (2008)	Jacques Whitford 2009
Top Crop I & II (2012-2013)	Good et al. 2013b
Wolfe Island, Ont (July-December 2009)	Stantec Ltd. 2010b
Wolfe Island, Ont (July-December 2010)	Stantec Ltd. 2011a
Wolfe Island, Ont (July-December 2011)	Stantec Ltd. 2012

Nocturnally Migrating Songbirds and Similar Birds

The level of collision risk for nocturnally migrating birds (including various shorebirds, songbirds, and other small-bodied land birds) at Icebreaker Wind is low. This conclusion stems from three principal observations, as follows:

1) Nocturnally migrating birds are primarily terrestrial animals, and their expected level of activity at the Project site is expected to be low, and generally restricted to migratory transits.

2) Although substantial broad-front nocturnal migration activity occurs throughout the Great Lakes region, and extends to birds' passage directly over the Great Lakes, including Lake Erie, nocturnally migrating birds exhibit a well-known tendency to avoid flying over large bodies of water if possible, evidenced in the central Lake Erie basin by a radar study that demonstrated that the density of nocturnal migrant bird passage was more than twice as high over land than it was over the Lake during both spring and fall migration.

3) Numerous studies of bird fatality rates at land-based wind energy facilities have demonstrated that fatality rates of nocturnal migrant birds at wind energy facilities are sufficiently low that there is no reasonable likelihood of such fatalities causing population-level impacts to any nocturnal migrant bird species.

The most informative source of information on the passage rates of nocturnally migrating birds through the Icebreaker Wind site and vicinity is a study of nocturnal bird migration density over the Great Lakes vs. over terrestrial environments within the region, published by a team of independent academic ornithologists in *The Auk* (Diehl et al. 2003). This study relied on a region-wide analysis of NEXRAD (WSR-88D) radar data to study nocturnal bird migration patterns over large spatial scales for the entire spring and fall migration periods of a representative year (2000). The authors applied techniques that had been developed over the course of three previous decades of radar ornithology for separating the radar echoes of migrating birds from those of insects, ground clutter, and precipitation, and for controlling for known sources of signal variation, such as signal refraction as a function of distance to the antenna. These authors focused their research on direct comparisons of estimated migrant densities over land versus over water at four locations in the Great Lakes, taking advantage of the locations of four NEXRAD radar antennae with ample viewsheds of both land-based and water-based environments within suitable distance of the antennae, and with minimal or no terrain-related blockage of the portions of the radar beam needed for the comparisons.

One of the locations selected for this comparison was the central Lake Erie basin, using data from the KCLE WSR-88D radar antenna in Cleveland, Ohio. The beam of the KCLE radar is well-suited for detecting nocturnally migrating birds in the central Lake Erie basin out to at least 40 miles from the southern shore, including the Icebreaker site and vicinity. Diehl et al.'s (2003) analysis revealed that the density of nocturnally migrating birds was 2.72 times higher over land than it was over water in the central Lake Erie basin during the spring migration period, and 2.13 times higher over land than over the lake during the fall migration period. Diehl et al. (2003) were also able to document the signature of dawn ascent of migratory birds over water, as well as directional reorientation of migrating birds toward land, suggestive of these birds' tendency to avoid flying over water. These observations are consistent with recent studies by Rathbun et al. (2016) and Horton et al. (2016), who used marine surveillance radar systems deployed in shoreline environments in Lake Ontario and Lake Erie, respectively, to demonstrate high concentrations of nocturnal migrant birds in Great Lakes shoreline environments.

Similar to the case of bats, information on pre-construction patterns of nocturnal migratory bird activity must be interpreted with caution when generating collision risk predictions for wind energy facilities, as the relationship between pre-construction use data and post-construction fatality patterns in birds is complex. For this reason, radar-based studies of nocturnal migrant bird passage rates or nocturnal utilization of airspace within proposed wind facility areas are not included within typical baseline studies for land-based wind farms in the US (Strickland et al. 2011, USFWS 2012). In spite of the known limitations of pre-construction baseline data in general, and radar data specifically (USFWS 2012, Erickson et al. 2014, Kerlinger 2016), for predicting fatality levels of nocturnally migrating birds at wind energy facilities, such data, when considered alongside empirically-derived fatality rates generated from systematic, bias-corrected post-construction monitoring studies at land-based wind energy facilities within the Great Lakes region, can provide a reasonable basis for making a rough quantitative prediction regarding the level of nocturnal migrant songbird fatalities likely to be generated by Icebreaker Wind.

Figure 8 illustrates empirically-derived, bias-corrected bird fatality estimates from 42 studies conducted at operational, land-based wind energy facilities within the Great Lakes region, representing all such studies with publicly available data for the region. Reference information on the studies illustrated in Figure 8 is provided in Table 5. Figure 8 reveals a distribution of bird fatality rates similar to that reported in an earlier analysis of such rates for the entire US (Strickland et al. 2011), although there appears to be a tendency toward lower bird fatality rates at land-based wind energy facilities in the Great Lakes region than for the US as a whole. Commercial wind energy facilities in the Great Lakes region incur roughly two to three bird fatalities per MW of installed wind energy capacity per year on average (Figure 8). Before extrapolating from these data to a prediction of nocturnal songbird fatality rates at Icebreaker, it should also be noted that the rates shown in Figure 8 and considered in recent studies of bird fatalities at land-based wind energy facilities (Strickland et al. 2011, Loss et al. 2013) include a significant proportion of collisions by birds that are local, diurnally active residents in the environment of the wind energy facilities, and whose fatalities are not likely due to collisions during nocturnal migratory flights (e.g., Horned Larks [*Eremophila alpestris*], meadowlarks [*Sturnella spp.*], various doves, Killdeer [*Charadrius vociferus*], and others; Strickland et al. 2011). For this reason, using total bird fatality rates as a basis for predicting nocturnal migrant songbird fatality rates at Icebreaker would likely result in an overestimate of migrant songbird fatality. Nonetheless, it is well-known that nocturnal migrant songbirds comprise the majority of total bird fatality at land-based wind energy facilities in the US (NAS 2007, Strickland et al. 2011), and a recent study by Erickson et al. (2014) demonstrated that fatality rates are typically between 2.10 and 3.35 birds per MW of installed capacity per year for small passerines, most of which are nocturnal migrants. Therefore, total bird fatality rates can serve as a useful, if conservative, basis for predicting the likely fatality rates of nocturnally migrating land birds at Icebreaker, where no diurnal land bird activity is expected.

Given the observation that the nocturnal migrant bird passage density recorded in the offshore environment in the central Lake Erie basin was less than half of the level recorded at comparable sites over land during both spring and fall migrations (Diehl et al. 2003), it is reasonable to predict that nocturnal migrant bird fatality generated by Icebreaker Wind may be lower than typical land-based facilities in the region (Figure 8), assuming all other factors are equal. This would suggest that bird fatality rates at Icebreaker in the range of 1-2 birds per megawatt of installed capacity per year. Given that the Project will contain 20.7 megawatts of installed capacity, one estimate for Icebreaker is 21-42 total bird fatalities per year, most of which will likely be nocturnal migrant land birds. At this level, or even if rates were towards the higher end of U.S. estimates, there is no reasonable likelihood that the Project could have a population level impact on any species of nocturnal migrant bird (see Arnold and Zink 2011 and Erickson et al. 2014 for recent discussions of the likelihood of population level effects in nocturnal migrant songbirds resulting from collisions with wind turbines or other anthropogenic structures).

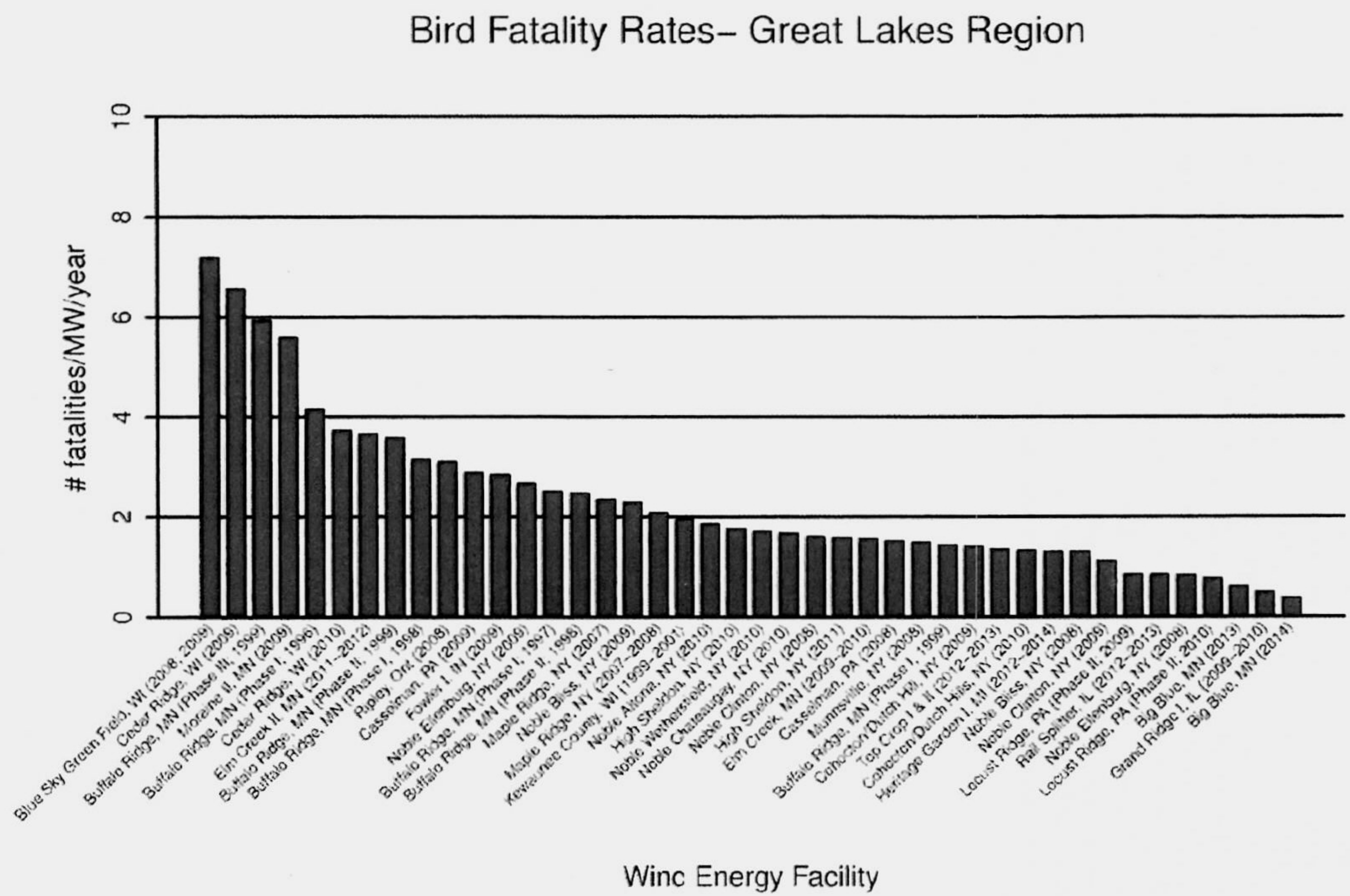

Figure 8. Bias-corrected bird fatality rates, expressed in terms of bird fatalities/megawatt of installed wind energy capacity/year, recorded in 42 studies from land-based wind energy projects in the Great Lakes region, representing all such projects for which comparable data are publicly available.

Table 5. Data sources for the bird fatality rate studies whose data are illustrated in Figure 8.

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Buffalo Ridge, MN (Phase II; 1998)	Johnson et al. 2000
Buffalo Ridge, MN (Phase I; 1999)	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 1998)	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 1999)	Johnson et al. 2000
Buffalo Ridge, MN (Phase III; 1999)	Johnson et al. 2000
Casselman, PA (2008)	Arnett et al. 2009a
Casselman, PA (2009)	Arnett et al. 2010
Cedar Ridge, WI (2009)	BHE Environmental 2010
Cedar Ridge, WI (2010)	BHE Environmental 2011
Cohocton/Dutch Hill, NY (2009)	Stantec 2010a
Cohocton/Dutch Hills, NY (2010)	Stantec 2011c
Elm Creek, MN (2009-2010)	Derby et al. 2010a
Elm Creek II, MN (2011-2012)	Derby et al. 2012
Fowler I, IN (2009)	Johnson et al. 2010a
Grand Ridge I, IL (2009-2010)	Derby et al. 2010b
Heritage Garden I, MI (2012-2014)	Kerlinger et al. 2014
High Sheldon, NY (2010)	Tidhar et al. 2012a
High Sheldon, NY (2011)	Tidhar et al. 2012b
Kewaunee County, WI (1999-2001)	Howe et al. 2002
Locust Ridge, PA (Phase II; 2009)	Arnett et al. 2011
Locust Ridge, PA (Phase II; 2010)	Arnett et al. 2011
Maple Ridge, NY (2006)	Jain et al. 2007
Maple Ridge, NY (2007-2008)	Jain et al. 2009b
Moraine II, MN (2009)	Derby et al. 2010c
Munnsville, NY (2008)	Stantec 2009
Noble Altona, NY (2010)	Jain et al. 2011a
Noble Bliss, NY (2008)	Jain et al.2009c
Noble Bliss, NY (2009)	Jain et al. 2010a
Noble Chateaugay, NY (2010)	Jain et al. 2011b
Noble Clinton, NY (2008)	Jain et al. 2009d
Noble Clinton, NY (2009)	Jain et al. 2010b
Noble Ellenburg, NY (2008)	Jain et al. 2009e
Noble Ellenburg, NY (2009)	Jain et al. 2010c
Noble Wethersfield, NY (2010)	Jain et al. 2011c
Rail Splitter, IL (2012-2013)	Good et al. 2013a
Ripley, Ont (2008)	Jacques Whitford 2009
Top Crop I & II (2012-2013)	Good et al. 2013b

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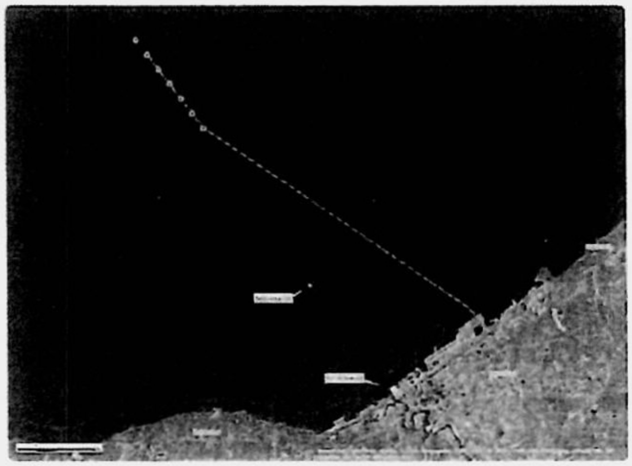
Summary of November 2016 Avian and Bat Risk Assessment for the Icebreaker Wind Project

March 20, 2018



Prepared for:

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1 INTRODUCTION

Icebreaker Windpower, Inc. (IWP) has filed an application with the Ohio Power Siting Board (OPSB) to construct the Icebreaker Wind Project (Project), a small, six-turbine, 20.7-megawatt (MW) demonstration offshore wind energy facility eight to 10 miles (mi; 13 to 21 kilometers [km]) from the shore of Cleveland, Ohio. Among other findings, the OPSB must determine that the Project poses the "minimum adverse environmental impact." To this end, in the fall of 2016, Dr. Caleb Gordon and Wally Erickson of Western EcoSystems Technology, Inc. (WEST) completed a risk assessment (RA) to evaluate the likely adverse impact posed by the proposed Project on birds and bats. The RA was submitted with the application for the Project as Exhibit J.

The RA consisted of a review and summary of baseline data and other publicly available data on bird and bat use within, or in the vicinity of the Project area, as well as other information relevant to the assessment of risk, including technical literature on taxon-specific collision susceptibility patterns, and past studies of bird and bat fatality rates conducted at existing wind energy facilities within the Great Lakes region. The surveys that were reviewed are summarized within Table 1.1, and the aerial coverage of these surveys is illustrated in Figure 1.1. A NEXRAD analysis was completed by WEST after submission of the RA; aerial coverage of the WEST NEXRAD analysis is shown in Figure 1.2.

The Risk Assessment concluded that the Project poses low risk of adverse impacts to birds and bats. This conclusion stemmed largely from two principal observations: 1) the Project is small in scale, consisting of six turbines; and 2) site-specific and other studies have documented that the level of use of this area by birds and bats is low compared to bird and bat use of terrestrial or nearshore environments. The RA also relied on previously published studies of bird and bat fatality rates at onshore wind energy facilities in the Great Lakes region to bracket the range of fatality rates likely to be generated by the Project.

Following are summaries of: 1) the RA; 2) a site-specific analysis of NEXRAD radar data completed by WEST in January, 2017; 3) WEST's 2017 Annual Report; and, 4) WEST's Draft Bird and Bat Conservation Strategy (BBCS). The first item was filed with the OPSB; the second was completed several months after the RA was completed and was filed as part of the OPSB application; the third has been shared with the Ohio Department of Natural Resources (ODNR) and US Fish and Wildlife Service (USFWS) and is being filed with OPSB; and, the final item is under discussion with the USFWS.

Table 1.1. Surveys reviewed during the development of the Risk Assessment.

A summary of the surveys reviewed, the type of information obtained, the entities who performed the work, and the geographic scope of the survey elements during the development of the WEST *Bird and Bat Risk Assessment* (Gordon and Erickson 2016).

Survey Technique (years of survey data analyzed)	Entity Who Performed Survey	Species Identification	Spatial Distribution	Temporal Distribution	Flight Ecology	Site-specific Data?
NEXRAD radar analysis (2003-2007)	Geo-Marine	no	yes	yes	yes	yes
NEXRAD radar analysis (2013-2016)	WEST	no	yes	yes	yes	yes*
Bird Acoustic Survey (2010)	Tetra Tech	yes	yes	yes	no	near (Crib)**
Bat Acoustic Survey (2010)	Tetra Tech	yes	yes	yes	no	near (Crib)
Merlin Radar Survey (2010)	Tetra Tech	no	yes	yes	yes	partial***
Boat-based Bird Surveys (2010)	Tetra Tech	yes	yes	yes	yes	near
Bird and Bat Fatality Surveys at 42 (birds) and 55 (bats) Wind Energy Facilities in the Great Lakes Region (years vary by project)	Various	yes	yes	yes	no	no
Aerial Bird Survey (2009-2011)	ODNR	yes	yes	yes	no	yes

*Finalized after the RA was completed

**Survey results successfully collected for spring migration period

***The maximum extent of the radar range overlapped with the southern end of the current turbine layout.

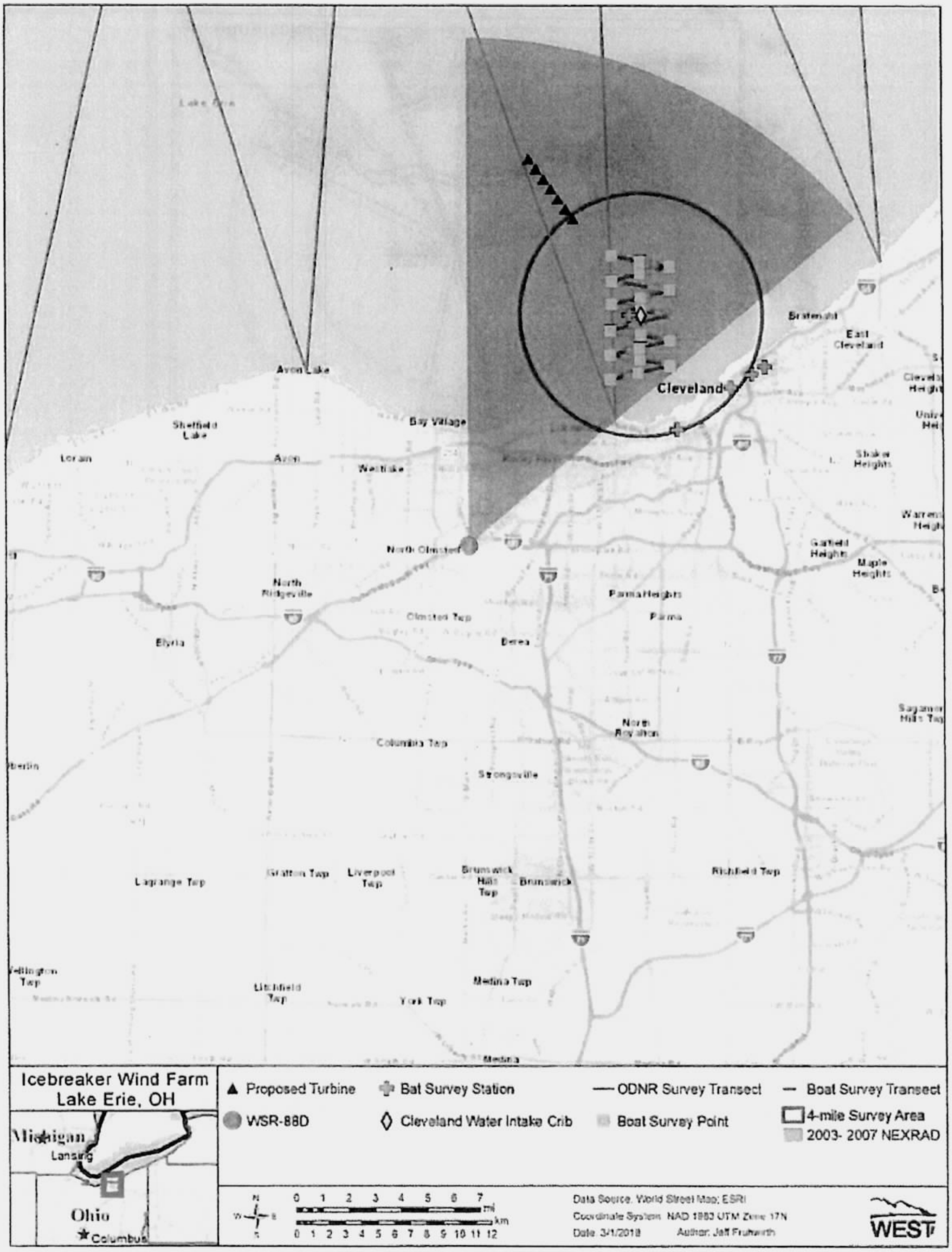


Figure 1.1. A map showing the coverage of the field surveys used to inform the risk assessment.

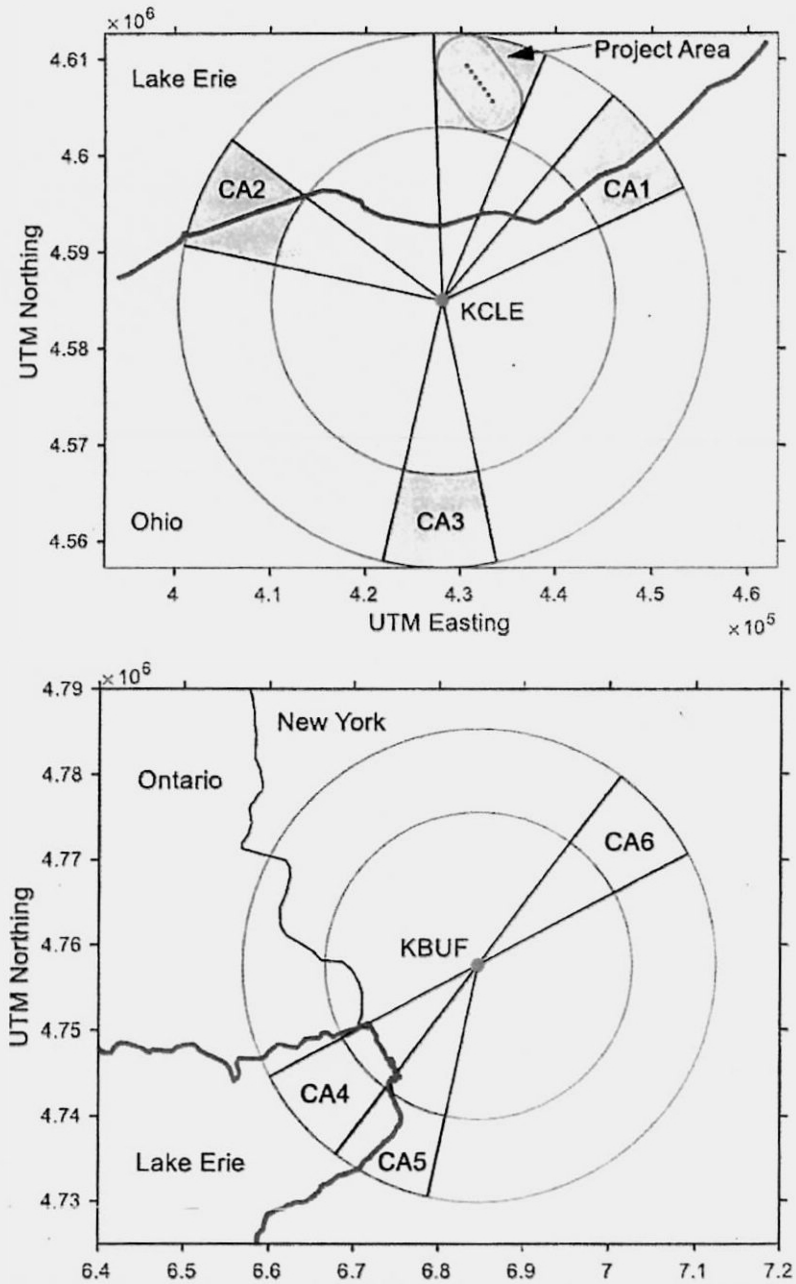


Figure 1.2. A map showing the coverage of the 2017 WEST NEXRAD analysis.

2 DOCUMENT SUMMARIES

2.1 WEST Risk Assessment

The WEST RA examined the potential project impacts on bird and bat species, including displacement, behavioral attraction and avoidance, and collisions.

2.1.1 Displacement Effects

A displacement effect is defined as the transformation of the Project area from suitable habitat to less suitable habitat by virtue of Project construction or operation.

<u>Results of Aerial Surveys</u>

Baseline data gathered by the ODNR in 2009-2011 indicated very low use of the offshore environment of Lake Erie in the vicinity of the Project area by diurnal waterbirds (Figure 2.1). Only six species of birds (including ring-billed gull (*Larus delawarensis*), herring gull (*Larus argentatus*), Bonaparte's gull (*Chroicocephalus philadelphia*), common loon (*Gavia immer*), horned grebe (*Podiceps auritus*), red-breasted merganser (*Mergus serrator*)) were documented regularly within the vicinity of the Project area, all of them in very low abundance.[1]

<u>Conclusion (Displacement Effect)</u>

Displacement effects are not likely because there are very few waterbird species or individuals to displace, as waterbirds do not regularly occur within the Project area. If any displacement effect were to occur, it would have minimal adverse impact on waterbird species, as very few individuals of waterbird species would be affected.

[1] IWP is currently conducting Aerial Waterbird/Waterfowl Surveys. Survey results to date confirm the ODNR survey results showing low usage of the Project area by waterbirds and waterfowl. An Interim Aerial Waterbird Survey Report was provided to ODNR and USFWS as part of the IWP's 2017 Annual Report.

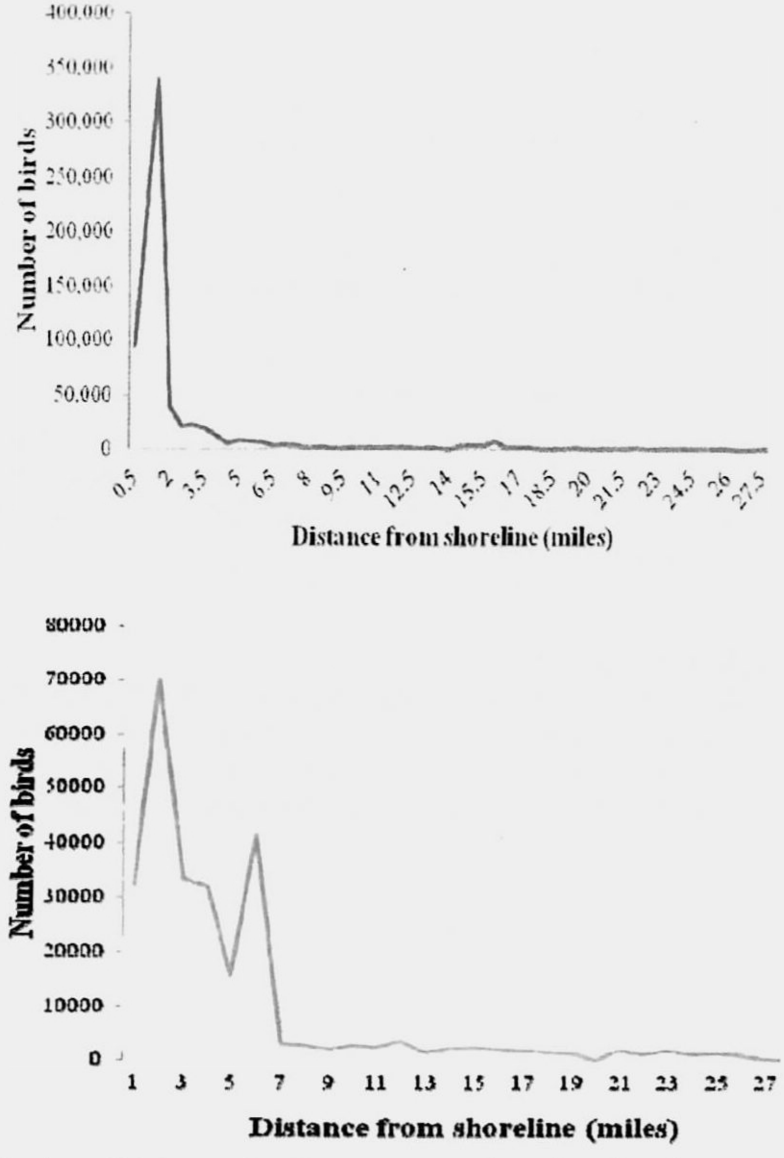


Figure 2.1. Number of birds as a function of distance from shoreline. The nearest proposed Icebreaker wind turbine is located 8 miles from the shoreline ODNR 2009-11.

2.1.2 Behavioral Avoidance or Attraction Effects

Behavioral attraction is defined as attraction to the Project area by bird or bat species that would otherwise utilize the area less frequently or not at all. Behavioral avoidance is defined as the avoidance of the Project area by species using the area strictly for transit. Researchers have shown that tree bats are attracted to on-shore wind turbines. Bird response to turbines has been more variable.

Aerial Surveys, NEXRAD, Acoustic and Boat-Based Surveys

Very few bird species or individuals currently utilize the Project area for foraging, feeding, or roosting. It is possible that some species may be attracted to the site for such activities after Project construction. Data from NEXRAD radar analysis (birds) and offshore acoustic studies (birds and bats) indicate that some bats and many nocturnally migrating birds regularly transit the Project area during migratory periods, though in both cases, exposure data indicate that the volume of such activity is lower than over terrestrial nearshore areas.[2] The extent to which nocturnally transiting bird and bat migrants may exhibit either avoidance or attraction to the facility is impossible to predict with pre-construction data.

Studies from European offshore wind facilities have shown that certain bird species tend to avoid flying through offshore wind farms or turbine strings, most notably migrating sea ducks, for whom the additional energy expenditure of flying around the facilities has been shown to be negligible. Certain other species have demonstrated attraction to European offshore wind facilities, most notably certain cormorants and gulls that may benefit from the availability of perching structures and/or the attraction of prey species by virtue of "artificial reef" effects. It is not known whether such effects are adverse or beneficial to the affected species.

Conclusion (Avoidance/Attraction Effects)

The Project has the potential to generate both behavioral avoidance and attraction effects in some groups of birds or bats, which may be either adverse or beneficial, but *are not expected to be substantial for any species*. The pre- and post-construction monitoring outlined in the Memorandum of Understanding (MOU) between the Ohio Department of Natural Resources (ODNR) and IWP, and the associated Monitoring Plan (MP), will allow evaluation of whether behavioral avoidance and/or attraction effects are evidenced at the Project.

2.1.3 Collision Effects

Birds and bats are known to collide with wind turbine blades causing injury or death. Collision rates and taxonomic patterns have been well-characterized for birds and bats at land-based wind energy facilities in the Great Lakes region and elsewhere in the US using bias-corrected carcass searching studies conducted during projects' operational phases. Less is known about collision rates at offshore wind energy facilities. The Great Lakes are distinct from marine

[2] WEST's Bat Activity Monitoring Report concludes that the 2017 survey effort results are consistent with the RA conclusions

environments, and some uncertainty exists in the expected per turbine rate of bird and bat fatalities; however the small size of the project, and lower expected exposure limits the total impact of the project compared to on-shore facilities. In Table 2.1, below, evidence from technical literature and site-specific information are integrated into the risk summaries for each of the major taxonomic or functional groups of birds and bats potentially exposed to wind turbine collision risk from the Project.

Conclusion (Collision Effects)

The collision risk from the Project is expected to be low. This conclusion is based both on the small size of the Project as well as the lower expected rate of exposure of birds and bats at the Project relative to on-shore facilities, as documented through the two NEXRAD radar analyses and the acoustic monitoring.

Table 2.1. Summary of collision risk assessment for specific bird and bat taxa or functional groups

Bird or Bat Group	Primary Evidence	Collision Risk Conclusion
Eagles and other raptors	• the Project **does not contain suitable nesting habitat** or substrate for any eagle or other raptor species • *the Project* ***does not contain suitable foraging*** **or feeding habitat** for any species in any season • the Project **is likely to receive very little raptor migratory passage**, as it is located in one of the widest sections of Lake Erie, and not in the vicinity of any islands or peninsulas that could attract migrating raptors, which are known to concentrate along shorelines and to minimize over water flight distances during migration in the region • **No eagles or other raptor species have been observed within the Project area** or vicinity in any of the surveys that were reviewed for the RA	**Low risk for all species during all seasons**
Waterfowl and other waterbirds	• **Very few (six) species occur regularly within the Project area** or immediate vicinity • **All of the species that do occur regularly** within the Project area or immediate vicinity **occur there in very low abundance** • An extensive aerial survey effort in Lake Erie documented a pattern of extreme bird concentration within the first several (up to seven) miles from shore; **bird abundance in the zone where the Project is located (eight to 10 miles from shore) is** ***consistently several orders of magnitude lower than it is closer to*** **shore** • **European studies have documented a strong tendency for waterfowl to avoid collisions** with *offshore* wind turbines • **US studies have documented low waterfowl collision rates** at land-based wind energy facilities located in close proximity to large waterfowl concentration areas	**Low risk for all species during all seasons**
Nocturnally migrating songbirds and similar birds	• The Project **does not contain suitable breeding, wintering, or migratory stopover habitat** for any species of bird in this category • **>100 species** of songbirds and other similar birds (e.g. cuckoos) **migrate at night in a broad-front pattern** over most of the US, including the Great Lakes region, including over the open water environment of Lake Erie and the Project area • In spite of this nearly ubiquitous exposure, **collision fatality rates for this group are consistently low across the country and within the region, and not likely to impact the population of any species.** A survey of 42 publicly available, bias-corrected bird fatality studies at wind farms in the Great Lakes region revealed that **bird fatality rates ranged from less than one to roughly seven birds/MW/year for all species** ***combined, most of which are nocturnal migrants***	**Low risk for all species during spring and fall migrations. No risk** ***at other times.***

Table 2.1. Summary of collision risk assessment for specific bird and bat taxa or functional groups

Bird or Bat Group	Primary Evidence	Collision Risk Conclusion
Bats	• Using the range of bird fatality rates within the region, and the installed capacity of the Project (20.7 MW), **the total predicted bird fatality rate for the Project is likely to be between 20 and 150 bird fatalities per year** • Site-specific NEXRAD analysis[3] revealed that nocturnal migrant passage rates **over the Project area are one third to one half of what they are in comparable areas along the central Lake Erie shoreline** or over land in the vicinity of Cleveland, and **one eighth of what they are over the eastern Lake Erie basin and shoreline**. • **If this site-specific exposure data for nocturnal bird migration is applied to the bird fatality rate prediction, it would suggest that the Project's bird fatality rate is likely to be on the low end of the spectrum of what has been observed elsewhere in the region (e.g. from 10 to 70 total bird fatalities/year)** • The Project **does not provide suitable roosting habitat for any species of bat** • Several migratory bat species are known to sometimes transit, and possibly forage over open water environments of the Great Lakes and may encounter the Project area • A baseline bat acoustic study showed that bat acoustic **activity was substantially (roughly 10x) lower offshore than in terrestrial environments** near Cleveland • In spite of the availability of this information on exposure from the acoustic baseline study, it was not considered to provide a strong indication of site-specific bat risk, as **the relationship between pre-construction bat acoustic activity and post-construction bat fatality is known to be complex**, and dependent on behaviors that are not well characterized in the offshore environment • A survey of 55 publicly available, bias-corrected bat fatality studies at wind farms in the Great Lakes region revealed that bat fatality rates ranged from less than one to roughly 30 bats/MW/year for all species combined • Using the range of bat fatality rates within the region, and the installed capacity of the Project (20.7 MW), **the total predicted bat fatality rate for the Project is likely to be between 20 and 600 bat fatalities per year**	**Low-moderate risk for migratory species**

[3] This statement refers to the conclusion from the WEST 2017 NEXRAD analysis, which was completed subsequent to the WEST RA. In the RA, a similar conclusion was reached regarding exposure of nocturnal migrant birds from NEXRAD data based on a study by Diehl et al. (2003). The WEST NEXRAD analysis was similar to Diehl et al.'s but it was based on more data, more recent data, and the study area was selected specifically to encompass the Project site and directly comparable areas.

2.2 WEST 2017 NEXRAD Analysis

WEST's January 2017 NEXRAD Analysis presents the results of an analysis of nocturnal migrant bird patterns inferred from NEXRAD weather radar data, intended to provide a robust comparison of nocturnal migrant bird passage rates over the Project area compared with nearby shoreline, terrestrial, and other open water environments (Figure 1.2). Data from peak spring and fall migration periods were analyzed for a three year period (2013 – 2016) for the Project area and six comparable sites, using analytical techniques that have been developed and refined over five decades of NEXRAD radar ornithology designed to identify and isolate migratory bird signals. Due to the nature of NEXRAD radar beams, and the distance of the study sites to the radar stations (roughly 23 km; 14 mi), the altitudinal ranges sampled at the study sites ranged from 114 to 963 meters above ground level, overlapping the upper portion of the rotor swept zone of the turbines that would be installed (146 meter maximum blade tip height), and encompassing the altitudes at which most of nocturnal songbird migration is known to occur.

Conclusion:

For the seven sites analyzed, the Project area contained the lowest migratory bird passage rate in each year, in each season, and at both beam angles (altitudes) analyzed (Figure 2.2). Overall, averaging all years and seasons, the migratory bird passage rate at the Project area was roughly one third that of the comparison site over land south of Cleveland, less than half that of the two shoreline comparison sites in the central Lake Erie basin, and roughly one eighth that of the shoreline and over water sites in the eastern Lake Erie basin. The conclusion of this study was that the Project area had consistently lower densities of nocturnal migratory bird passage compared to shoreline or terrestrial sites within the region.

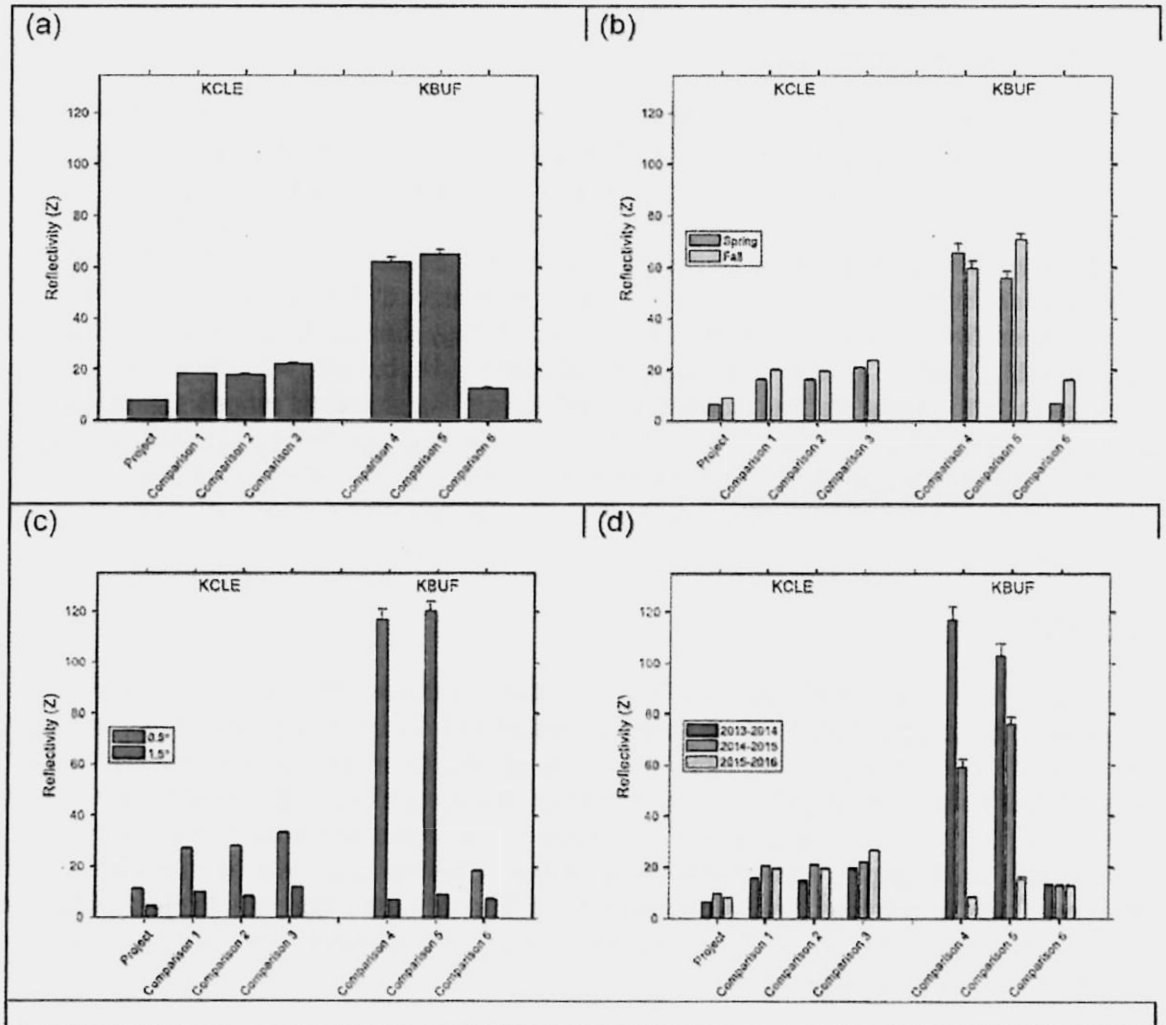


Figure 2.2. Mean reflectivity (bar heights) plus 1 standard error (error bars) at the seven sample areas:
(a) degrees overall – averaged across season, year, and elevation
(b) by season – averaged across year and elevation
(c) by elevation – averaged across season and year
(d) by year – averaged across season and elevation.

2.3 WEST Annual Report

WEST's Bird and Bat Monitoring Annual Report, dated February 20, 2018, presents the results of the Bat Acoustic Monitoring conducted in 2017; the Aerial Waterbird Survey results to date; the ongoing research into collision monitoring technologies in preparation for selection of the best and most practical technology available at the time the selection decision must be made; and results of the evaluation of vessel based radar to collect baseline data prior to construction for comparison to post-construction data to assess any actual avoidance/attraction and behavioral effects. **While not presented as the basis for making a determination regarding**

the Project's environmental risk, the survey results to date are consistent with the conclusions of the RA.

2.4 Draft Bird and Bat Conservation Strategy

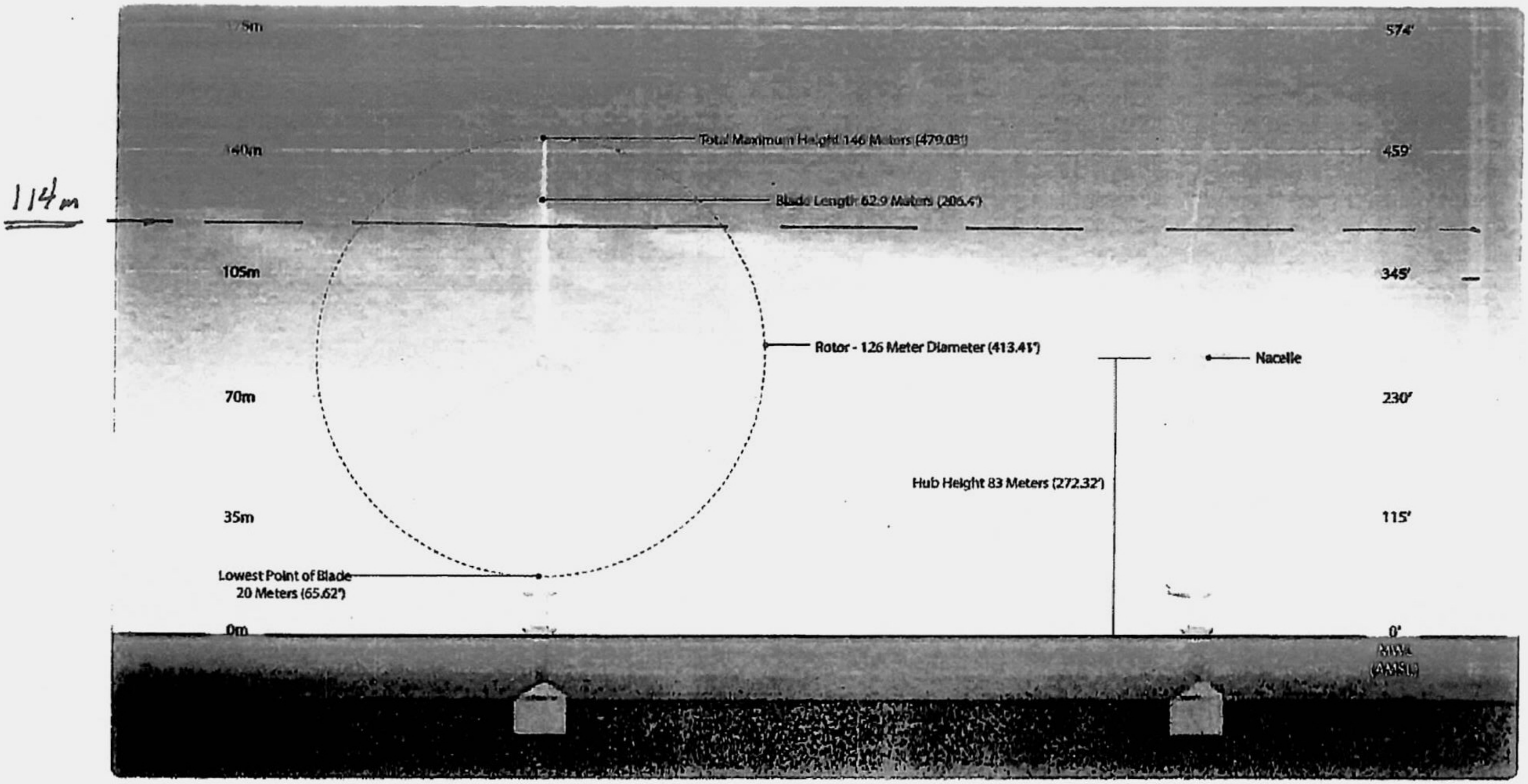
The BBCS is currently being prepared to ensure that the Project avoids, minimizes, and mitigates any adverse environmental impacts that could result from the Project. The BBCS draft contains complete, or near-complete, versions of most of the typical elements of a BBCS (a summary of the Project and bird and bat risk assessment, description of the impact avoidance/minimization/mitigation measures to which the Project team has already committed, and a record of agency coordination). It will also include adaptive management strategies to further reduce any unforeseen adverse environmental impacts to birds and bats. **As such, a BBCS that has been approved by wildlife agencies will provide a mechanism to ensure that the Project poses the "minimum adverse environmental impact."**

During the fall of 2017, WEST completed the first draft of the BBCS for the Project. IWP submitted this draft to the USFWS for its review, and received emailed comments back from the USFWS on November 21, 2017. The IWP team held a teleconference with USFWS in early December to discuss comments on the draft BBCS. The BBCS is a living document, and will be continually updated, as specific impact thresholds and adaptive management measures will be dependent upon the precise nature of the post-construction monitoring methods and data. A final BBCS that has been agreed to by the Applicant and wildlife agencies can be made a condition of the Project s permit, to be submitted prior to construction

3 CONCLUSION

The Risk Assessment concluded that the Project poses low risk of adverse impacts to birds and bats based on 1) the Project is small in scale, consisting of six turbines; and 2) site-specific and other studies have documented that the level of use of this area by birds and bats is low compared to bird and bat use of terrestrial or nearshore environments. Subsequent studies completed for Icebreaker further support this assessment.

NEXRAD Coverage – Turbine Closest to Shore



Lake Erie, City of Cleveland, Cuyahoga County, Ohio

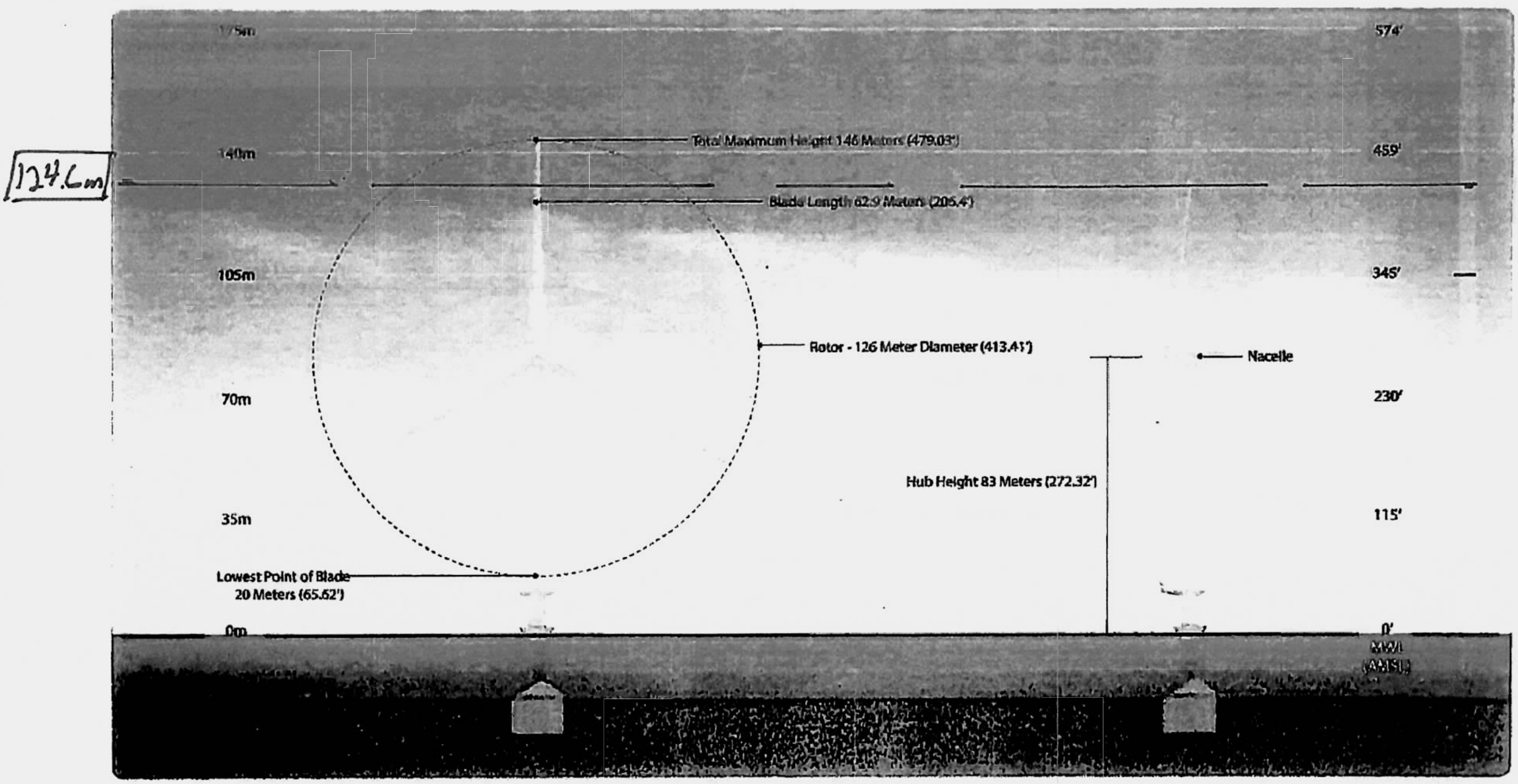
Figure 3: Turbine Design

November 2016

EXHIBIT Bratenahl Residents 10

PENGAD 800-631-6989

NEXRAD Coverage - Turbine Farthest from Shore



Lake Erie, City of Cleveland, Cuyahoga County, Ohio
Figure 3. Turbine Design
November 2016

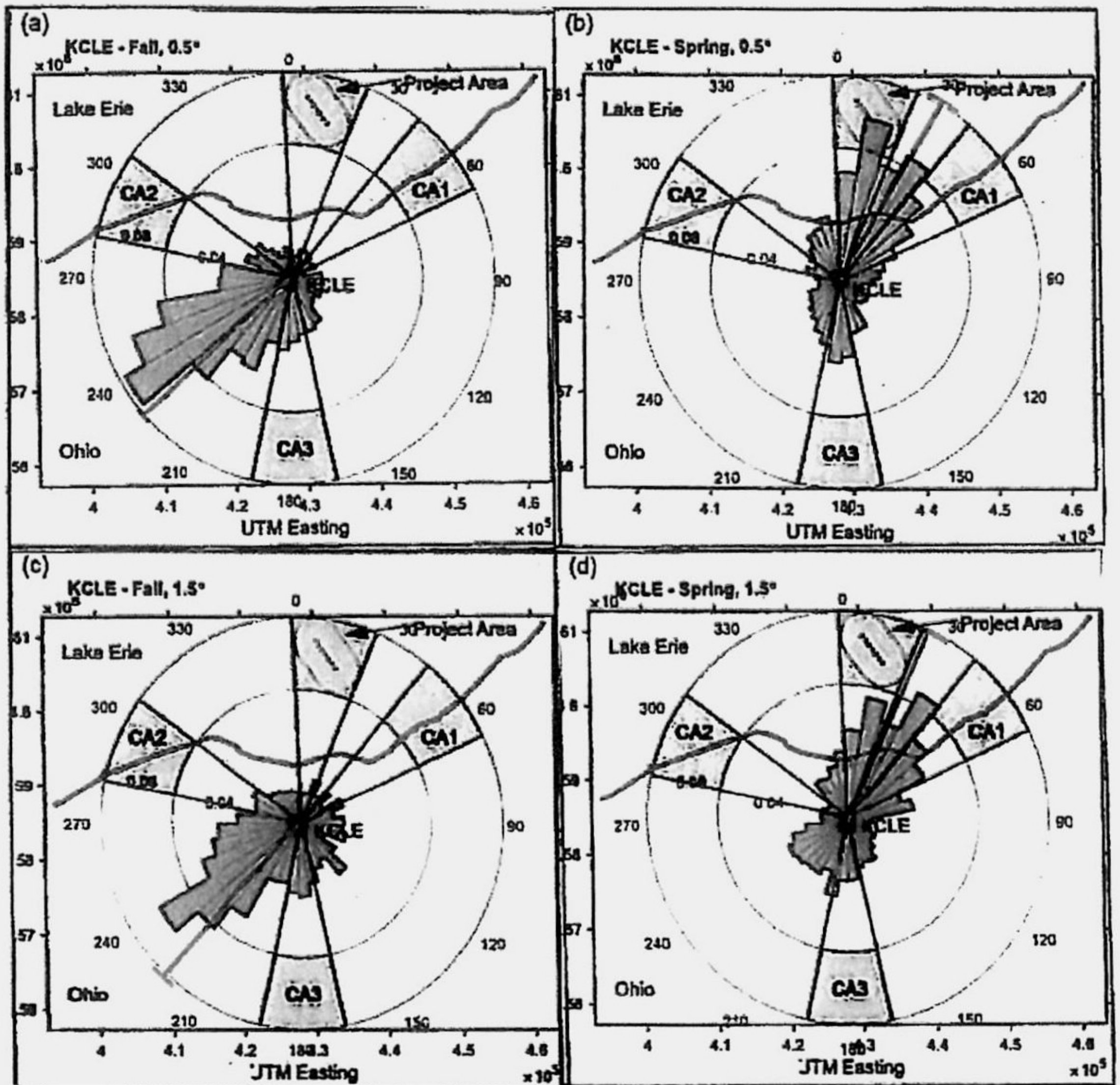


Figure 4. Rose plots showing target movement directions at KCLE at radar beam elevations of 0.5° (a and b) and 1.5° (c and d) in Fall (a and c) and Spring (b and d). Red lines indicate mean direction (radial segment) and 95% confidence interval (perpendicular "T" segment).

United States Department of the Interior

FISH AND WILDLIFE SERVICE

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October 4, 2017

U.S. Department of Energy
Golden Field Office
Attn: Kristin Kerwin
15013 Denver West Parkway
Golden, CO 80401

TAILS# 03E15000-2017-I-1867

Re: Draft Environmental Assessment for Lake Erie Energy Development Corporation's Project Icebreaker, Offshore Cleveland, OH (DOE/EA-2045)

Dear Ms. Kerwin:

This is in response to your August 22, 2017 Draft Environmental Assessment (EA) for the Lake Erie Energy Development Corporation's (LEEDCo's) proposed Project Icebreaker, which involves the construction and operation of six 3.5 megawatt (MW) wind turbines, 12 miles (mi) (19.3 kilometers (km)) of transmission cable, and a substation. The turbines would be installed in Lake Erie, 8-10 mi (12.9-16.1 km) offshore of Cleveland, Cuyahoga County, Ohio. The transmission cable would run from the turbines, across the lake bottom, to the shore, where it would connect to a new substation to be located at the Cleveland Public Power substation. Additionally, 150 feet (ft) (45.7 m) of overhead transmission lines would be constructed to link the new and existing substations. The turbines are expected to operate for 25 years. Each turbine has a rotor diameter of 413 ft (126 m), yielding a rotor-swept area of 3.08 acres (0.012 km^2) per turbine, and 18.48 acres (0.075 km^2) for the total project. At its closest point, each blade will be approximately 65 ft (20 m) above water level. The EA states that LEEDCo (applicant) plans to conduct post-construction monitoring to assess all-bird and all-bat mortality and to monitor avoidance/attraction/displacement that may occur. The EA also states that the applicant plans to develop a Bird and Bat Conservation Strategy that would outline conditions for adaptive management implementation based on the results of post-construction monitoring.

Funding for the project may be provided by the U.S. Department of Energy (DOE) as a U.S. Offshore Wind: Advanced Technology Demonstration Project. According to the Draft EA, "By providing funding, technical assistance, and government coordination to accelerate deployment of these demonstration projects, DOE can help eliminate uncertainties, mitigate risks, and support the private sector in creating a robust U.S. Offshore Wind Energy Industry." Additionally, the U.S. Army Corps of Engineers (Corps) may permit the project under sections 404 and 408 of the Clean Water Act and section 10 of the Rivers and Harbors Act. The Corps published a Public Notice on September 13, 2017 soliciting review and comment on the project under their authorities (Application No. 2010-00223). The U.S. Coast Guard will assess the impact of the project on navigation. The Draft EA has been developed to analyze the potential impacts to the human environment that may occur if DOE authorizes the expenditure of federal funding on this project and the Corps issues permits to allow for construction.

This letter transmits the U.S. Fish and Wildlife Service's (Service) comments on the Draft EA. The Service and DOE have concluded section 7 informal consultation under the Endangered Species Act of 1973, as amended (ESA), thus this letter does not address any ESA issues.

General Comments

In general, the Service agrees with the characterization of impacts to fisheries and benthos included in the Draft EA. Our comments in this letter address our three outstanding concerns: 1) characterizing bird and bat use of the project area; 2) evaluating collision mortality of birds and bats from the operating project; and 3) monitoring to inform items 1 and 2.

Section 2.7.2 of the Draft EA references the Memorandum of Understanding (MOU) between LEEDCo and the Ohio Department of Natural Resources (ODNR) committing to pre- and post-construction wildlife monitoring and states that LEEDCo has had discussions with ODNR and the Service to develop a sampling plan that lays out testing and analyses that will be conducted before, during, and post-construction for birds and bats. While the Service has been engaged in discussions with LEEDCo, please note that the Service is not a party to the MOU, and that only some of the Service recommendations on pre- and post-construction monitoring have been included in the MOU or sampling plan (See Service comments dated Feb. 28, 2017, attached). Also note that the MOU and sampling protocol do not provide detailed methods for several critical components of the pre-and most components of the post-construction monitoring. We *recommend that DOE condition the funding of the project on inclusion of a robust pre- and post-construction monitoring protocol reviewed and commented on by the Service, and that specific funding be targeted for this project component.*

The conclusions reached in the Draft EA regarding potential impacts to birds and bats are based on available data collected primarily outside of the project area. For example, some of the data are from the Cleveland water intake crib (located approximately 3 miles offshore of Cleveland, approximately 5 miles from the project area) or nearshore areas of the lake near Cleveland. Additional data on bird use of the airspace were generated using NEXRAD weather radar data from the Cleveland area which provides limited data about bird and bat use within the airspace that will be occupied by the turbines (the "rotor-swept zone"). Waterfowl surveys conducted by ODNR over Lake Erie several years ago that occurred in the project vicinity are used to inform waterfowl distribution within the project area. Collision mortality estimates were generated using land-based wind projects in the U.S. and Canada. The available bird and bat data is summarized in several appendices to the Draft EA (Appendices J, K, and L). Studies of bird and bat use of the specific project area have been recommended by the Service for several years (Attachment 1, Service correspondence dated April 24, 2009, November 15, 2013, March 24, 2014, October 21, 2016, February 28, 2017, March 3, 2017) but are just starting to be implemented. A bat acoustic study within the project area was started in spring 2017 and aerial waterfowl surveys will begin in fall 2017. Data from these site-specific studies are not available for inclusion in the Draft EA, though the first quarterly report for the bat acoustic survey was recently provided to the Service.

Thus, the conclusions in the Draft EA are based on assumptions that observations from other parts of Lake Erie are relevant to the project area, and that impacts at onshore wind facilities in the U.S. and Canada are relevant predictors of impacts to birds and bats at offshore wind developments in Lake Erie. These assumptions may or may not be accurate. Because of the potential risk of bird and bat mortality, and because this project is designed to be a demonstration project to evaluate offshore wind installation in the Great Lakes, pre-construction monitoring to inform risk and post-construction monitoring to assess actual impacts are necessary components of the project that must be implemented. Should the findings of site-specific pre-construction monitoring yield results that contradict the assumptions in the Draft EA, the findings in the Draft EA should be revisited to ensure accurate information on risk to birds and bats is publicly available. All pre- and post-construction data should be made publicly available such that this project can inform future project planning.

We note that the small size of the project (6 turbines) is driving the effects analysis relative to potential impacts to birds and bats. That is to say, because there are only 6 turbines, even if the per-turbine mortality rates for bird or bats at the project area were to be much higher than at land-based wind projects, the total impact of this project will be minor. While that may be true, one goal of this demonstration project should be to measure what the actual effect of offshore turbines is on birds and bats, to inform potential future wind development in the Great Lakes. If per-turbine impacts are not accurately measured for this precedent-setting project, risk levels of larger future projects may be substantially underestimated.

Section 3.4.1.3

Section 3.4.1.3 of the Draft EA describes the Affected Environment relative to birds and bats. Pages 3-29 and 3-32 describe a NEXRAD weather radar analysis of bird and bat use of the project area (Draft EA Appendix J, Nations and Gordon 2017). Page 3-32 states, "Several recent studies employing marine radar in shoreline environments have demonstrated relatively high densities of nocturnal migrant birds along the shorelines of Lake Erie and Lake Ontario, reinforcing the understanding that such migrants tend to concentrate along coastlines and avoid flying over large water bodies, such as Lake Erie, if possible (Rathbun *et al.* 2016; Horton *et al.* 2016)." Page 3-51 includes a similar statement. These statements are misleading; Rathbun *et al.* (2016) and Horton *et al.* (2016) both document that large numbers of migrants do fly over water bodies. For example, Horton *et al.* (2016) showed that nocturnal migrants flew predominantly to the north and northeast from the coast of Erie County, Ohio during spring. Overwater flight has been observed at all Great Lakes sites reported in these publications. These publications instead state that migrants concentrate on the shoreline during dawn and daytime when they land to rest and refuel. During the actual nocturnal migration, however, migrants commonly cross Lake Erie and all of the other Great Lakes. Additional evidence for migrants crossing over Lake Erie is included in the NEXRAD weather radar analysis appendix (Nations and Gordon 2017). In the spring, the predominant migration movement direction (Figure 4, Appendix J) was to the NNE from Cleveland, indicating that migrants are heading out to cross over the lake.

The NEXRAD weather radar analysis primarily provides data on migrating birds and bats located above the rotor-swept zone, thus most of these migrants would not be at risk from turbine operation. There was, however, some overlap between the rotor-swept zone of the turbine and the area included in the NEXRAD radar analysis (Nations and Gordon 2017):

> "...at the 0.5 degree elevation the height of the lower −3 dB point ranged from 105 to 135 m above the Project Area. Thus, there was some overlap of the radar beam and the rotor-swept zone for the proposed turbines, which have a maximum blade tip height of 146 m."
>
> And
>
> "Differences in migration intensity with radar elevation indicate that, at the Project Area, there are more than twice as many birds at the lower 0.5 degree elevation (Figure 6c and Table 5). While the airspace sampled at this elevation does overlap with the rotor-swept zone, the extent of overlap is small (Figure 3), thus the migrant bird activity detected by this lower beam primarily comes from altitudes immediately above the rotor swept zone of the turbines. Given the limitations of NEXRAD resolution, it is not possible to determine the precise flight altitudes of birds within the radar beam."

Thus, due to the coarse resolution of NEXRAD data, it is impossible to use this data to determine *if birds and bats are flying within the rotor-swept zone or above it. Bird and bat densities at* higher altitudes do not always correlate with densities at lower altitudes, and this may especially be the case in a different environment such as offshore. The general pattern of increasing densities of birds and bats at lower altitudes does fit with what the Service's Avian Radar Team has found at many sites across the Great Lakes (Rathbun *et al.* 2016; Horton *et al.* 2016). However, unlike NEXRAD, the radar units used by the Service are able to track individual targets and distinguish target flight altitude exactly. The densities shown in the Service results indicate that densities often increase as altitude decreases, especially and often significantly at lower altitudes (50-150m) that include the rotor-swept zone. This area is a key gap in the NEXRAD analysis, and a main reason that the Service recommended on-site avian radar studies to be conducted for pre- and post-construction. Unpublished data collected on Lake Erie in Cleveland this fall by the Service (Attachment 2) using avian marine radar indicates large numbers of bats and birds migrating across the lake during fall, often within or near the rotor-swept zone.

The ongoing bat acoustic surveys will help to elucidate how distance from shore affects the number of bat calls detected and will provide project-area specific information on bat call detections as well as information on seasonal passage rates that may inform risk, but more detectors, and detectors within the rotor-swept zone, as requested in the Service's February 28, 2017 letter, would provide a better understanding of these patterns. Other authors (Kunz et al. 2007) have recommended even more acoustic detectors on a per-turbine basis to effectively assess potential flight activity through the rotor-swept zone.

The first quarterly report on the bat acoustic survey was provided to the Service in September, 2017 (Gordon *et al.* 2017). This report indicates that hundreds of bat calls are being detected at both the 7-mile buoy (within the project area) and 3-mile buoy (near the crib) location, and that bats are being detected in spring, summer, and fall at 3 and 7 miles from shore, implying that bats migrate across the lake. A large proportion of bat calls recorded at both buoys have been migratory tree bats (the three species most frequently involved with wind turbine collisions (Arnett *et al.* 2008; Kunz *et al.* 2007; Cryan *et al.*, 2014), and specifically hoary bats, a species of concern for the Service due to their high mortality rates at wind energy facilities (Arnett and Baerwald, 2013).

Page 3-33 of the Draft EA states, "Because there were substantially lower levels of bat activity 3 miles from shore when compared to the onshore activity, and the proposed turbines would be 8 to 10 miles offshore, even lower levels of bat activity are expected where the turbines would be located." This is not an appropriate assumption, as bats that are migrating across Lake Erie could encounter both the crib at 3 miles from the shoreline, and the project area at 10 miles from the shoreline. Acoustic monitoring efforts to date have been inadequate for assessing bat use of the project airspace and risks to bats.

<u>Section 3.4.2.3.</u>

Section 3.4.2.3 of the Draft EA assesses environmental impacts to birds and bats. Birds are known to collide with tall stationary structures such as buildings, power lines, and communication towers. It is estimated that between 100 million and 1 billion birds are killed annually in the U.S. from striking man-made structures (Klem 1990; Manville 2000). Wind turbines pose an added threat to birds which may collide with the stationary base, or may be struck by the spinning blades. Erickson *et al.* (2014) evaluated 116 post-construction mortality studies from wind power projects and based on these estimated that 368,000 birds are struck by turbines each year. Of the observed bird mortality, wood warblers comprise 10.8% of all bird mortalities, second only to larks which comprise 13.7% and are dominated by horned lark mortalities. Horned larks have aerial breeding displays which may make them particularly susceptible to wind turbine collisions (Erickson *et al.* 2014). Shorebirds comprise 1% and waterbirds comprise 0.2% (Erickson *et al.* 2014). Rates of avian collision mortality at existing wind facilities in the east and upper Midwest of the United States have been documented to range from zero to approximately 11 bird fatalities per MW per year (Erickson *et al.* 2014), and post-construction studies at land-based wind projects in Ohio from April-November fall within this range (USFWS unpublished data).

Canada recently analyzed post-construction collision data for 37 wind power projects in Ontario over multiple years ranging from 2006-2014. Data collection was standardized to occur within 50 m of the turbine from April 1-October 31. Based on this data, the estimated mortality for non-raptors was 6.14 +/- 0.31 birds/turbine, with a range of 0-44.31 birds/turbine (Bird Studies Canada *et al.* 2016). Passerines accounted for the most mortality (69%) across wind projects in all of Canada, while waterbirds (which would include shorebirds) accounted for 3.2% of mortality (Bird Studies Canada *et al.* 2016). For projects located along the north shore of Lake Erie in Ontario opposite Cleveland (Port Alma, South Kent, and Erieau), bird mortality rates ranged from 1.15-2.5 birds/MW/year
(see: <u>https://drive.google.com/drive/folders/0B24A4SH_cewXV0VbTENxTGp3LVk</u>). Results from the NEXRAD study (Nations and Gordon 2017) suggest that bird/turbine collision risk for the proposed offshore project is lower than it would be for a similar project located near shore or onshore in the Cleveland area because migration intensity was 2.5 times lower at the project area than over land. However, this fails to account for the observations that birds will sometimes seek

man-made structures to land on while migrating over large bodies of open water such as oil platforms or even freighters (Perkins 1964). This probably results from the migrants encountering adverse weather conditions during the crossing. In such cases, attraction to the turbines could increase mortality rates.

Although avian collision mortality can occur at any time of year, patterns in avian collision mortality at tall towers, buildings, wind turbines, and other structures suggest that the majority of fatalities occur during the spring and fall migration period (NRC 2007). Data from Ontario indicated slightly higher bird mortality during fall (mid-July-Oct. 31) (Bird Studies Canada *et al.* 2016). Erickson *et al.* (2014) also found a peak in mortality in fall, and a smaller peak in spring but cautioned that peaks may be influenced by species-specific behaviors (e.g., horned larks are often found as mortalities in spring, when aerial mating displays may result in more flights into the rotor-swept zone of the turbine). Limited data from existing wind facilities suggest that migrant species represent roughly half the fatalities, while resident species represent the other half (NRC 2007).

The Draft EA indicates that waterfowl and waterbirds have overall low collision susceptibility and are not found in large numbers in the project area. Further, it finds that gulls have high maneuverability and are likely to avoid turbine collisions. The proposed aerial flight surveys in 2017 and 2018 will help to elucidate how distance from shore affects the distribution of waterfowl and waterbirds, and will provide project-area specific information on seasonal passage rates that may inform risk.

While the density of migrating passerines over Lake Erie may be "less than half" than the density over land based on the NEXRAD analysis (Nations and Gordon 2017), there are still likely to be millions of individual birds crossing Lake Erie during spring and fall migration each year, and a proportion of these are flying at altitudes within the rotor-swept zone (Horton *et al.* 2016, also see Attachment 2). Weather patterns likely influence large migration events to some degree, although these patterns are probably complex (Newton, 2008). Among birds, passerines comprise the majority of mortality at wind power projects. With the available data we are unable to estimate how many passerines might be crossing through the project area while flying at altitudes within the rotor-swept zone, and thus that might be at risk of collision with the turbines. The Service recommended conducting a radar study to evaluate this risk, but implementation of the study within the project area has not occurred to date. According to the Draft EA, based on land-based mortality, "studies show fatality rates would most likely be between 2.10-3.35 birds/MW/year for small passerines, most of which are nocturnal migrants, which would lead to roughly 21-42 total bird fatalities per year for the proposed project. However, this is making the assumption that conditions and migrant behavior are the same over land and over water, which as described above may not be accurate.

To minimize the risk of mortality for all birds, LEEDCo has proposed to utilize only flashing red and yellow lights on the turbines and work platforms, respectively. Gehring *et al.* (2009) found that communication towers lit at night with only flashing lights, as opposed to steady-burning lights resulted in 50–71% fewer avian fatalities. If future bird studies in the project area indicate the potential for large numbers of birds to be exposed to the turbines, additional minimization measures (such as turning turbines off during high risk weather events during night migration periods) should be proactively implemented, particularly at night during spring and fall migration when mortality is expected to peak. Further, if post-construction monitoring indicates that bird mortality rates are higher than predicted in the Draft EA, then additional minimization measures should be used in an adaptive management context. The EA currently does not provide or require specific plans to obtain this data. As currently written, future studies remain undefined, are not required, and may not reliably indicate the number of fatalities for both birds and bats that occurs once operations begin. Studies need to be fully defined, should be reviewed by both appropriate state and federal agencies, and be required as part of the EA to be of value in determining impacts on biological systems.

Wind energy facilities in various habitats across the U.S. and Canada have been documented to cause "widespread and often extensive fatalities of bats" (Arnett *et al.* 2008). Within the midwestern U.S. states, bat mortality rates (adjusted for bias such as searcher efficiency, carcass removal, and unsearched areas) range from a low of 1.43 bats/MW/study period at the Big Blue facility in Minnesota (Fagen Engineering, LLC 2014), to 30.61 bats/MW/study period at the Cedar Ridge facility in Wisconsin (BHE Environmental, Inc. 2010). For wind projects located along the north shore of Lake Erie in Ontario opposite Cleveland (Port Alma, South Kent, and Erieau), bat mortality rates ranged from 3.37-6.8 bats/MW/year within 50 m of the turbine from April 1-October 31
(see: https://drive.google.com/drive/folders/0B24A4SH_cewXV0VhTENxTGp3LVk).

At this time, research into the mechanisms that cause mortality of bats at wind power sites is ongoing but collisions associated with moving turbine blades are clear proximate causes of death. It is unclear if bats are attracted to turbines, but the potential for attraction is of concern, particularly in an offshore setting where attraction may be intensified if turbines are perceived by bats as the only available roost (Cryan and Barclay, 2009). Research on how to avoid fatalities is continuing. Currently, only a few operational tools have shown success at avoiding or minimizing take. Feathering of turbines (changing the orientation of the blades out of the direction of the wind in order to stop the blades from turning during low wind speeds) during times when bats are most at risk has been shown to reduce mortality (Arnett *et al.* 2011, Good *et al.* 2012).

The draft EA concludes that the project is most likely to cause mortality of 1-4 bats/MW/year, but because bat and turbine interactions are not well understood, it could cause mortality of as many as 20-30 bats/MW/year. The ongoing bat acoustic studies may help to characterize patterns of bat use of the offshore airspace during various seasons and provide relative information on bat use of the project area (10 mi offshore) compared to areas closer inland. This data may help to inform collision risk to some degree.

To minimize the risk of mortality for all bats LEEDCo has proposed to feather turbine blades until the manufacturer's cut-in speed of 3.0 m/s has been reached at night during fall migration. At a study at Fowler Ridge, IN, feathering below the manufacturer's cut-in speed (3.5 m/s) reduced all-bat mortality by 36% and feathering at higher cut-in speeds showed greater reductions in bat mortality rates (Good *et al.* 2012). If the acoustic studies currently ongoing indicate the potential for large numbers of bats to be exposed to the turbines then DOE should require that the applicant implement higher cut-in speeds, particularly in the fall (August 1-October 31) when most bat mortality occurs, as a minimization measure. For all species of bats, nearly all migration occurs when temperatures are above 50 degrees Fahrenheit, and wind speeds are less than 6.9 m/s at night. Feathering during these conditions could avoid a large proportion of bat mortality (Bowden *et al.* 2014).

Further, if post-construction monitoring indicates that bat mortality rates are higher than 1-4 bats/MW/year, the EA should state whether higher cut-in speeds will be used in an adaptive management context.

<u>Post-construction monitoring</u>

Because of the potential risk of bird and bat mortality, and because this project is designed to be a demonstration project to evaluate offshore wind installation in the Great Lakes, post-construction mortality monitoring is a necessary component of the project that this EA is evaluating. It will be difficult to detect carcasses struck by turbines in the open water environment. Developing and validating methods for generating robust mortality estimates for bats and birds, and testing methods to collect and identify carcasses at offshore wind projects is critically important if this demonstration project is to inform future offshore wind development in the Great Lakes and elsewhere. LEEDCo has proposed several methods of post-construction monitoring and the Service has recommended pursuing certain options, including emerging technological tools (see Service's Feb. 28, 2017 letter, also Flowers 2015, Suryan et al., 2016). However, in order to first test if these technologies would be effective, preferably in conjunction with each other, they need to be tested on land where traditional fatality monitoring could also be done for validation purposes. To date these tests have not occurred. The Service recommends that the draft EA be revised to include a plan for effective fatality monitoring and that the techniques be validated using land-based facilities prior to funding construction and preferably prior to finalizing the EA. We strongly recommend that DOE condition the funding of the project on inclusion of a robust post-construction mortality monitoring protocol which has been reviewed and commented on by the Service, and that specific funding be targeted for this project component.

<u>National Environmental Policy Act (NEPA)</u>

In our October 21, 2016 letter (attached), we advised DOE that we believed an EA was not the proper document for the proposed project. We stated, starting on page 7, that this project had three attributes that typically require an Environmental Impact Statement (EIS) according to CEQ regulations. This included (1) that possible effects on the human environment are uncertain and (2) that the project is precedent setting since it is the first proposed off-shore wind facility in freshwater and that it is intended as a demonstration project. Finally, (3) there is uncertainty regarding the potential impacts of this project, which may be understandable and acceptable for a demonstration project; however, given the lack of defined robust pre- and post-construction studies, there is likely to be little more certainty of biological impacts after the project is constructed and operating than is currently available.

The draft EA is also missing two additional components that should be found in a NEPA document. Except for the Proposed Alternative, this document does not fully analyze any additional alternatives as called for in 40 C.F.R. § 1502.14. The Service recommends an alternative where a complete set of detailed pre- and post-construction studies for impacts to birds and bats are presented and required, along with a robust adaptive management plan to address impacts, should they be greater than anticipated.

A second missing component is a discussion in the Cumulative Impacts section that addresses the cumulative impacts of commercial wind development in Lake Erie under both the existing alternative and the one proposed above. The draft EA states that "by providing funding, technical assistance, and government coordination to accelerate deployment of these demonstration projects, DOE can help eliminate uncertainties, mitigate risks, and support the private sector in creating a robust U.S. Offshore Wind Energy Industry." Thus, one of the cumulative effects of funding the project could be the accelerated development of utility-scale wind power in the offshore waters of Lake Erie. The Cumulative Impacts section does not anticipate or analyze this reasonable outcome. The importance of including detailed studies and adaptive management in one of the alternatives and comparing that to the current Proposed Alternative is that the Cumulative Impacts analysis would showcase the difference in impacts to birds and bats from utility-scale wind developing in Lake Erie between an alternative that provides robust biological studies and assessments of impacts and one with less rigorous pre-construction monitoring and an uncertain post-construction impact analysis method. An alternative with robust pre-and post-construction monitoring and adaptive management would clearly help eliminate uncertainties and mitigate risk, as per the goals of funding the demonstration project, better than an alternative with a to-be-determined method of monitoring, as currently proposed.

<u>Summary</u>

In summary, there is great uncertainty as to how birds and bats are using the airspace in and around the project area, and how many individuals may be exposed to and strike the proposed turbines over the life of the project. Birds and bats in the offshore environment may behave similarly to those on land, or they may not. Pre-construction monitoring data that is in the process of being collected and may be collected in the near future may help to inform some of these gaps. But there are not any detailed plans the Service is aware of to accurately determine numbers and altitudes of nocturnal migrants passing over the construction site which would both help inform the potential for interactions and fatalities and could also determine whether birds and bats are displaced by turbines. Methods for post-construction fatality studies are only conceptual at this point, and will require substantial time and effort to develop and validate. These studies are imperative in order for this project to serve as a valid demonstration project for commercial construction. Bird and bat interactions with wind turbines are not well understood and this is especially true for off-shore facilities.

Existing off-shore wind projects in Europe have collected post-construction data relating to avoidance and displacement of waterfowl, but mortality data has proven to be much more difficult to collect. Pre-construction studies are needed to determine the numbers, altitudes, and behavior of nocturnal migrants and robust post-construction mortality monitoring will be essential to address whether risks are translated to fatalities. Innovative technological methods will be necessary in the offshore environment where traditional monitoring methods are not feasible, but in order to rely on these innovations, they need to be validated at on-shore locations.

We believe that an EA is the incorrect NEPA document for this project. Additionally, in order for an EA to be reasonably sufficient, we believe that DOE should include an alternative that presents defined and adequate pre- and post-construction studies and an adaptive management strategy. Finally, the NEPA analysis should include an analysis of the potential cumulative impacts of facilitating accelerated development of utility-scale wind power in Lake Erie. Thank you for the opportunity to provide comments on this proposed project. Please contact Megan Seymour at extension 16 in this office for further information.

Sincerely,

Dan Everson
Field Supervisor

cc: Erin Hazelton, ODNR Division of Wildlife, Columbus, Ohio. Erin.Hazelton@dnr.state.oh.us
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Attachments:

Attachment 1: Service correspondence on the LEEDCo project: March 3, 2017; February 28, 2017; October 21, 2016; March 24, 2014; November 15, 2013; and April 24, 2009.

Attachment 2: U.S. Fish and Wildlife Service avian radar, preliminary data from Cleveland, Ohio, early fall 2017

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ATTACHMENT 1

Service Correspondence on the LEEDCo Project

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614) 416-8993 / FAX (614) 416-8994

March 3, 2017

Mr. Patrick Donlon
Ohio Power Siting Board
180 East Broad St.
Columbus, OH 43215-3793

TAILS: 03E15000-2016-TA-1571

Re: Icebreaker Wind Farm Project 16-1871-EL-BGN

Dear Mr. Donlon:

This is in reference to the Ohio Power Siting Board's (OPSB) February 2, 2017 letter regarding the proposed Icebreaker Wind Farm Project Application (Application), to be located in Lake Erie offshore of Cleveland, Cuyahoga County, Ohio. The proposed Icebreaker Wind Farm involves the installation of up to six wind turbine generators, submerged electric collection cables, and a facility substation. The total generating capacity of the facility will not exceed 20.7 megawatts (MW). The project is located approximately eight to ten miles off the coast of Cleveland. Only the substation interconnection is occurring on land; no impacts to wetlands or forested areas are anticipated. The project is being proposed by Icebreaker Wind Project Incorporated (Applicant).

The following comments are being provided pursuant to the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d; BGEPA), the Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA), the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1544, 87 Stat. 884; ESA), and the Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j, not including 742 d-l; 70 Stat. 1119), as amended.

GENERAL COMMENTS:

The U.S. Fish and Wildlife Service (Service), Applicant, their representatives, and the Ohio Department of Natural Resources (ODNR) have been involved in discussions regarding this proposed project since 2008. We have participated in numerous meetings and conference calls, and provided recommendations relative to addressing fish and wildlife impact assessment throughout the development of this project. The project has evolved over the years, including changes to the number of turbines and the location of the project relative to the shoreline.

Construction and operation of offshore wind turbines presents a very different set of challenges than land-based turbines in terms of wildlife impact mitigation. Not only are common techniques for quantifying mortality impossible to implement (e.g. carcass surveys), large inland water bodies such as the Great Lakes have unique hydrological, biotic, and ecological properties compared to sea and land installations, for which there is no data and no precedent. This will be the first installation of wind turbines in a freshwater ecosystem anywhere in the world. It will be the first installation of offshore wind anywhere in the Great Lakes, and likely only the second offshore wind facility in the western hemisphere. The manner in which this project is evaluated and permitted will be a model for future similar projects. According to the Application, this project is proposed as a "demonstration-scale project to help assess the potential success for future larger-scale offshore wind farms in Lake Erie and other Great Lakes." Information gathered from this project will be used to assess the feasibility of developing commercial-scale wind facilities in Lake Erie, or the Great Lakes as a whole.

Because of the unknown consequences of developing offshore wind energy in the Great Lakes and the precedent-setting nature of this project, the pre- and post-construction evaluations of potential impacts on fish and wildlife are crucial. As such, it is essential to have rigorous and scalable pre- and post-construction studies within the project area to evaluate potential impacts.

Some pre-construction wildlife studies were initiated by the Applicant in 2010 based on recommendations from the Service and ODNR. These included bat acoustic monitoring April 1 - November 10, 2010 and radar monitoring March 31-October 12, 2010 (Svedlow et al. 2012) from the Cleveland Crib. Two additional surveys were conducted that were not part of the studies recommended by ODNR or the Service (avian acoustic surveys, and boat based nocturnal surveys). Substantial complications occurred during the 2010 radar studies that rendered the study results uninformative to the proposed project area. Further, the radar and acoustic studies did not include the currently proposed project area. The Applicant provided analysis of bird and bat risk using NEXRAD radar data (Livingston, 2008; Nations and Gordon 2017). While these reports characterize bird and bat migration in spring and fall over the project area compared to other areas in the region, NEXRAD data by nature do not provide information on numbers and altitudes of birds and bats flying within the rotor-swept zone of the turbines, which is the data we need to inform risk to these species. Thus, the Service, ODNR, and the Applicant are working on developing a new bird and bat study protocol to be implemented in 2017-2018 that should help inform risk to birds and bats within the currently proposed project location.

Implementation of a pre-construction bird and bat study protocol is challenged by the remoteness of the project area, the depth of water, and limited accessibility during certain seasons (e.g., winter). All of these accessibility limitations drive up the cost of studies and present unique technological hurdles. The Service and ODNR are working with the developer to design a pre-construction bird and bat study protocol that is technologically and economically feasible, scaled to the project size (6 turbines), gathers site specific data where possible, and uses comparable data collected from a more accessible location (for example, the Cleveland Crib) when necessary. While this is not ideal and would not be appropriate for a utility-scale offshore wind project, we believe it will be sufficient for a demonstration scale project. We are also working with the Applicant to design an innovative post-construction monitoring protocol that will use emerging technology to assess a suite of impacts to birds and bats.

ODNR and the Service also requested a suite of aquatic and benthic studies to assess the importance of the project area to fish and to establish baseline conditions pre-construction. The Applicant began implementing these surveys in 2016, and work continues.

Any certificate issued by the OPSB should be contingent upon full implementation of the pre- and post-construction studies agreed upon by the Service, ODNR, and the Applicant.

MIGRATORY BIRD COMMENTS:

The Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA) implements four treaties that provide for international protection of migratory birds. The MBTA prohibits taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. While the MBTA has no provision for allowing unauthorized take, the Service recognizes that some birds may be taken during activities such as wind turbine operation even if all reasonable measures to avoid take are implemented. The Service's Office of Law Enforcement carries out its mission to protect migratory birds not only through investigation and enforcement, but also through fostering relationships with individuals and industries that proactively seeks to eliminate their impacts on migratory birds. Although it is not possible under the MBTA to absolve individuals, companies, or agencies from liability (even if they implement avian mortality avoidance or similar conservation measures), the Office of Law Enforcement focuses on those individuals, companies, or agencies that take migratory birds with disregard for their actions and the law, especially when conservation measures have been developed but are not properly implemented.

The Service strongly encourages developers to coordinate with Service biologists regarding their projects. Proper coordination will help developers make informed decisions in siting, constructing, and operating their facilities. Additionally, the Service hopes to work cooperatively with wind developers to advance the state of the art of wind power siting, construction, and operation. Advancements in these areas will represent great strides toward the environmentally safe development of this otherwise renewable and clean source of energy. The Service recommends that the Applicant develop a Bird and Bat Conservation Strategy (BBCS) to address pre- and post-construction monitoring to assess risk to migratory birds and bats, to identify minimization measures that will be implemented to minimize risk, and to identify potential mitigation actions to implement if such risk reaches high levels. We note and appreciate that page 122 of the Application includes a commitment to complete a BBCS.

The proposed project location is between 8-10 miles off the coast of Cleveland, thus does not provide habitat for many species of birds that breed in Ohio. However, millions of migrating birds move through the Great Lakes region during spring and fall migration each year (Rich et al. 2004, France et al. 2012, Horton et al. 2016) and could cross through the project area and potentially be exposed to risk.

Gordon and Erickson (2016) completed a bird and bat risk assessment for the project using data collected from other land-based wind projects, offshore projects in Europe, and NEXRAD. This assessment concludes low risk of adverse impacts to birds primarily because of the small scale of the project (6 turbines) and because "the level of use of this area by birds and bats is low compared to bird and bat use of terrestrial or nearshore environments" (Gordon and Erickson 2016). We agree that the small number of turbines generally will result in a limited amount of impacts from both mortality and displacement, but we do not believe that the data currently available provides conclusive evidence of low risk based on the level of bird use.

Further, because this project is meant to be a demonstration project with wider applicability to future offshore wind projects, we believe it is important to gather site specific data to understand the baseline use of the project area by birds and compare that with post-construction data to elucidate what the actual impacts are, and to be able to extrapolate those conclusions to a larger project. Thus the question is not just, "is this project 'low' risk to birds?" rather we want to understand larger issues such as, how much risk to birds do offshore turbines present relative to land-based turbines (e.g., how much mortality occurs on a per-MW basis), and how do birds respond to offshore turbines in the Great Lakes?

The waters around Cleveland provide important overwintering habitat for gulls (herring, ring-billed, Bonaparte's, great black-backed, etc.), ducks (greater and lesser scaup, red-breasted and common mergansers, goldeneye, bufflehead, redhead, canvasback), common loons and horned grebes. During winter, flocks of over 10,000 birds are not uncommon near Cleveland. Additionally, several locations (Wendy Park, Edgewater Park, Cleveland Lakefront Preserve, etc.) along the lakeshore are known for their large concentrations of passerines during migration. The site is approximately 4.5 miles from an area designated by The Audubon Society as the Cleveland Lakefront Important Bird Area (IBA). This area was selected as an IBA due to the large concentrations of birds that congregate there during spring and fall migration (also wintering waterfowl, gulls, and eagles). ODNR completed two years of spring and fall pelagic bird distribution surveys in the offshore waters of Lake Erie (Norris and Lott 2011). These surveys indicate that during spring and/or fall common loon, horned grebe, Bonaparte's gull, common merganser, red-breasted merganser, ring-billed gull, herring gull, double-crested cormorants, and goldeneye are likely to occur in the vicinity of the project area in numbers ranging from single individuals to flocks of several hundred (Norris and Lott 2011).

The Application indicates that risk to waterfowl is low due to the low abundance of birds near the turbine sites and the tendency for waterfowl to avoid turbine locations, but project-specific data on waterfowl use and abundance is lacking. We are currently working with the Applicant and ODNR to recommend site-specific pre- and post-construction waterfowl surveys fall through spring to quantify waterfowl use in the project area before and after construction, to better document displacement effects, should they occur.

Large concentrations of waterfowl in the offshore environment may attract raptors. Peregrine falcons have been observed hunting from the Cleveland Crib (~3 miles from shore); therefore turbines may provide similar foraging opportunity for species like peregrines, though most species of raptor avoid flying over large open bodies of water due to the absence of thermals. We generally agree that because the project is so far from the shoreline, overall raptor use of the project area is likely to be low, and thus collision risk to raptors is also likely low.

The bird and bat risk analysis (Gordon and Erickson 2016) categorizes the risk to nocturnally migrating songbirds as "low," based on our understanding of bird migration along the shorelines of the Great Lakes and NEXRAD analysis of the open water. NEXRAD data generally provides coarse information on densities of birds migrating well above the height of the rotor-swept zone and thus does not accurately characterize risk to songbirds flying within the rotor-swept zone. While the intent of the 2010 radar study was to help quantify the risk to migratory songbirds from the Applicant's project, and was at a scale appropriate to address the question, due to radar malfunctions, the site where the radar was located, the time when the radar was operational, and other factors, the data obtained was not sufficient to inform risk. The Service is now working with the Applicant to design a radar project (both pre- and post-consruction) to provide important site-specific information for assessing the potential impacts of offshore wind facilities on nocturnally migratory songbirds.

BALD EAGLE COMMENTS:

The project lies within the range of the bald eagle (*Haliaeetus leucocephalus*). Bald eagles are protected under the Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA), and are afforded additional legal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d, BGEPA). The BGEPA prohibits, among other things, the killing and disturbance of eagles.

Bald eagles nest in super canopy trees and typically forage on fish, mammals, and carrion. The project area does not support suitable nesting habitat, and it is unlikely that eagles would forage eight to ten miles offshore during the summer, when plentiful food resources are present much closer to their nesting habitats. The Service anticipates that take of eagles is unlikely during the summer due to the distance this facility is from the shoreline. Conversely, in winter when ice forms along the shoreline it may force wintering birds closer to the proposed facility. Within the last several years Lake Erie has almost completely frozen over. As the ice builds along the shoreline it forces ducks, gulls, etc. further into the lake. Eagles, which will feed on fish and waterfowl, will congregate long the leading edge of the ice, or near open leads in the ice. Should the ice extend far enough, it may put waterfowl and eagles in close proximity to the turbines. The Service is currently working with the Applicant to develop a study protocol and analysis of Lake Erie ice formation that will inform bald eagle risk during the winter based on ice conditions. If take of eagles cannot be avoided, the Applicant should work with the Service's Division of Migratory Birds to obtain an eagle take permit.

ENDANGERED SPECIES COMMENTS:

The proposed project is located in Cuyahoga County, in Ohio. There are five species of birds or bats that are federally endangered, threatened, proposed, or candidate species that may occur in Cuyahoga County during some portion of the year: Indiana bat (*Myotis sodalis*, endangered), northern long-eared bat (*Myotis septentrionalis*, threatened) Kirtland's warbler (*Setophaga kirtlandii*, endangered), piping plover (*Charadrius melodus*, endangered), and red knot (*Calidris canutus rufa*, threatened).

Cuyahoga County has confirmed records for Indiana and northern long-eared bats. Suitable summer habitat for Indiana bats and northern long-eared bats consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags ≥3 inches diameter at breast height (dbh) that have any exfoliating bark, cracks, crevices, hollows and/or cavities), as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Individual trees may be considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 feet (305 meters) of other forested/wooded habitat. Northern long-eared bats have also been observed roosting in human-made structures, such as buildings, barns, bridges, and bat houses; therefore, these structures should also be considered potential summer habitat. Both of these species may travel several hundred miles between their summering habitat and winter hibernacula (Griffin 1945, Winhold and Kurta 2006). In the winter, Indiana bats and northern long-eared bats hibernate in caves and abandoned mines.

The project area does not provide suitable summer or hibernation habitat for Indiana bats or northern long-eared bats. Thus, no impact to these species is anticipated during the summer or winter. The only potential risk periods for either of these species are during spring and fall migration.

The Indiana bat range does not extend into Canada. Thus, there is no reason to expect that Indiana bats would be flying across Lake Erie during spring or fall migration. Therefore we do not anticipate that this species will be impacted by the proposed project.

The range of the northern long-eared bat does include Canada north of the project area. However, northern long-eared bats are thought to be short-distance migrants. Short migratory movements between summer roost and winter hibernacula between 56 km (35 mi) and 89 km (55 mi) have been documented most often (Nagorsen and Brigham 1993 p. 88; Griffin 1945, p. 53). However, movements from hibernacula to summer colonies may range from 8 to 270 km (5 to 168 mi) (Griffin 1945, p. 22). Thus it is unlikely that northern long-eared bats would be migrating long distances across the open waters of Lake Erie (~50 miles of open water from the Cleveland shore to the Canada shore). Additional acoustic surveys proposed to occur offshore will help to evaluate potential risk to this species from offshore wind development.

Piping plovers, red knots, and Kirtland's warblers all migrate through Ohio but none are known to nest or overwinter within the state.

The Great Lakes population of piping plover nests primarily in Michigan and consists of approximately 63 pairs of birds. These birds overwinter primarily along the Atlantic coast, with some along the Gulf coast (USFWS 2009). While their migration paths are unknown, they have been documented to stop over on sand beaches along the shore of Lake Erie in Ohio. It is unknown if they migrate across the open waters of Lake Erie, or if their migration path would take them through the proposed project area.

Kirtland's warblers nest in young stands of Jack pines primarily in Central Michigan. Their current population is over 3,000 individuals (USFWS 2012a). They overwinter in the Bahamas. Individual birds have been banded during spring and fall migration, and geo-locators have indicated at least some of these birds are likely to have migrated across open waters of Lake Erie. Further, Kirtland's warblers have been documented to stop over all along the Lake Erie shoreline in Ohio (USFWS 2012a).

Red knots nest in the high arctic, and winter along both coasts of North America and south into Central and South America. While the vast majority of the red knot population migrates along the Atlantic and Pacific coastlines, occasionally small numbers of birds have been found in Ohio, typically along marshes in the western basin of Lake Erie. The proposed location for the facility does not have suitable habitat for these species. Most observations of these species in Ohio occur along the shoreline of the western basin of Lake Erie where there is more stopover habitat.

FISHERIES COMMENTS:

One of the responsibilities of the Service is to manage interjurisdictional fisheries, i.e., fisheries that are managed by more than one state or nation. The waters of Lake Erie are managed by four states (Michigan, Ohio, Pennsylvania, and New York), and Canada. A component of the pre-construction survey project developed jointly between ODNR and the Service are studies to assess the fisheries in the proposed project area and to evaluate potential risk to fish during construction and operation of the project, including the electrical lines. Pre-construction studies began in 2016 and are still ongoing to establish baseline conditions. Post-construction studies are being developed by ODNR and the Applicant, with Service input to evaluate actual impacts to fish and the aquatic environment.

NON-LISTED BAT COMMENTS:

Less than a decade ago the biggest threats to bat populations were loss of hibernacula and destruction of summer habitat. Since then the spread of white-nose syndrome (WNS), a novel fungal disease rapidly spreading across the Midwest, has caused the death of millions of cave hibernating bats (USFWS 2012b). Populations of cave bats have declined so significantly, mostly attributed to WNS, that the Service has recently listed the northern long-eared bat as a threatened species. The Service is currently conducting status reviews for two additional species, the little brown bat (*Myotis lucifugus*) and tri-colored bat (*Perimyotis subflavus*) due to declines associated with WNS. Both of these species were documented in acoustic surveys conducted in 2010 (Svedlow et al. 2012).

As of September 2011, the 13,361 installed MW of wind energy in the Midwestern U.S. is anticipated to cause mortality of, on average, 106,000 bats per year (Arnett and Baerwald 2013). The majority of these are long-distance migrating tree bats, but cave hibernating bats also make up a small proportion of mortality. A recent publication indicated that the hoary bat population could experience "rapid and severe declines…within 50 years and increased risk of extinction in 100 years" solely based on mortality occurring at existing wind projects (Frick et al. 2017).

The results of the bat acoustic study at the Cleveland Crib (Svedlow et al. 2012) state that 4 bat passes/detector-night were recorded in 2009. Ninety five percent of the calls recorded were of the three bat species most susceptible to collisions with wind turbines (Svedlow et al. 2012, Arnett and Baerwald 2013). The bird and bat risk assessment (Gordon and Erickson 2016) indicates that the number of bat calls detected during acoustic monitoring at the Cleveland Crib in 2010 was on the low end of detections compared to other land-based wind projects, but fails to note that other comparable land-based wind projects with similar rates of bat acoustic calls are among the sites with the highest post-construction bat fatality rates (e.g., Fowler Ridge, Forward Energy, Blue Sky Green Field, etc.).

There are several factors that confound the results of the bat acoustic survey conducted on the Cleveland Crib in 2009. Since all monitoring had to be conducted from the Cleveland Crib, acoustic monitoring sites were co-located with radar monitoring locations. Radar has been shown to reduce bat activity, potentially due to electromagnetic fields causing discomfort (Nicholls and Racey 2007). Large concentrations of insects were also observed swarming above the Cleveland Crib. Bats have been observed pausing during migration to take advantage of congregations of insects around offshore wind turbines (Ahlén et al. 2007, 2009). Thus the acoustic monitoring included a factor that may reduce bat activity, and one that may increase bat activity. It is unknown if either factor influenced the number of detections recorded at this site.

The Applicant's bird and bat risk assessment acknowledges the difficulty in predicting bat mortality rates for the project due to our limited understanding of bat and wind turbine interactions, but concludes that the overall bat collision risk is low due to the small number of turbines (Gordon and Erickson 2016), regardless of whether or not the mortality rates per megawatt are at the low or high end of the spectrum of mortalities seen at land-based wind facilities.

We believe that the available information is insufficient to determine bat mortality risk on a per-MW basis, given the lack of site-specific data and the inconsistencies in pre- and post-construction data collected at land-based wind projects. We believe it is important to gather site specific data to understand the baseline use of the project area by bats and compare that with post-construction data to elucidate what the actual impacts are, and to be able to extrapolate those conclusions to a larger project. Thus the question is not just, "is this project 'low' risk to bats?" rather we want to understand larger issues such as, how much risk to bats do offshore turbines present relative to land-based turbines (e.g., how much mortality occurs on a per-MW basis), and how do bats respond to offshore turbines in the Great Lakes?

The Service is working with the Applicant to develop a new radar and acoustic monitoring protocol that will evaluate bat activity within the proposed project area pre- and post-construction. These studies are anticipated to be completed in 2017-2018. These studies will provide a baseline index of bat activity within the project with which to compare post-construction data on behavior and mortality. Innovative methods will be used to estimate bat mortality post-construction with the aim of generating bat megawatt mortality rates that can be extrapolated to larger offshore projects, compared with onshore projects, and to determine if minimization measures to limit mortality are necessary.

To date the only mechanism known to reduce bat mortality at wind turbines is to curtail turbines during nights of low wind speed, which is the period when bats are most susceptible to being struck. Should this facility be constructed, the Service requests that at a minimum, turbines should be curtailed (the blades should be oriented such that they do not catch the wind) until the manufacturer's cut-in speed (3.0 m/s for the turbine model proposed in the Application) is reached at night during bats' active periods (generally April-October). If, based on the results of post-construction monitoring, bat mortality is anticipated to be high, a higher cut-in speed may be warranted during periods of time when bats are most at risk.

POST-CONSTRUCTION MONITORING:

In order to assess the actual impact of the project in migratory birds, bats, fish, and the aquatic environment, post-construction monitoring is critical. Further, one of the purposes of a small-scale demonstration project is to assess the impacts of the project and be able to extrapolate those impacts to a larger scale. Thus, this project should have a valid post-construction monitoring plan that is approved by both the ODNR and Service that quantitatively and qualitatively describes impacts to birds, bats, and aquatic resources.

This project presents unique risks to migratory bats and migratory birds due to the proximity of the project area to the offshore waters of Lake Erie. Because the turbines will be sited in an open water environment, conventional post-construction mortality monitoring to determine impact of the project and birds and bats will be impossible to implement. Thus, innovative new methods for monitoring bird and bat mortality in the offshore environment will have to be developed and implemented, and their reliability is unknown. The Applicant, Service, and ODNR are currently evaluating multiple innovative methods for assessing impacts to birds and bats. A post-construction monitoring plan for fisheries has been developed and is being finalized. Implementation of a post-construction monitoring plan for birds, bats, fish, and the aquatic environment, agreed upon by the Service, ODNR, and Applicant should be made a condition of any issued permit.

This letter provides technical assistance only and does not serve as a completed section 7 consultation document. If project plans change, if portions of the proposed project were not evaluated, or if additional information on listed or proposed species or their critical habitat becomes available, it is our recommendation that you reinitiate coordination with this office.

If you have questions, or if we can be of further assistance in this matter, please contact our office at (614) 416-8993 or ohio@fws.gov.

Sincerely,

Dan Everson
Field Supervisor

cc: Scudder Mackey, ODNR (via e-mail)
Kate Parsons, ODNR (via e-mail)
Jeff Gosse, USFWS Region 3 (via e-mail)

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LeedCo Icebreaker Pre-construction and Post-construction Monitoring Survey Protocol

U.S. Fish and Wildlife Service and Ohio Department of Natural Resources Division of Wildlife

Comments

Feb. 28, 2017

The below comments represent U.S. Fish and Wildlife Service and Ohio Department of Natural Resources Division of Wildlife recommendations relative to the matrix of pre- and post-construction monitoring options provided by LeedCo via e-mail on January 5, 2017.

1. Bat acoustic monitoring
   a. Pre-construction
      i. On 10 mile large buoy—high (~50 m or as high as possible) and low (~water level) detectors. If the "high" and "low" detectors are separated by at least 40 m, add a "middle" (~30 m) detector too.
      ii. On 3 and 7 mile buoys—low detector
      iii. On Cleveland crib—high (~50 m) and low (close to water surface) detectors
      iv. Per ODNR protocol, use AnaBat detectors (either SD1 or those equipped with CF ZCAIMS), with sensitivity adjusted to detect a calibration tone3 at 20 meters.
      v. March 15-November 15, half hour before sunset until half hour after sunrise; all monitors running concurrently for the entire season.
   b. Post-construction
      i. On 3 turbines (at least one on an end)—high (nacelle), medium (~ 30 m), and low (~10 m)detectors
      ii. On crib—high, low detectors
      iii. On 10 mile buoy –high and low detectors
   c. Rationale
      i. Provides bat species composition at various altitudes, index of bat activity overall and at various heights, seasonal patterns of movements. Allows comparison between site-specific data and crib data, assuming that site-specific data may not be as high as can be obtained from crib.
   d. Successful performance criteria
      i. 80% of nights per detector recorded during active period (March 15-Nov 15)
2. Waterfowl aerial surveys—with observer
   a. Pre-construction, *see attached protocol*
      i. Focus on waterfowl (esp. red-breasted mergansers that are easily spooked), bald eagles, ice relative to location of birds
      ii. Survey transects should run parallel to the turbine string.
      iii. Dates: mid-October - end of May
      iv. Frequency: Every 2 weeks

v. Transect spacing: Transects should be close enough to the turbines to observe birds between the turbines, but need to be a safe distance from the blades.
vi. Flight heights: 76-100 m in order to detect small waterbirds.
vii. Flight speeds: 150-200 km/h (unless constrained by local flying restrictions)
viii. Weather conditions: 4 or below on the Beaufort scale, winds approximately 37 km/h or less. Minimum of 3.2 km of visibility (or pilot's discretion).
ix. GPS location for each bird or flock should be recorded.

b. Post-construction
  i. Similar transect protocol as pre-construction
  ii. Year 1 after construction, year 4 after construction

c. Rationale
  i. *Species numbers, distribution, use of project area seasonal patterns; eagles;* ice; avoidance/attraction/displacement

d. Successful performance criteria
  i. Bi-weekly surveys during designated timeframe in appropriate weather conditions.

3. Radar
  a. Boat based radar is not technologically there yet, nor cost advantageous, and it focuses on waterfowl, but we have other methods outlined to address waterfowl. NEXRAD data is not useful for assessing bird/bat behavior within rotor swept zone, which is the data we need. Thus we suggest these approaches should not be considered further.
  b. Pre-construction
    i. We strongly recommend S-band radar, *see attached protocol.*
    ii. Preferred is radar data from project area—FWS and ODNR have been requesting this information since 2008. We still advocate for a single radar, on its own platform, within project area for spring and fall season of pre-construction monitoring as the preferred option.
    iii. *Our second choice* is to install one or all turbine bases prior to fall (2017), put a radar on one of the turbine bases for fall 2017-spring 2018, then install turbines after spring 2018.
    iv. Our third choice is to install one or all turbine bases prior to fall. Once the first turbine base is installed at the furthest point from shore, place radar unit on it and begin collecting data on fall migration as other bases are being installed. Install towers, with radar on platform collecting data until last tower is erected. *(Assumes data collected for 6-8 weeks over fall migration period, which is key focus).* Additionally, install radar on Cleveland crib with elevated antenna for spring and fall.
      1. Limitations of this approach: We are only getting fall data (we believe that fall is the most important season due to high bat mortality in fall migration), no information on spring risk. We would use the comparison between crib data and onsite data in fall to extrapolate what may be occurring onsite in spring. *This is not ideal, but we think it is workable.*

Construction activities may cause "clutter" on the radar map and may alter bird activity within the project area.

v. Site specific radar data is critical to our analysis. If none of the above options can be implemented, we will work with the applicant to evaluate other methods of obtaining site specific radar data.

c. Post-construction

i. Preferred is single radar, on its own platform, within project area, in years 1, 3, and 5, from spring-fall.

ii. Our second choice is 2 radars mounted on turbine platforms, in years 1, 3, and 5, from spring-fall.

d. Rationale

i. Site specific data on night migration of birds and bats. Altitude data of bird and bat targets within rotor swept zone, counts of targets, peak dates of migration, seasonal patterns. Avoidance/attraction/displacement.

ii. Because this is a pilot project the intent is to study and understand the impact of the project on various resources. Without project-specific radar information we cannot get key information needed to understand that impact.

e. Successful performance criteria

i. Site-specific data; radars operating and collecting data over at least 80% of nights during spring/fall migration period.

4. Carcass monitoring

a. Pre-construction—proof of concept development

i. Bat nets—We believe this concept could have merit, but we would like to see a more fleshed-out conceptual proposal first. Please draft a detailed proposal and plans, and a land-based test concept and submit to FWS and ODNR for review. Be sure to consider carcass distribution of bats relative to distance from turbine. Net should be designed to collect at least 30% of bat carcasses and carcasses should be recoverable from the nets.

ii. "Thunk" detection—We believe this concept could have merit. We request follow-up with the technology developer to ensure the technology could be ready to deploy within the project timeframe (testing in year 1, deployment in 2018-2019, etc.). Please draft a detailed proposal and plans, and a land-based test concept and submit to FWS and ODNR for review.

iii. Identiflight—The original application for this technology (detecting golden eagles during daylight and shutting down turbines) is very different that the application needed for this project (detecting small nocturnal animals striking turbines). We think that the other options are more applicable and closer to being ready than this option. We suggest not using this option at this time.

b. Post-construction

i. Bat nets— If proof-of-concept test works, then install on 3 turbines during years 1, 3, and 5, and through the lifespan of the technology.

ii. "Thunk detection"—If proof-of-concept test works, then install on 3 turbines during years 1, 3, and 5, and beyond, through the lifespan of the technology.

iii. Live observers—do not recommend this for carcass monitoring, as most mortality is expected to occur at night and could not be observed. Do not recommend this for waterfowl displacement study because aerial flights and radar would be better to address displacement.

c. Rationale—to detect collisions of birds/bats, identify carcasses at least to guild

d. Successful performance criteria—ability to detect bird/bat collisions. Generate a reasonable estimate of collisions/MW/year. Set up an adaptive management program to address potential performance issues with new technology.

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. Fish and Wildlife Service
Ecological Services Office
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Columbus, Ohio 43230
(614) 416-8993 / Fax (614) 416-8994

October 21, 2016

Mr. Roak Parker
U.S. Department of Energy
15013 Denver West Parkway,
Golden, CO 80401

TAILS: 03E15000-2016-TA-1571

Re: Development of an Environmental Assessment for the Icebreaker Wind Facility, DOE/EA-2045

Dear Mr. Parker:

This is in reference to the development of an Environmental Assessment for Lake Erie Energy Development Corporation's ("LEEDCo") proposed Icebreaker Wind Facility. The proposed project involves the installation of up to six wind turbine generators, underground collection cables, and connection to an existing substation. The total generating capacity of the facility will not exceed 20.7 MW.

The project is located in Lake Erie, approximately eight to ten miles off the coast of Cleveland, OH in Cuyahoga County. This project plans to connect to an existing substation in Cleveland, thus transmission lines will be trenched into the substrate of Lake Erie from the shoreline to the project (~12 miles). The majority of this project will occur within Lake Erie with only the substation interconnection occurring on land; no impacts to wetlands or forested area are anticipated.

The following comments are being provided pursuant to the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d; BGEPA), the Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA), the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1544, 87 Stat. 884; ESA), the Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j, not including 742 d-l; 70 Stat. 1119), as amended.

The U.S. Fish and Wildlife Service (Service), LEEDCo, their representatives, and the Ohio Department of Natural Resources (ODNR) have been involved in discussions regarding this proposed project since 2008. We have participated in numerous meetings, conference calls, and correspondence regarding this project. LEEDCo initiated some pre-construction wildlife studies in 2010 based on recommendations from the Service and ODNR. These included bat acoustic monitoring April 1 - November 10, 2010 and radar monitoring March 31-October 12, 2010 (Svedlow et al. 2012). Two additional surveys were conducted that were not part of the studies recommended by ODNR and the Service (avian acoustic surveys, and boat based nocturnal surveys). Due to the potential impacts to fisheries ODNR and the Service requested several surveys to assess the importance of the area as a fishery. LEEDCo is currently working with

ODNR and the Service to undertake the fisheries studies. Substantial complications occurred during the 2010 radar studies that rendered the study results uninformative to the proposed project area. Further, the radar and acoustic studies did not include the currently proposed project area. Thus, the Service and LEEDCo are working on developing a new radar and acoustic study protocol (among other studies) to be implemented in 2017 that should help inform risk to wildlife from the proposed project at the proposed location.

GENERAL COMMENTS:

Construction of offshore wind turbines presents a very different set of challenges than land-based turbines in terms of wildlife impact mitigation. Not only are common techniques for quantifying mortality impossible to implement (e.g. carcass surveys), large inland water bodies such as the Great Lakes have unique hydrological, biotic, and ecological properties compared to sea and land installations, for which there is no data and no precedent. Because of the unknown consequences of developing offshore wind energy in the Great Lakes and the precedent-setting nature of this project, the pre- and post-construction evaluations of potential impacts on wildlife necessarily must meet a standard of rigor greater than wind projects on land. Further, this project has always been, and continues to be, proposed as a "demonstration project" or "pilot-project." Information gathered from this project will be used to assess the feasibility of developing commercial-scale wind facilities in Lake Erie, or the Great Lakes as a whole. As such, it is essential to have scalable pre- and post-construction studies to evaluate potential impacts.

MIGRATORY BIRD COMMENTS:

The Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA) implements four treaties that provide for international protection of migratory birds. The MBTA prohibits taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. While the MBTA has no provision for allowing unauthorized take, the Service recognizes that some birds may be taken during activities such as wind turbine operation even if all reasonable measures to avoid take are implemented. The Service's Office of Law Enforcement carries out its mission to protect migratory birds not only through investigation and enforcement, but also through fostering relationships with individuals and industries that proactively seeks to eliminate their impacts on migratory birds. Although it is not possible under the MBTA to absolve individuals, companies, or agencies from liability (even if they implement avian mortality avoidance or similar conservation measures), the Office of Law Enforcement focuses on those individuals, companies, or agencies that take migratory birds with disregard for their actions and the law, especially when conservation measures have been developed but are not properly implemented.

The Service strongly encourages developers to coordinate with Service biologists regarding their projects. Proper coordination will help developers make informed decisions in siting, constructing, and operating their facilities. Additionally, the Service hopes to work cooperatively with wind developers to advance the state of the art of wind power siting, construction, and operation. Advancements in these areas will represent great strides towards the environmentally safe development of this otherwise renewable and clean source of energy. The Service recommends that LEEDCo develop a Bird and Bat Conservation Strategy (BBCS) to address pre- and post-construction monitoring to assess risk to migratory birds and bats, to identify minimization measures that will be implemented to minimize risk, and to identify potential mitigation actions to implement if such risk reaches high levels.

The proposed project location is between 8-10 miles off the coast of Cleveland, thus does not provide habitat for many species of birds that breed in Ohio. But, millions of migrating birds move through the Great Lakes region during spring and fall migration each year (Rich et al. 2004, France et al. 2012, Horton et al. 2016).

The waters around Cleveland provide important overwintering habitat for gulls (herring, ring-billed, Bonaparte's, great black-backed, etc.), ducks (greater and lesser scaup, red-breasted and common mergansers, goldeneye, bufflehead, redhead, canvasback), common loons and horned grebes. During winter, flocks of over 10,000 birds are not uncommon near Cleveland. Additionally, several locations (Wendy Park, Edgewater Park, Cleveland Lakefront Preserve, etc.) along the lakeshore are known for their large concentrations of passerines during migration. The site is approximately 4.5 miles from an area designated by The Audubon Society as the Cleveland Lakefront Important Bird Area (IBA). This area was selected as an IBA due to the large concentrations of birds that congregate there during spring and fall migration (also wintering waterfowl, gulls, and eagles). Within the 2013 Avian Risk assessment it contends that "the Icebreaker site does not appear to be on a heavily used migration path for waterfowl or seabirds." While large numbers of birds may not feed within the area, they likely cross through *the area* to reach their overwintering areas near shore. These large concentrations of birds may attract raptors. Peregrine falcons have been observed hunting from the Cleveland crib (~3 miles from shore); therefore turbines may provide similar foraging opportunity for species like peregrines.

While the intent of the 2010 radar study was to help quantify the risk to migratory birds from construction and operation of the LEEDCo project, due to radar malfunctions, the site where the radar was located, the time when the radar was operational, and other factors, the data obtained was not sufficient to inform risk. The Service is now working with LEEDCo to design a radar project (both pre- and post-construction) to address our concerns and provide critical information for assessing the potential impacts of offshore wind facilities in the Great Lakes. We anticipate that this new radar study will occur in 2017. Until we have the results of this study we cannot assess the potential impact of the project on migratory birds.

BALD EAGLE COMMENTS:

The project lies within the range of the bald eagle (*Haliaeetus leucocephalus*). Bald eagles are protected under the Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA), and are afforded additional legal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d, BGEPA). The BGEPA prohibits, among other things, the killing and disturbance of eagles.

Bald eagles nest in super canopy trees and typically forage on fish, mammals, and carrion. The project area does not support suitable nesting habitat, and it is unlikely that eagles would forage eight to ten miles offshore during the summer, when plentiful food resources are present much closer to their nesting habitats. The Service anticipates that take of eagles is unlikely during the summer due to the distance this facility is from the shoreline. Conversely, in winter when ice forms along the shoreline it may force wintering birds closer to the proposed facility. Within the last several years Lake Erie has almost completely frozen over. As the ice builds along the shoreline it forces ducks, gulls, etc. further into the lake. Eagles, which will feed on fish and waterfowl, will congregate long the leading edge of the ice, or near open leads in the ice. Should the ice extend far enough, as it did this past winter, it may put waterfowl and eagles in close proximity to the turbines. The Service is currently working with LEEDCo to develop a study protocol that will inform bald eagle risk during the winter. Until this study is completed, we cannot assess the potential impact of the project on bald eagles. If take of eagles cannot be avoided, LEEDCo should work with the Service's Division of Migratory Birds to obtain an eagle take permit.

ENDANGERED SPECIES COMMENTS:

The proposed project is located in Cuyahoga County, in Ohio. There are five species of birds or bats that are federally endangered, threatened, proposed, or candidate species that may occur in Cuyahoga County. Indiana bat (*Myotis sodalis*, endangered), northern long-eared bat (*Myotis septentrionalis*, threatened) Kirtland's warbler (*Setophaga kirtlandii*, endangered), piping plover (*Charadrius melodus*, endangered), and red knot (*Calidris canutus rufa*, threatened).

Cuyahoga County has confirmed records for Indiana and northern long-eared bats. Suitable summer habitat for Indiana bats and northern long-eared bats consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags ≥3 inches diameter at breast height (dbh) that have any exfoliating bark, cracks, crevices, hollows and/or cavities), as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Individual trees may be considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 feet (305 meters) of other forested/wooded habitat. Northern long-eared bats have also been observed roosting in human-made structures, such as buildings, barns, bridges, and bat houses; therefore, these structures should also be considered potential summer habitat. Both of these species may travel several hundred miles between their summering habitat and winter hibernacula (Griffin 1945, Winhold and Kurta 2006). In the winter, Indiana bats and northern long-eared bats hibernate in caves and abandoned mines.

The LEEDCo project area does not provide suitable summer or hibernation habitat for Indiana bats or northern long-eared bats. Thus, no impact to these species is anticipated during the summer or winter. The only potential risk periods for either of these species are during spring and fall migration.

The Indiana bat range does not extend into Canada north of the project area. Thus, there is no reason to expect that Indiana bats would be flying across Lake Erie during spring or fall migration. Therefore we do not anticipate that this species will be impacted by the proposed project.

The range of the northern long-eared bat does include Canada north of the project area. However, northern long-eared bats are thought to be short-distance migrants. Short migratory movements between summer roost and winter hibernacula between 56 km (35 mi) and 89 km (55 mi) have been documented most often (Nagorsen and Brigham 1993 p. 88; Griffin 1945, p. 53). However, movements from hibernacula to summer colonies may range from 8 to 270 km (5 to 168 mi) (Griffin 1945, p. 22). Thus it is unlikely that northern long-eared bats would be migrating long distances across the open waters of Lake Erie (~50 miles of open water from the Cleveland shore to the Canada shore). Additional acoustic surveys proposed to occur offshore are currently being developed by the Service and LEEDCo and will help to evaluate potential risk to this species from offshore wind development.

Piping plovers, red knots, and Kirtland's warblers all migrate through Ohio but none are known to nest or overwinter here.

The Great Lakes population of piping plover nests primarily in Michigan and consists of approximately 63 pairs of birds. These birds overwinter primarily along the Atlantic coast, with some along the Gulf coast (USFWS 2009). While their migration paths are unknown, they have been documented to stop over on sand beaches along the shore of Lake Erie in Ohio. It is unknown if they migrate across the open waters of Lake Erie, or if their migration path would take them through the proposed project area.

Kirtland's warblers nest in young stands of Jack pines primarily in Central Michigan. Their current population is over 3,000 individuals (USFWS 2012a). They overwinter in the Bahamas. Individual birds have been banded during spring and fall migration, and geo-locators have indicated at least some of these birds are likely to have migrated across open waters of Lake Erie. Further, Kirtland's warblers have been documented to stop over all along the Lake Erie shoreline in Ohio (USFWS 2012a).

Red knots nest in the high arctic, and winter along both coasts of North America. While the vast majority of the red knot population migrates along the Atlantic and Pacific coastlines, occasionally small numbers of birds have been found in Ohio, typically along marshes in the western basin of Lake Erie. The proposed location for the facility does not have suitable habitat for these species. Most observations of these species in Ohio occur along the shoreline of the western basin of Lake Erie where there is more stopover habitat.

FISHERIES COMMENTS:

One of the responsibilities of the Service is to manage interjurisdictional fisheries, i.e., fisheries that are managed by more than one state or nation. The waters of Lake Erie are managed by four states (Michigan, Ohio, Pennsylvania, and New York), and Canada. A component of the pre-construction survey project developed jointly between ODNR and the Service were studies to assess the fisheries in the proposed project area and to evaluate potential risk to fish during construction and operation of the project, including the electrical lines. These studies are underway, but have yet to be completed. Until these studies are complete we are unable to evaluate the potential impacts of the project on interjurisdictional fisheries.

BAT COMMENTS:

Less than a decade ago the biggest threats to bat populations were loss of hibernacula and destruction of summer habitat. Since then the spread of white-nose syndrome (WNS), a novel fungal disease rapidly spreading across the Midwest, has caused the death of millions of cave hibernating bats (USFWS 2012b). As of September 2011, the 13,361 installed MW of wind energy in the Midwestern U.S. is anticipated to cause mortality of, on average, 106,000 bats per year (Arnett and Baerwald 2013). The majority of these are long-distance migrating tree bats. Populations of cave bats have declined so significantly, mostly attributed to WNS, that the Service has recently listed the northern long-eared bat as a threatened species. The Service is currently conducting status reviews for two additional species, the little brown bat (*Myotis lucifugus*) and tri-colored bat (*Perimyotis subflavus*) due to declines associated with WNS. Both of these species were documented in acoustic surveys conducted in 2010 (Svedlow et al. 2012).

LEEDCo's Bat Risk Assessment states that "relatively small numbers of migratory bats are likely to encounter the project." Long distance migrants including the eastern red (*Lasiurus borealis*), hoary (*Lasiurus cinereus*), and silver-haired (*Lasionycteris noctivagans*) bats are the species most susceptible to mortality at wind turbines (Arnett and Baerwald 2013). These species are known to cross large bodies of water and can be found far from shore (Pelletier et al. 2013). The results of the acoustic study (Svedlow et al. 2012) state that 4 bat passes/detector-night were recorded offshore at the Cleveland crib during acoustic surveys in 2009. Ninety five percent of the calls recorded were of the three bat species most susceptible to collisions with wind turbines (Svedlow et al. 2012, Arnett and Baerwald 2013). There are several factors that confound the results of acoustic surveys. Since all monitoring had to be conducted from the Cleveland Crib, acoustic monitoring sites were co-located with radar monitoring locations. Radar has been shown to reduce bat activity, potentially due to electromagnetic fields causing discomfort (Nicholls and Racey 2007). Large concentrations of insects were also observed swarming above the Cleveland Crib. Bats have been observed pausing during migration to take advantage of congregations of insects around offshore wind turbines (Ahlén et al. 2007, 2009). Thus the acoustic monitoring included a factor that may reduce bat activity, and one that may increase bat activity. It is unknown if either factor influenced the number of detections recorded at this site.

The results of the offshore acoustic monitoring conducted as part of LEEDCo's application showed higher numbers of bat calls than similar monitoring that has occurred at two existing wind facilities in Ohio. These two onshore wind projects, Timber Road and Blue Creek, recorded 2.78 and 1.31 passes/detector-night respectively. Both projects have resulted in higher than anticipated bat fatalities, based on post-construction monitoring conducted over three years of operation. Based upon this information it is unclear if the LEEDCo project will pose greater or lesser bat fatalities than onshore facilities.

The Service is working with LEEDCo to develop a new radar and acoustic monitoring protocol that will evaluate bat activity within the proposed project area. These studies are anticipated to be completed in 2017. Until these studies are complete, we are unable to evaluate the potential risk to bats from the proposed project.

To date the only mechanism known to reduce bat mortality at wind turbines is to curtail turbines during nights of low wind speed, which is the period when bats are most susceptible to being struck. Should this facility be constructed, the Service requests that at a minimum, turbines should be curtailed (the blades should be oriented such that they do not catch the wind) until the manufacturer's cut-in speed is reached. If, based on the results of the acoustic or radar study, bat mortality is anticipated to be high a higher cut-in speed may be warranted during periods of time when bats are most at risk.

POST-CONSTRUCTION MONITORING:

In order to assess the actual impact of the project in migratory birds, bats, fish, and the aquatic environment, post-construction monitoring is critical. Further, one of the purposes of a small-scale demonstration project is to assess the viability and potential impacts of the project. This project should have a valid post-construction monitoring plan that is approved by both the ODNR and Service. LEEDCo recently provided the Service with several potential methods for assessing impacts. These are currently being reviewed by the Service and ODNR.

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMMENTS:

The National Environmental Policy Act (NEPA) requires federal agencies to incorporate environmental considerations in their planning and decision-making through a systematic interdisciplinary approach. An Environmental Impact Statement (EIS) is required for any project subject to Federal control and responsibility that significantly affects the quality of the human environment (42 U.S.C. § 4332(C); 43 C.F.R. § 46.100(a)). Conversely, if impacts are not anticipated to be significant, an Environmental Assessment (EA) may be completed. Currently the DOE proposes to complete an EA. According to the CEQ NEPA regulations, the following are some of the issues that should be considered when evaluating whether a project's effect on the environment is significant:

a) *The degree to which the effects on the quality of the human environment are likely to be highly controversial (40 C.F.R. § 1508.27(b)(4)).* There is significant public interest in wind power and potential impacts from wind power on wildlife (particularly birds and bats). The Service has been contacted by multiple non-government entities regarding wildlife concerns over small wind projects near Lake Erie recently; we were subject to a lawsuit over a wind project's impact on bats in central Ohio several years ago; and one conservation group sent a notice of intent to sue over the NEPA analysis for a single turbine project on federal land in northwest Ohio in 2014. Overall, we anticipate a high degree of interest in this project, and substantial concerns from groups associated with conservation of wildlife resources. Further, because the extent of impacts to wildlife is uncertain (see additional discussion below), we anticipate more controversy than for a project on land.

b) *The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks (40 C.F.R. § 1508.27(b)(5)).* This project presents unique risks to migratory bats and migratory birds including the bald eagle due to the proximity of the project area to significant migratory bird and bat habitat and concentration areas, specifically the offshore waters of Lake Erie. Because the turbines will be sited in an open water environment, conventional post-construction mortality monitoring to determine impact of the project and birds and bats will be impossible to implement. Thus, innovative new methods for monitoring bird and bat mortality in the offshore environment will have to be developed and implemented, and their effectiveness is unknown. Regardless, it will be difficult to monitor and quantify the impact of the project on birds and bats.

c) *The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration (40 C.F.R. § 1508.27(b)(6)).* This will be the first installation of wind turbines in a freshwater ecosystem anywhere in the world. It will be the first installation of offshore wind anywhere in the Great Lakes, and likely only the second offshore wind facility in the western hemisphere. The manner in which this project is evaluated and permitted will be a model for future similar projects. LEEDCo calls this a "demonstration" project and has indicated to audiences in prior years that the intent of the demonstration project is to show that freshwater offshore wind power in the Great Lakes is possible and to provide a roadmap for future development. Although the current project is described as a pilot project, LEEDCo indicated in a December 12, 2012, "Media Advisory Notice" that the ultimate intent is to expand from an initial 20-30 megawatt demonstration project to a 1,000 MW build-out by 2020. Thus, it is not unreasonable to expect that, if the demonstration project is found to be economically viable, it may likely be expanded to a much larger project, itself, as well as serve as a model for other full-scale projects elsewhere in the Great Lakes and other areas in the U.S. Given the precedent-setting nature of this demonstration project and potential influence on potential future off-shore wind project development, we believe an EA is inadequate to fully address the potentially significant, precedent setting aspects of this project.

We believe that the three factors above indicate that the project warrants an EIS-level analysis. We recommend that the DOE conduct an EIS to document the significance of the proposed project on fish and wildlife resources.

This letter provides technical assistance only and does not serve as a completed section 7 consultation document. If project plans change, if portions of the proposed project were not evaluated, or if additional information on listed or proposed species or their critical habitat becomes available, it is our recommendation that you reinitiate coordination with this office. We recommend that the project be coordinated with the Ohio Department of Natural Resources due to the potential for the project to affect state listed species and/or state lands. Contact John

Kessler, Environmental Services Administrator, at (614) 265-6621 or at john.kessler@dnr.state.oh.us.

If you have questions, or if we can be of further assistance in this matter, please contact our office at (614) 416-8993 or ohio@fws.gov.

Sincerely,

Dan Everson
Field Supervisor

cc: Scudder Mackey, ODNR (via e-mail)
Kate Parsons, ODNR (via e-mail)
Jeff Gosse, USFWS Region 3 (via e-mail)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

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March [illegible] 2014

Mr. Klaus Lambeck
Ohio Power Siting Board
180 East Broad Street
Columbus, OH 43215-3793

TAILS: 31420-2009-TA-0771

Re: Icebreaker Wind Facility, 13-2033-EL-BGN

Dear Mr. Lambeck:

This is in reference to the Lake Erie Energy Development Corporation's ("LEEDCo") application to the Ohio Power Siting Board for a Certificate of Environmental Compatibility and Public Need (Certificate) for the proposed Icebreaker Wind Facility. The proposed project involves the installation of up to six 3.0 MW wind turbine generators, underground collection cables, and connection to an existing substation. The total generating capacity of the facility will not exceed 18 MW.

The project is located approximately seven to nine miles off the coast of Cleveland in Lake Erie. Approximately 60.6 acres (10.5 ac of permanent disturbance) of lakebed will be disturbed and 11 miles of interconnection cable will be needed. This project plans to connect to an existing substation in Cleveland. The majority of this project will occur within Lake Erie with only the substation interconnection occurring on land; no impacts to wetlands or forested area are anticipated.

The U.S. Fish and Wildlife Service (Service) received your letter requesting our review of the application for the informational completeness on February 10, 2014, and we submit this letter in response. The following comments are being provided pursuant to the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d; BGEPA), the Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA), the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1544, 87 Stat 884; ESA), the Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j, not including 742 d-l; 70 Stat. 1119), as amended.

The Service, LEEDCo, their representatives, and the Ohio Department of Natural Resources (ODNR) have been involved in discussions regarding this proposed project since 2008. We have participated in meetings, and engaged in numerous conference calls and emails regarding this project.

[illegible] on these facilities, the Service currently does not have [illegible] pre-construction monitoring protocols to assess impacts of offshore wind facilities. The Service worked closely with the ODNR in developing a pre-construction monitoring protocol for this offshore wind energy facility which was the first of its kind for the region. LEEDCo conducted the following pre-construction wildlife surveys requested by ODNR and the Service: bat acoustic monitoring April 1 – November 10, 2009 and radar monitoring April 1 – May 31 and August 15 – October 15, 2010. Two additional surveys were conducted; these were not part of the studies recommended by ODNR and the Service (avian acoustic surveys and boat based nocturnal surveys). Due to the potential impacts to fisheries ODNR and the Service requested several surveys to assess the importance of the area as a fishery. LEEDCo has yet to conduct these studies.

GENERAL COMMENTS:

Currently there are no offshore wind facilities in North America; additionally there are very few (potentially only 1) wind facilities sited in a freshwater environment world-wide. The LEEDCo project has always been, and continues to be, proposed as a "demonstration project" or "pilot-project." Information gathered from this project will be used to assess the feasibility of developing commercial scale wind facilities in Lake Erie, or the Great Lakes as a whole. As such, it is essential to have scalable pre- and post construction studies to evaluate potential impacts to fish and wildlife Trust resources. Within the documents provided as part of the OPSB application LEEDCo provided results from portions of the recommended pre-construction monitoring (e.g., bird and bat monitoring), but portions of the recommended pre-construction monitoring were not conducted at all (fisheries monitoring), and no post-construction studies were proposed to assess potential impacts to birds, bats, and fisheries. Therefore, the Service finds that this application is incomplete. More specific comments on various issues of concern to the Service are presented below.

MIGRATORY BIRDS

Migratory birds are a Federal Trust resource entrusted to the Service by the MBTA. The proposed project location is between 7-9 miles off the coast of Cleveland, thus lacks habitat for many species of birds that breed in Ohio. The site is approximately [illegible] miles from an area designated by The Audubon Society as the Cleveland Lakefront Important Bird Area (IBA). This area was selected as an IBA due to the large concentrations of waterfowl and gulls that congregate there during spring and fall migration (also wintering waterfowl, gulls, and eagles) (Ritzenthaler 2008). The waters around Cleveland provide important overwintering habitat for gulls (herring, ring-billed, Bonaparte's, great black-backed), sea ducks (greater and lesser scaup, red-breasted and common mergansers, goldeneye, bufflehead, redhead, canvasback), common loons and horned grebes. During winter flocks of over 10,000 birds are not uncommon near Cleveland and the maximum daily counts recorded [illegible] in recent years has reached 250,000 (Ritzenthaler 2008). Additionally, several locations (Wendy Park, Edgewater Park, Cleveland Lakefront Preserve, etc.) along the lakeshore are known for their large concentrations.

of passerines during migration. Within the Avian Risk assessment it contends that "the Icebreaker site does not appear to be on a heavily used migration path for waterfowl or seabirds." While large numbers of birds may not feed within the area, they are likely to cross through the area to reach their overwintering areas near shore and they do congregate in large numbers within just a few miles of the project. Due to the lack of offshore wind facilities in North America several LEEDCo documents cite the experiences of Europe to draw information. Yet several European countries have banned offshore facilities from within 12 miles of the shoreline (Rein et al. 2013) this may be in part due to the congregations of waterfowl found near shore.

Thus, the Service believes that waterfowl are at risk of mortality and possibly displacement from the Icebreaker project. LEEDCo should develop a Bird and Bat Conservation Strategy (BBCS) that outlines minimization measures, monitoring methods, and adaptive management that will be implemented to protect these species.

The boat landing that will be at the base of each turbine may attract species such as double-crested cormorants, herring and ring-billed gulls. Herring gull, lesser black-backed gull, great black-backed gull fly within the rotor swept zone between 30-35% of the time (Furness 2013). Also, during the pelagic bird surveys that were conducted by ODNR large numbers of ring-billed and herring gulls were observed feeding on the bi-catch of commercial fishing vessels. It is unclear whether commercial fishing vessels will be using this area, which could increase incidences of bird collisions by increasing the number of birds in the area. Thus, waterbirds are at risk from the project and LEEDCo should address these species in the BBCS.

LEEDCo's Environmental Assessment states that between 4-13% migrants fly within the height of modern wind turbine rotors, and that tens- to hundreds of millions of birds migrate over Lake Erie. Based upon these numbers it would mean that between 400,000-13,000,000 songbirds fly at rotorswept height when flying over Lake Erie. Within the "Final Avian Risk Assessment 2013" it states that "Fatality numbers and species impacted at the offshore site are likely to be similar, on a per turbine basis, to those found at projects that have been studied in eastern North America." Post-construction studies at onshore Canadian wind facilities average 8.2 ± 1.4 birds per turbine (Zimmerling et al. 2013) and 6.86 birds per turbine for the United States (Loss et al. 2013). If waterfowl and waterbird mortality rates will be similar to those of European facilities, as suggested in the Avian Risk Assessment (see below), and if baseline songbird mortality rates will be similar to onshore facilities, it's likely that total bird mortality on a per turbine basis may be greater than at onshore facilities due to the increased abundance of waterfowl and waterbirds near the turbines.

Mortality estimates from European offshore wind facilities,

- 0.01-1.2 birds/turbine (Winkelman 1989, 1992a, 1992b, 1992c, 1995)[?]
- 6 birds/turbine (Painter et al. 1999)
- 4-23 birds/turbine (Everaert et al. 2001)

[illegible] and [illegible]ilkin [illegible]).

As part of the review of this project the Ohio Ecological Services Field Office sent the *Spring – Fall 2010 Avian and Bat Studies Report Lake Erie Wind Power Study* (Tetra Tech 2012) to a team of individuals in our Regional Office that conducts radar monitoring of birds and bats. This group provided 11 pages of comments and questions related to the radar report to LEEDCo on November 15, 2013 (attached). The Service has yet to receive a response to these questions. Without clarification on these questions the Service is unable to assess the results of the radar monitoring report and thus we believe that this application is incomplete.

BATS

Less than a decade ago the biggest threats to bat populations were loss of hibernacula and destruction of summering habitat. Since then, the expansion of the wind industry and the spread of white-nose syndrome (WNS), a novel fungal disease rapidly spreading across the Midwest have caused the death of millions of bats (USFWS 2012, Arnett and Baerwald 2013). Populations of cave bats have declined so significantly, mostly attributed to WNS, that the Service has proposed listing the northern long-eared bat (*Myotis septentrionalis*) as a federally endangered species[1]. The Service is also currently conducting status reviews for two additional species, the little brown bat (*Myotis lucifugus*) and tri-colored bat (*Perimyotis subflavus*). Both of which were documented acoustically offshore at during the LEEDCo study.

While the offshore environment does not appear to provide habitat for tree-roosting bats, presence of habitat does not seem to be a good predictor of bat mortality at wind turbines during fall migration. Bat mortality at some wind facilities in agricultural landscapes in the Midwest has been occurring at rates as high as 40 bats per megawatt per year (Good et al. 2011), and when this mortality rate is applied across all operating wind facilities in the Midwest, it results in substantial total bat mortality. Research has indicated that bat mortality at operating turbines can be significantly reduced by feathering the turbine blades at low wind speeds.

LEEDCo's Bat Risk Assessment states that "relatively small numbers of migratory bats are likely to encounter the project." Long distance migrants such as eastern red (*Lasiurus borealis*), hoary (*Lasiurus cinereus*), and silver-haired (*Lasionycteris noctivagans*) bats are known to cross large bodies of water and can be found far from shore (Pelletier et al. 2013). The report states that 3.7 passes/detector-night were recorded at the offshore location and compares that to what was recorded onshore in Cleveland (38.0 passes/detector-night) to conclude that impacts to bats from the Icebreaker project would be less than a comparable onshore project.

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[1] The proposed listing of northern long-eared bat, which was proposed in October of 2013, was not included in either the Bat Risk Assessment or the Summary of Sensitive Species. See "Endangered Species Comments" below.

The offshore acoustic monitoring conducted as part of LEEDCo's application detected bat activity at higher rates than during pre-construction monitoring that has occurred at 2 land-based operating wind facilities in Ohio. Timber Road and Blue Creek wind facilities in Paulding County, recorded 2.78 and 1.31 passes/detector-night respectively. Based upon this information it is unclear as to whether this offshore wind facilities will pose less of a threat to bats than onshore facilities. Additionally, there are several factors that confound the results of acoustic surveys. Since all offshore acoustic monitoring had to be conducted from the Cleveland Crib, acoustic monitoring sites were co-located with radar monitoring locations. Radar has been shown to reduce bat activity, potentially due to electromagnetic fields causing discomfort (Nicholls and Racey 2007). Large concentrations of insects were also observed swarming above the Cleveland Crib. Bats have been observed pausing during migration to take advantage of congregations of insects around offshore wind turbines (Ahlén et al. 2007, 2009). Thus there is a factor that may reduce bat activity, and one that may increase bat activity, therefore it is unknown if either influenced the number of detections recorded at this site. Regardless, 95% of the calls recorded were of the three species most susceptible to collisions with wind turbines. To date the only mechanism known to reduce bat mortality at wind turbines is to curtail turbines during nights of low wind speed, which is the period when bats are most susceptible to being struck.

Thus, the Service believes that bats are at risk from the project and LEEDCo should address these species in the BBCS. Should this facility be constructed, the Service requests that a condition be included within the Certificate requiring the curtailment of turbines at least up until the manufacturer's cut-in speed is reached at night during the fall migratory period. This measure should not affect energy generation, but may measurably reduce bat mortality.

ENDANGERED SPECIES COMMENTS:

The proposed project is located in Cuyahoga County, in Ohio. There are five species of birds or bats that are federally endangered, threatened, proposed, or candidate species that may occur in Cuyahoga County: Indiana bat (*Myotis sodalis*) [Endangered], northern long-eared bat [Proposed Endangered], Kirtland's warbler (*Setophaga kirtlandii*) [Endangered], piping plover (*Charadrius melodus*) [Endangered], and red knot (*Calidris canutus rufa*) [Proposed Threatened].

Cuyahoga County has confirmed records for Indiana and northern long-eared bats. While northern long-eared bats may be relatively scarce in Ontario, as mentioned in the Bat Risk Assessment, they are captured at ~47% of mist net sites in Ohio and comprise ~12% of the bats captured. Both of these species may travel several hundred miles between their summering habitat and winter hibernacula (Griffin 1945, Winhold and Kurta 2006).

While Indiana bats have been documented to fly over Lake Erie (Niver 2013, personal communication), given that no maternity colonies are known to occur in Canada, and that the majority of their hibernacula are to the south of the project area, it is unlikely that Indiana bats will encounter the LEEDCo project. Northern long-eared bats are a forest dwelling species.

feeding on insects gleaned from vegetation or forest floor ([illegible]). However, historically abundant, the northern long-eared bat has rarely been found during mortality surveys at onshore wind facilities. Since the facility is not located near any forested areas and because northern long-eared bats seem to be less susceptible to collision mortality from wind turbines it is unlikely that northern long-eared bats will encounter the LEEDCo project.

Piping plovers, red knots, and Kirtland's warblers all migrate through Ohio. Only the piping plover has historically nested within the state. The Great Lakes population of piping plover nests primarily in Michigan and consists of approximately 63 pairs of birds. Kirtland's warblers nest in young stands of Jack pines primarily in Central Michigan. Their current population is over 3,000 individuals (USFWS 2012). Red knots nest in the high arctic and winter along both coasts of North America. While the vast majority of the red knot population migrates along the coastline, occasionally small numbers of birds have been found in Ohio, typically along marshes in the western basin of Lake Erie. The proposed location for the facility does not have suitable habitat for these species. Most observations of these species occur in the western basin of Lake Erie, where there is more stopover habitat. Finally, given the scale of the project it is the Service's believe at this time that it is unlikely these species will encounter the LEEDCo project.

BALD EAGLE COMMENTS:

Bald eagles are protected under the MBTA and are afforded additional legal protection under the BGEPA. BGEPA prohibits, among other things, the killing and disturbance of eagles. Due to the proposed project location and the distance this facility is from the shoreline, the Service believes that take of eagles is unlikely during the breeding, egg laying and incubation, chick rearing, and fledging periods. However, bald eagles winter along the shoreline of Lake Erie and are regularly observed along the lakeshore in Cuyahoga County (avianknowledge.net). In winter when ice forms along the shoreline it may force wintering birds closer to the proposed facility. Within the last several years Lake Erie has almost completely frozen over. As the ice builds along the shoreline it forces ducks, gulls, etc. further into the lake. Eagles, which will feed on fish and waterfowl, will congregate along the leading edge of the ice, or near open leads in the ice. Should the ice extend far enough, as it did this past winter, it may put waterfowl and eagles in close proximity to the turbines. Thus, bald eagles may be at risk from the Icebreaker project. The Service recommends that LEEDCo develop a BBCS to address this issue. If take of eagles cannot be avoided LEEDCo should work with the Service's Division of Migratory Birds to obtain an eagle take permit.

Within in the "Summary of Sensitive Species" the Applicant states that "the nearest [bald eagle] nest is located is located near Sandusky (Peterjohn and Rice 1991)", this information is outdated. In the 23 years since the original Breeding Bird Atlas was conducted the bald eagle population has expanding significantly. Ohio now has over 200 nesting pairs of bald eagles; the nearest known nest to the proposed project area is located in Cuyahoga County approximately [illegible] miles away.

FISHERIES:

One of the responsibilities of the Service is to manage interjurisdictional fisheries, i.e., fisheries that are managed by more than one state or nation. The waters of Lake Erie are managed by four states (Michigan, Ohio, Pennsylvania, and New York), and Canada. A component of the pre-construction survey project developed jointly between ODNR and the Service were studies to assess the fisheries in the proposed project area. These studies have yet to be completed, thus this application should be deemed incomplete.

COORDINATION WITH THE U.S. ARMY CORPS OF ENGINEERS:

This project will require a section 10 permit of the River and Harbors Act and authorization under section 401 of the Clean Water Act. Both are administered by the U.S. Army Corps (Corps) of Engineers (Buffalo District). The Service reviews permit applications under these laws and works with the Corps to address fish and wildlife impacts. The Service will consult with the Corps under Section 7 of the ESA, if necessary, and will provide additional comments to the Corps under the National Environmental Policy Act.

POST-CONSTRUCTION MONITORING:

One of the purposes of a small-scale demonstration project is to assess the viability and potential impacts of the project. As such, if constructed this project should have a valid post-construction monitoring plan that is approved by both the ODNR and Service. Any and all results of post-construction mortality studies must be provided to both ODNR and the USFWS. This should be included as a condition of their Certificate.

The Service appreciates the opportunity to comment on this application, and looks forward to continued collaboration on this project. If you have questions, or if we may be of further assistance in this matter, please contact Keith Lott at extension 31 in this office.

Sincerely,

Mary Knapp, Ph.D.
Field Supervisor

Cc: Ms. Jennifer Norris, ODNR, DOW, Columbus, OH
Mr. Nathan Reardon, ODNR, REALM, Columbus, OH
Mr. Joe Loucek, OEPA
Mr. Joe Krawczyk, USACE, Buffalo, NY

Attachment: "Review of: Spring-Fall 2010 Avian and Bat Studies Report Lake Erie Wind Power Study (Prepared by: TetraTech, A. Svedlow et al.) by USFWS Region 3 Radar Team."

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Review of:

Spring – Fall 2010
Avian and Bat Studies Report
Lake Erie Wind Power Study

(Prepared by TetraTech, A. Svedlow et al.)

by USFWS Region 3 Radar Team*

Thank you for the opportunity to review this report. We are aware of the challenges that the authors have faced related to the logistics of this type of study. We have experienced many of these types of challenges ourselves. We continue to gain experience with the Merlin Avian Radar systems. To date we have collected data over 3 spring and 3 fall migration seasons. Data has been collected on the shorelines of Lakes Michigan, Huron, Erie and Ontario. Therefore we have experience with migration patterns on both north-south and east-west shorelines. During this time we have, through trial and error, become quite experienced in the capabilities and *limitations of these types of systems. Although we are currently using radar that has* S-band capability for both the VSR and HSR antennas, we also have experience (spring 2011) with the unit that TetraTech was employing during this study.

Our primary concern is that this study is likely to be considered a precedent for studies for larger offshore wind farms. Because there is no currently effective methodology for post-construction mortality surveys of offshore wind turbines, pre-construction surveys/reports must be robust in their methods, analysis, and conclusions. Because of our experience with this type of radar system, we feel we can adequately justify our comments, concerns, and recommendations for this study. These are reported below.

*Contact: Jeff Gosse, jeff_gosse@fws.gov, telephone: 612-713-5138

Methods

- We would like to see the clutter maps from each site for both the VSR and HSR antennas and a series of TrackPlots (hourly summaries of targets) for each site and antenna in order to ascertain the degree of interference related to weather, sidelobes, building interference on the crib, waves, insects, etc., that may influence target counts.
- How were times with "clear air" determined? (Pg 12 and 17). Review of visual radar data (Trackplots) for HSR and VSR separately (with lines connecting each plot) over 15 minute increments is how we filter out rain, and would also be appropriate for invertebrates.
- Page 7: VSR orientation directly E/W may have reduced the radar's ability to track targets moving directly north due to the number of consecutive hits needed on a target to record it in the database. Slightly offsetting the E/W azimuth could have increased target time in the radar beam and possibly reduce the number of missed targets.
- Pages 8-10: The report assumes little or no insect clutter, although it contradicts this assumption at other times, but results from the spring offshore data seem to suggest that insects were tracked with very high target counts and low mean flight heights. Please explain methods used for reducing insect clutter that were used.
- What was the VSR offset? It is reported as 750-1750m on Pg ii and 250-1250 on Pg 11.
- What were the true dates of the onshore portion of the study, March 31-April 20, or March 31-April 30? Pg 6 vs Pg 12.
- Page 7: What was the true number of days with useable data when offshore, 11 or 13?
- How were initial settings established and did the settings remained unchanged through the season? Were any settings changed between Spring 2010 onshore, offshore, and Fall 2010 offshore?
- Please separate the VSR and HSR radars when referring to hours the radar was collecting data (Pg 12 and 17). Were data from both radars removed if one had issues with "clear air", insects, or wave clutter?

Analysis

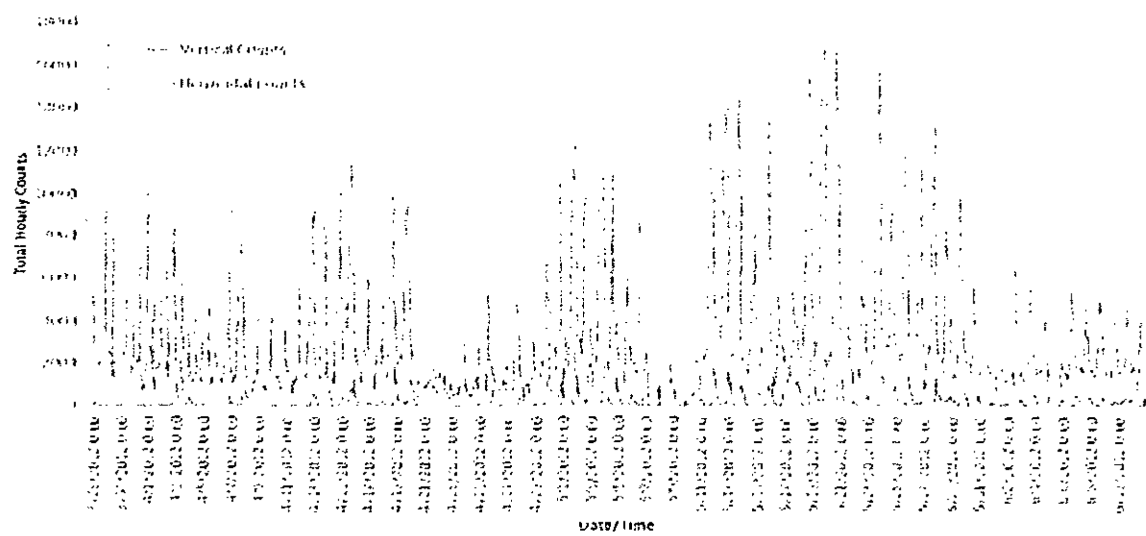
- Survey effort (volume sampled) differed between areas below the RSZ, within the RSZ and above the RSZ. So reporting percentages below, within, and above are biased towards the area with higher effort (above the RSZ). Given the small amount of volume that occurs within and below the RSZ, a disproportionately large percentage of targets occurred within these high risk zones.

- Activity differs throughout the day and night and over the season, so reporting daily (24hr) or seasonal mean TPRs/heights/RSZ counts/percentages may mask times of higher risk (Pg 12-25).

- *Timelines of radar data with VSR and HSR plotted hourly throughout the entire field* season should be included in this report. This type of graph can help to distinguish between periods of migration and normal localized traffic. See example below.

Increases in vertical radar targets coincident with horizontal radar increases indicate migration, especially when the peak of activity is near midnight as illustrated below. Timelines can also be *helpful in determining when vertical or horizontal radar was offline during the season.*

Time Series Graph Showing Hourly Target Counts Recorded by a Radar Unit Located 3/4 of a Nautical Mile Inland of the Lake Erie Shoreline, Erie County Ohio, Spring 2012



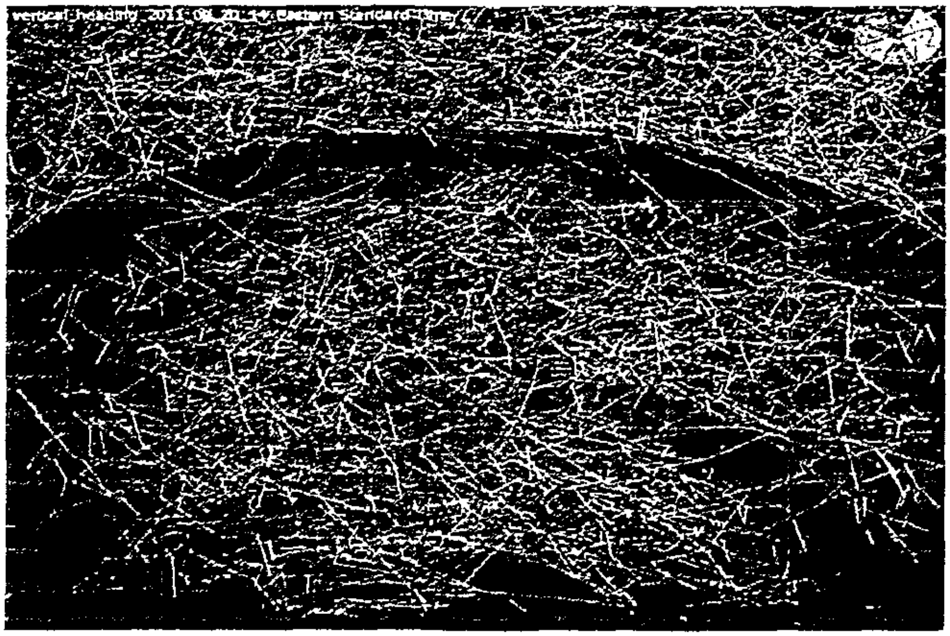
Vertical gridlines are at mid night.

- Pp. 26 and 27, Figures 2.15, 2.16, and 2.17. Had the directional graphs been separated into four time periods (dawn, day, dusk, and night) we believe you would have seen more clearly what was occurring. Our data tends to show little directional movement during daylight (local movement), general north (spring) and south (fall) movement *during night, and often a strong movement toward shore at dawn. By combining dawn* and dusk with night, some of the nuances are lost and it is more difficult to understand what is occurring. The intermittent sampling may have also missed many of the strong migration pulses, also making the data more difficult to interpret.

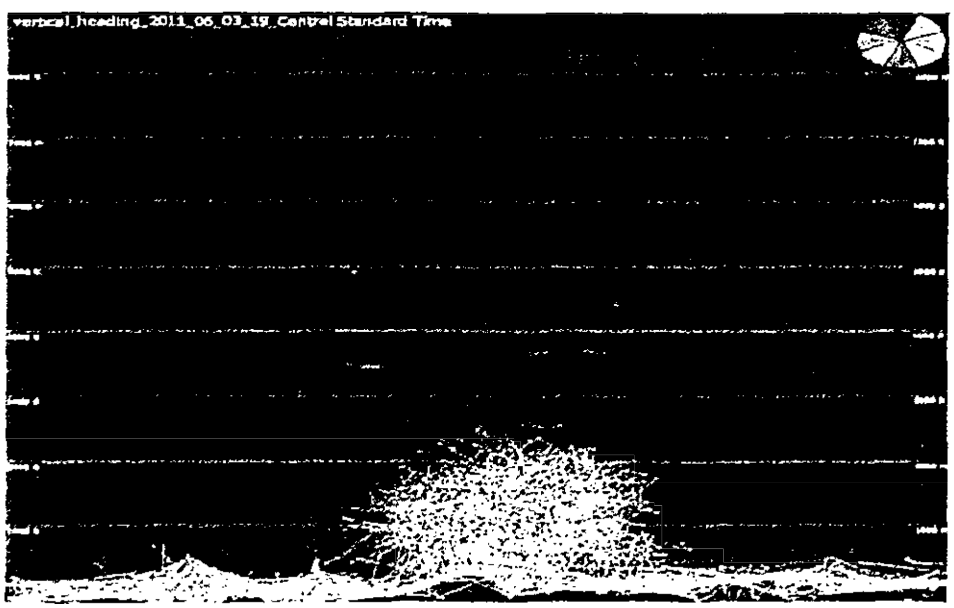
- Caution should be used if using means as a metric for heights due to the potential for skewed distribution of targets. Medians, or preferably, 50m band graphs are much better at representing the data.
- Onshore data from the spring appears to only have captured 2 pulses of nocturnal migration in 11 nights of data collection (Pg 14). Mean TPR during this time would not reflect the migration pulses but be more reflective of the lulls in migration.
- Insect clutter can be reduced by manually editing it out. Cleaning the data this way may increase the number of hours of useable data and reveal times when vertebrates are feeding on insects and may be at risk.
- Below/in/above the RSZ are too broad of categories, as targets could be present just outside of the RSZ and be classified with targets much further away.
- Page 17: Times with high winds were excluded from the data analysis due to the resulting high amounts of wave clutter. Our data has shown that high winds can promote migration (depending on wind direction) and so migration pulses may have been thrown out.
- Your activity patterns were very unusual during the spring (Pg 13) when compared to the patterns we have seen with our radar data across the Great Lakes. The fall data matches more with what we would expect (Pg 21). Did the spring insect blooms and/or their potential to attract gulls and other birds have a large effect on the spring data?
- Page 9: Are rain tracks from virga events still included in the data? It is stated that these times are not thrown out. If the virga rain tracks are included that will bias the counts and height estimates; if they are removed then please state how they were identified and removed.
- Page 11: Why was 5.4m subtracted from the altitude measurements? We assume this is the height of the crib. If so, wouldn't the authors want to add 5.4m to each offshore target height? For example, if an offshore target is tracked at 20m, wouldn't the height actually be 25.4m? Adding or subtracting this value may move many targets from within the RSZ in the spring to above or below the RSZ.
- Timelines of acoustic data, specifically bat passes, can also support driving factors of migration related to wind speed, precipitation, etc.

- Adequate pictorial examples of interference (waves, insects, rain) as well as high migration nights and observed phenomenon (e.g., reverse migration, directional patterns parallel to or going into shore) should be included in this report. Some examples are illustrated below:

Rain Event on S-Band Vertical Radar. Note the random directionality of most plots. TrackPlots summarized at 15-minute intervals can easily be filtered out.

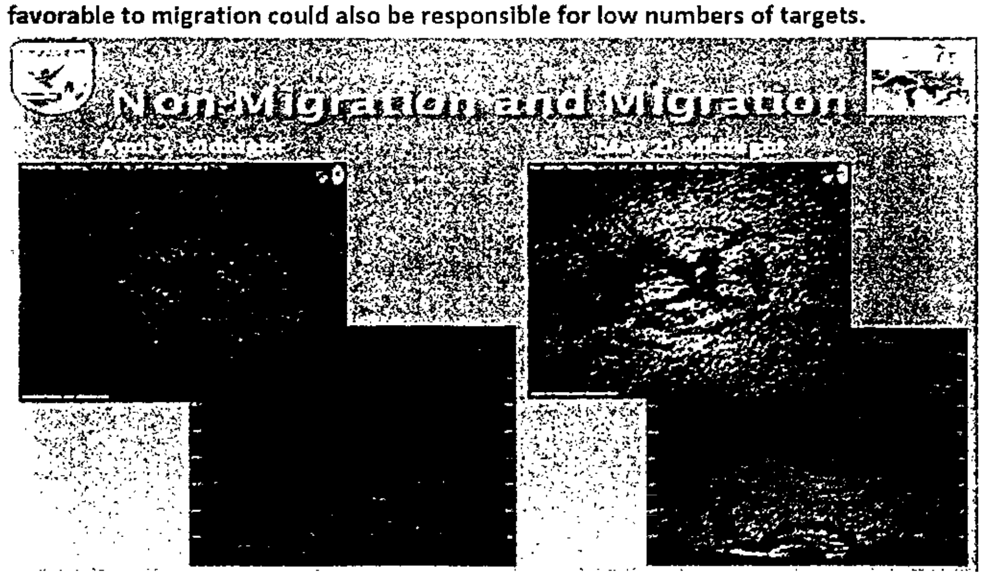


Insect Event on X-Band Vertical Radar. Episodes like this preclude any gathering of relevant data and must be filtered.

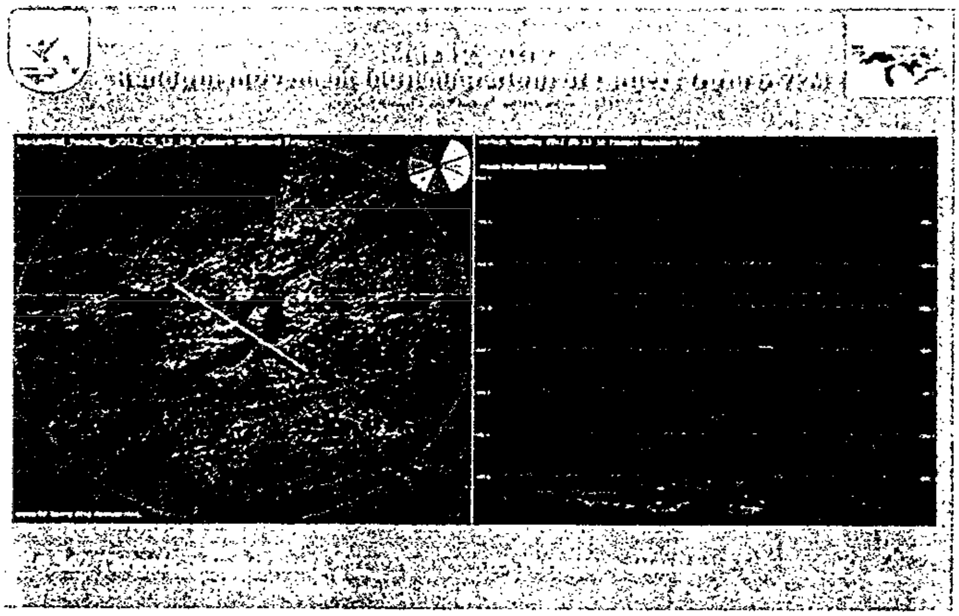


Migration along Lake Erie shoreline (left) and movement to shore at dawn (right). Compass rose color indicates direction of targets. Blue indicates north. In this example the green and light blue lines indicate northeast movement along the Lake Erie shoreline (left). The yellow/green lines indicate targets moving to the shoreline from open water (right) while onshore targets continue to move northeast at dawn.

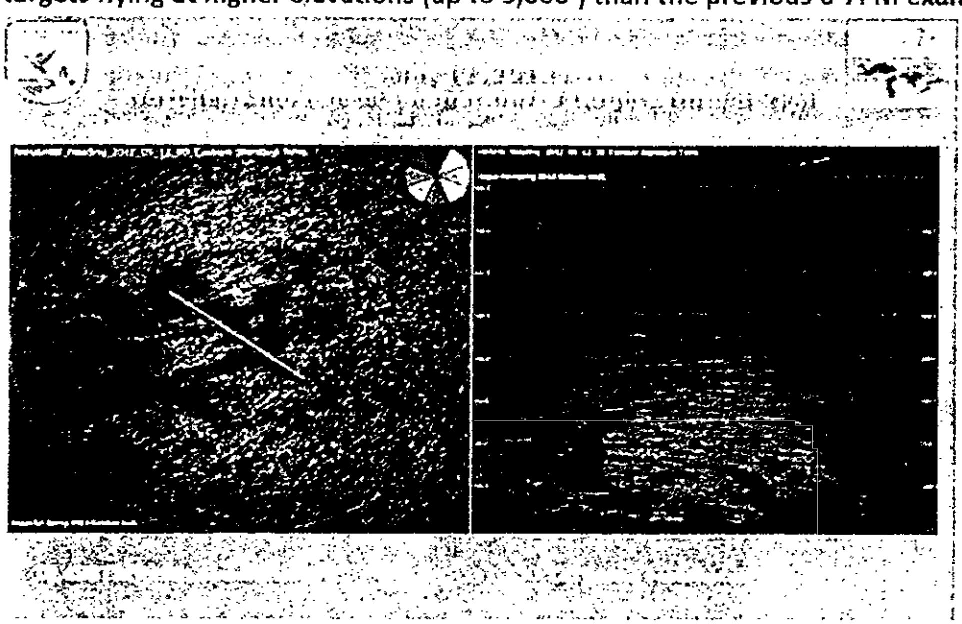
An example of target activity prior to and during spring migration. Horizontal scanning radar is at the top of the picture and vertical scanning radar is shown at the bottom of the picture. Although there is no indication of rain interference on April 1, strong winds in a direction not favorable to migration could also be responsible for low numbers of targets.



Random daytime (pre-sunset) movement of targets. Horizontal scanning radar on left **shows** random movements as portrayed by the various colored plots in relation to the compass rose. Blue indicates north direction. There is little high elevation target activity on the vertical scanning radar on the right.



Strong nighttime movement of targets. Horizontal scanning radar on left shows strong northern directionality of targets. The vertical scanning radar on left shows targets flying at higher elevations (up to 5,000') than the previous 6-7PM **example.**



Conclusions:

Given the complications the authors report for the radar portion of the study during the spring field season and the lack of timeline graphs, it is difficult to draw any conclusions regarding migration or potential risks to migrants from the proposed project. These complications include the loss of data at low elevation due to clutter during the onshore portion of the study, the mid-season shift to the offshore site, and the influence of insects and the Crib light source on TPR and height estimates. During both the spring and fall seasons there was substantial radar downtime that also complicates interpretation of the data. During the fall season, the data provided in the report seems to indicate that migration was occurring and, contrary to the author's conclusions, migrants were passing through the high risk zones (within and below the RSZ) at a high passage rate. Below are a few of the author's statements with our concerns bulleted:

Pg. 23: *"Pooled target counts from spring and fall within 50 m increments are presented in Figure 2.12. The vast majority of targets flew well below the RSZ, presumably near the surface of the lake."*

- There appears to be several problems with Figure 2.12. The figure is reported to depict the pooled targets for both spring and fall, yet a rough estimate of the total number of targets shown in the graphic is well below 2 million targets. According to appendix C.3 and C.5 there were nearly 7.5 million targets recorded during the spring and fall offshore portion of the study. The y-axis label indicates that the labels represent the "top of 50-meter increments" – so the 50-m band contains height values that range from 0.1 – 50 m. From our experience, this is consistent with how the DeTect SQL query bins height values. If true, then the most densely populated bin (the 50-m bin) includes heights that are within the RSZ and should be colored red. The y-axis extends up to 2800 m and then starts over at 1500 m. Reporting information in this manner is confusing and the spring and fall height profiles should be shown separately.

- Figure 2.7 and particularly Figure 2.12 indicates a very high number of targets occurring within or near the RSZ. This is without correcting for volume sampled and without knowing what the VSR clutter map looked like. These figures and the data they represent appear to disagree strongly with the text in the report.

Pg. 23: *"During periods of peak activity in spring most targets flew well below RSZ, . . ."*

Pg. 64-65: *"It is plausible that attraction to the rapidly flashing Crib lights could have attracted birds, bats, and insects, thereby causing higher than expected nighttime TPR recorded by the radar. Thus, higher than expected nighttime TPR could have been a result of lights attracting aerial vertebrates, as well as possibly insects, which can be seen with radar"*

- The light source was located at about 17 m above water level which coincides with the mean night flight height. Is seems that vertebrate and invertebrate targets that were attracted to the light source also influenced the large number of targets recorded below the RSZ.

Pg. 28: *"However, it is evident from the fall TPRs that nocturnal migration was occurring, and at high rates, offshore, although most of these nocturnal migrants flew above the RSZ, as was evident from the mean altitudes that exceeded 300 m regularly during the night."*

- That mean altitudes exceeded 300 m regularly during the night does not indicate that most nocturnal targets flew above the RSZ (see comment above regarding Figures 2.7 and 2.12). Due to the distribution of migrant flight altitude the mean is a misleading indicator of central tendency. As a simple example, if the VSR counted 100 targets with 80 targets at 100m and 20 targets at 1000 m the mean height is at 280 m– so, while the mean might suggest that targets are at safe height, the reality is that 80% of the targets have passed through the RSZ.
- As well, reporting the TPR that is below, within, and above the RSZ is misleading in that the three categories do not represent the same sampling effort. Reporting the number of targets ***per altitude band*** that are below, within, and above the RSZ reduces the discrepancy in sampling effort among the three categories and is a more fair comparison. For example, Table 2.4 on pg 18 reports that at night during the fall season TPR below, within, and above the RSZ are 126.3, 638.5, and 929.3, respectively. The three categories contain 0.5, 3.5, and 52 altitude bands respectively (assuming they sampled to 2,800 m). Adjusting the TPR to account for this difference results in a TPR of 252.6, 182.4, and 17.9 respectively. (This method of stating TPRs would then be in closer agreement with what is observed in Figure 2.12.)

- Page 21: Are targets flying just below or above the RSZ really at little or no risk from turbines? Studies suggest that migrants adjust their flight height with different environmental conditions, so slight weather changes may cause high risk.
- Can valid conclusions be made from only ~250 hours of offshore radar data for each season when the migration season (Aug 1 – Nov 1) is 2208 hours long? This may cause pulses of high migrant activity to be missed and prevent analysis at the fine scale needed to observe patterns and asses times when migrants may be at risk. Did it really rain that much or was data removed for other reasons? The small proportion of useable data makes it difficult to adequately draw conclusions from this study. A breakdown of times due to equipment failure, weather, and other reasons for the reduced times of useable data would be helpful.
- Page 8: X band radar is much more affected by insects than S band and may not have led to accurate counts on the VSR and reduced the number of hours sampled with "clear air".
- An algorithm should be included to correct for the sample volume structure and density of targets (targets/1,000,000 m^3) per 50 m altitude band per hour of each biological period. Otherwise, RSZ numbers can be erroneously skewed and inaccurate.

- Our data suggests that there are correlations between weather and migrant activity for both acoustic monitors for bats and with the radar data. Sparse or intermittent data collection may be the reason that these correlations were not detected in the radar data for this project either due to pulses/favorable conditions being missed or sample size being too low.
- P19 and 20, Tables 2.9 and 2.10: Applying a straight regression line to TPR during the migration season seems meaningless. Migration builds and then decreases during the season and tends to look more like a bell curve than a straight regression.
- The report implies that most of the birds found offshore are gulls based upon visual observations. However such observations would not easily detect nocturnal passerines nor bats. Nocturnal directional movement would be indicative of migrants rather than gulls which are localized. A review of eBird data for Cuyahoga County indicates that many passerines such as warblers are observed during spring and fall migration periods indicating that they are passing through, either over the lake or along the shoreline.
- Currently in the literature, the use of cut-in speeds for the protection of bats seems to be the best proactive measure once turbines are in place. That, along with seasonal curtailment, could be used if it is determined that additional protection is needed once turbines are up and running. These will likely be included in a Section 7 consultation for the Indiana bat and northern long-eared bat if they occur in the development site.

Additional comments on other aspects of the study

<u>Bat Acoustics:</u>

- Page 63: The report mentions that the Crib lighting may attract bats/insects as a reason for high numbers of calls. Turbine lighting may play a similar role in attracting insects/bats. This relationship between offshore turbines and bats is discussed in the literature supporting the possibility of turbines attracting bats including suggestions that structures in large bodies of water generally attract emerging aquatic insects as well.
- Page 59: Even though activity offshore is less than activity onshore, the monitors still show there are bat species present offshore and they will be impacted by the turbines.
- Bat mortality caused by wind turbines is heaviest during fall migration. Since the acoustic monitoring portion failed to survey for bats in the fall season, this report falls short of adequately describing potential effects to bats by this project.
- Additional relevant information concerning bats and offshore behavior has been studied by Stantec Consulting Services Inc. The citation is: *Pelletier, S.K., K. Omland, K.S. Watrous, T.S. Peterson. 2013. Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities – Final Report. U.S. Dept of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM 2013-01163. 119 pp.*

Bird Acoustics:

- Without fall data, it is hard to make conclusions, especially since the radar data was so different between the seasons. (Pg 48)
- Boat surveys had few passerines (1) (Pg 33 and 36), but the acoustics said there were some detected (Pg 46).
- We use the same acoustic monitors and our maximum range is under 100m (not the 300m as reported on Pg 44).

Boat Based Surveys:

- This type of survey is biased due to human observers working from the surface of the water, timing of surveys (gulls/ducks/cormorants are more active at dawn/dusk to go between feeding grounds and passerines active at night when most difficult to detect), and infrequent schedule of surveys (once a week or so). This methodology also is biased due to the conditions surveys were performed in that may not have been optimal for migration.
- Data from the boat surveys for birds is used to claim that most/all activity seen on the radar in the area was gulls/cormorants/ducks. The methodology of the boat survey biased the counts towards large, low flying birds that are active around dawn and dusk as the detection at night of any birds is very difficult visually. The acoustic data shows that there were passerines flying over that the boat surveys missed, either due to the infrequent schedule that they were conducted on or due to the bias of the methods used. Fall acoustic data would have helped because the radar results were much more typical.

Comments from the November 12 Presentation

- Failed to address northern long-eared bat as a proposed species.
- Referred to 1 year of acoustic monitoring. It was actually one season.
- Would like to see the NEXRAD study, the distance between the radar site and the development site seems too close for optimum study.
- Focused primarily on avian fatalities. Most wind facilities have found higher bat than bird fatalities. This includes not only the Appalachian ridges but also multiple facilities in Wisconsin and at least one in northern Indiana.
- We question the appropriate use of the equation for predicting bird fatalities and also as referring to it as the Service's Model. The fact that it was utilized once by a Field Office does not make it the Service's.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

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April 24, 2009

Mr. David Nash
McMahon DeGulis LLP
812 Huron Rd., Suite 650
Cleveland, OH 44115

Dear Mr. Nash:

This is in response to your recent e-mail regarding an Avian Distribution and Use Study for the proposed Great Lakes Wind Energy Center, Cleveland, Cuyahoga County, Ohio. Though many details have not yet been decided, it is likely that the project will include 3 or more turbines of undetermined size approximately 3 miles offshore of Cleveland, in Lake Erie. A Feasibility Study describing the project in depth is anticipated to be released publicly on April 30, 2009.

As you know, the U.S. Fish and Wildlife Service (Service) and Ohio Department of Natural Resources (ODNR) have been actively involved in working with wind power developers throughout the State of Ohio and the Great Lakes Region through venues such as the Ohio Wind Working Group and Great Lakes Wind Collaborative. Specifically regarding this project, the Service and ODNR have provided informal recommendations and suggestions at numerous meetings (most recently on March 27, 2009) and conference calls (most recently on April 13, 2009) over the past few years regarding fish and wildlife issues, lake habitat, and the permitting aspects of siting an offshore wind project in Lake Erie, one of Ohio's most significant natural resources.

As you are aware, offshore wind power development within the waters of the Great Lakes has not yet been developed, though several companies are considering it in both the U.S. and Canada. This project could very well be the first of its kind in the region, and as such could be precedent-setting in terms of providing pre-construction, construction, and operational standards for Great Lakes offshore wind. Similarly, because offshore wind power has not been accomplished in the Great Lakes, or even in North America, there are many issues that have yet to be addressed, and a pilot project would be a good opportunity to take a first look at such issues. As a self-proclaimed "pilot project," we have all agreed since the first inception that this project can and should serve as a model for other offshore projects, to show how to "do it the right way," and to make sure it is a "green energy" project in every sense of the phrase and not simply renewable energy. As such, we believe that we have been clear in our desire to work closely with the project proponents to avoid and minimize impacts on fish and wildlife and their habitat, and to monitor and respond to any impacts that may occur.

As discussed at the March 27, 2009 meeting, both the Service and ODNR believe it is necessary to take a comprehensive look at all the details of the proposed project, and to provide recommendations on necessary surveys based on the development plan. At this time, we understand that a decision as to the number of turbines, their location, and their size has not yet been made. It will be difficult for us to fully evaluate the need for various surveys and methods without this critical information. Further, while we do believe that pre-construction bird surveys are a critical component of the wildlife surveys needed, fisheries, benthic, and bat studies will likely also be necessary. As mentioned at the meeting, based on the general project location, the project lies within a region designated as having "extensive" or "moderate high" limiting factors based on ODNR's Wind Turbine Placement Favorability Analysis Map for offshore projects in Lake Erie (http://www.ohiodnr.com/LakeErie/WindEnergyRules/tabid/21234/Default.aspx). This indicates that multiple fish, wildlife, habitat, cultural, and/or historical issues exist in this region that must be addressed. In lieu of reviewing and recommending individual surveys at various times, we would prefer to recommend and comment on the suite of surveys necessary to fully evaluate the project at one time. Additionally, many of these surveys could be completed concurrently, possibly reducing total time and money spent on surveys for the project. For these reasons, we suggest a comprehensive look at all fish, wildlife and habitat issues, and a pre- and post-construction survey protocol that defines how each will be addressed, similar to how the Service and ODNR have been reviewing land-based wind power projects.

ODNR is in the process of developing a draft Lake Erie Open Water Sampling Protocol for Offshore Wind Power Siting. This document will include a broad suite of studies to address most natural resource issues associated with offshore wind power siting. For birds, this draft document recommends boat or aerial transects to identify waterfowl and waterbird use of the project site as well as avian and bat radar monitoring. Likewise, recommendations from the Service's Division of Migratory Birds also include both a transect and a radar component. The proposed Avian Distribution and Use Study lacks the radar study component. While we agree that this is a demonstration project and does not warrant the same level of study as a full-scale development, we believe that a radar component is required for the following reasons:

1) The Avian Risk Assessment Report and accompanying Analysis of WSR-88D Data to Assess Nocturnal Bird Migration Offshore of Cleveland, Ohio provided to our office for review several weeks ago contained a significant amount of useful information; however, the key limiting factors of this information and the inherent problems with using NEXRAD data for assessing the potential for avian impacts at wind power facilities are that the NEXRAD radar does not encompass the rotor-swept area, and that it is difficult to discern the vertical distribution of targets. Therefore, in order to assess nocturnal bird use and flight height within the project area, site-specific radar monitoring is necessary. Because this is a demonstration project, we would be willing to consider a modified scope of study versus what would be recommended for a full-scale offshore wind project. For example, we may use the NEXRAD analysis to identify peak migration times, and focus radar studies during those times.
2) There are real concerns that it will be difficult, if not impossible to accurately assess post-construction mortality at any offshore wind farm. Several methods have been tried in Europe, but so far they have been of limited scope and utility. In order for the State and Federal wildlife agencies to have a level of certainty that nocturnal migrating songbirds will not be at significant risk from this proposed facility, we need site-specific information on the flight height and density of birds using the rotor-swept airspace.

3) Depending on the project area, impacts to bats may also be a concern. Bat activity within the project area could be assessed by radar coupled with acoustic monitoring and thermal imagery for validation purposes.

Another significant concern relative to the proposed Avian Distribution and Use Study is that the spring migration season, particularly for waterfowl, is already well underway. By the time that the study team is mobilized and the study, as proposed in the Avian Distribution and Use Study, begins, peak waterfowl migration will have passed. Based on recommendations from the Service's Division of Migratory Birds, the key times to monitor waterbirds and waterfowl in Lake Erie during spring is from the time that lake ice begins to thaw through May 10. Because there are potentially significant congregations of some waterfowl species within the project area during the migration season (for example, Lake Erie including the project area, supports continentally important populations of red-breasted merganser as documented within the Avian Risk Assessment Report, and by the Service's Division of Migratory Birds), we strongly believe that it is not appropriate to complete an abbreviated waterfowl survey in the spring. Instead, we recommend commencing the waterfowl and waterbird monitoring this fall, and continuing it into the spring of 2010 to obtain a solid understanding of bird use within the project area for the entirety of the migration season. Additionally, there is an option to combine the waterfowl surveys with ODNR's proposed aerial waterfowl surveys during fall of 2009 and spring of 2010, which will be funded by a Service grant, providing monetary savings to the project proponents.

While we understand that there is a desire to move this project forward quickly, based on the number of State and Federal permits that will be required to complete the project, including a Section 404 permit from the U.S. Army Corps of Engineers and accompanying NEPA review, a Section 401 permit from the Ohio Environmental Protection Agency, a Submerged Lands Lease and other permits from the Ohio Department of Natural Resources Coastal Management Program, and a Certificate of Environmental Compatibility and Public Need from the Ohio Power Siting Board, we believe there is ample time to complete these studies prior to when project construction begins. Again, as a first of its kind, we anticipate that the permitting process for this project will be comprehensive and will likely require a significant amount of time to complete. Wildlife (avian and bat), fish and habitat studies could be conducted concurrently with preparing and submitting project applications to State and Federal agencies for review and public notice. Failure to conduct comprehensive studies for this project will prolong the lack of information regarding potential impacts to wildlife. This will make developing a full-scale project more difficult and defeat the purpose of developing a pilot project.

In summary, the Service believes this project is a unique opportunity to take a close look at how fish, wildlife, and Great Lakes habitat may be impacted by a pilot wind power development. The pre-and post-construction monitoring that is designed for this project will likely serve as a model for future offshore wind power projects in the Great Lakes. In lieu of taking a piecemeal or rushed approach to recommending surveys for various fish, wildlife and habitat impacts, we recommend looking comprehensively at all environmental aspects of the project, and recommending both pre- and post-construction survey protocols that will address all concerns in a timely, efficient, and cost-effective manner. This is how we typically review on shore wind power developments. We believe that the current Avian Distribution and Use Study is too limited in scope to provide the necessary information to appropriately evaluate this project. Additionally, we do not have all the project information necessary to recommend the most effective survey protocol for fish, wildlife, and habitat. Finally, due to the numerous State and Federal permits required for this project, we do not believe that conducting a full fall/winter/spring bird use study focusing on key migration times would delay implementation of the project. In fact, the information that the Service is requesting will be critical in completing any NEPA document required for the Section 404 permit. Until a full project scope is ready, we are not in a position to recommend a full suite of fish, wildlife, and habitat pre- and post-construction studies; however, we are committed to making these recommendations in a timely manner when complete project information is available.

Thank you for the opportunity to review this proposal. We look forward to working with you and your partners to develop a fish, wildlife, and habitat survey protocol that suits the informational needs of the permitting agencies and balances those needs with the nature of a demonstration-scale project. If you have questions or would like to discuss this further, please contact Megan Seymour at extension 16 in this office.

Sincerely,

Mary Knapp

Mary Knapp, Ph.D.
Supervisor

cc: Keith Lott, ODNR, 2514 Cleveland Road East, Huron, OH 44839
Stuart Siegfried, PUCO, 180 E. Broad St., Columbus, OH 43215
Dave Lepat, Buffalo District Corps of Engineers, Buffalo, NY
John Watkins, ODNR, Office of Coastal Management, Sandusky, OH

Attachment 2

U.S. Fish and Wildlife Service Avian Radar Preliminary Data from Cleveland, Ohio, Early Fall 2017 October 2, 2017

Attachment 2 contains preliminary data from the U.S. Fish and Wildlife Service's (Service) avian radar unit located on the shore of Lake Erie in Cleveland, Ohio during fall 2017. The radar unit is actively collecting bird and bat fall migration data that may inform the analysis in the LEEDCo Project Icebreaker Draft EA.

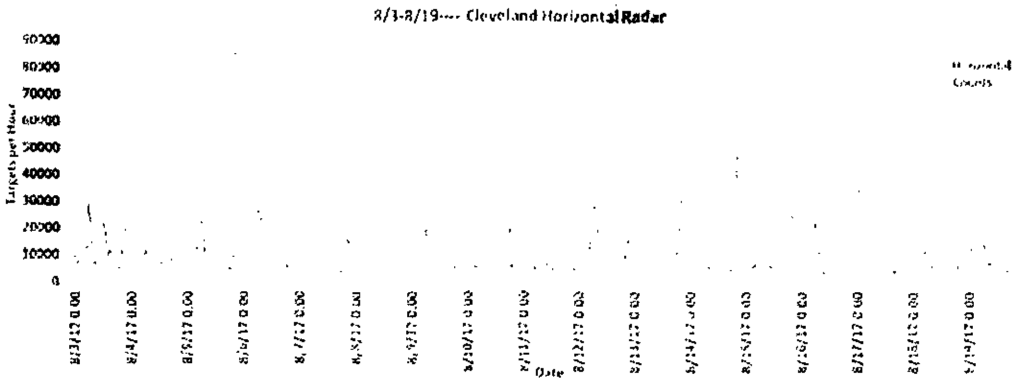
Summary of Migration Timing, Direction, and Altitude

Below are visual summaries of the data analyzed to date (August 3 – September 5), showing the pulsed nature of migration using an hourly time series, a set of graphs showing the main direction of migrants in the four major biological periods (dawn, day, dusk, night), and graphs showing the volume-corrected density of migrants by altitude. These graphs should be taken as preliminary, as a large portion of the migratory season has not yet occurred and full analysis has not been completed. In addition, these data are being collected on the coastline, out of range of the project area. However, these findings do show a substantial amount of migratory activity, occurring in part from lake crossing movements, with substantial migrant traffic within or near the rotor-swept zone.

While data collection is ongoing, the data presented in this attachment are only from the first part of the fall 2017 migration season, when migration activity was only underway for about 2 weeks (Figures 1 and 2). This is the only data that was available for analysis at this point in time, however as the season progresses additional information will be obtained and analyzed. From our other radar survey locations across the Great Lakes, we observe that fall migration generally peaks around mid to late September (Horton et al. 2016, Rathbun et al. 2016). However, from August 3 – September 5 on the Cleveland shore we recorded large numbers of migrants moving towards shore, presumably crossing Lake Erie. The conservative estimate from the vertical scanning radar (VSR) indicates that even during this early migration period, 2,000-2,500 targets per kilometer per hour were moving through the area during the night. Depending on the night, many of these targets were moving in from over the water (Figure 3 and Attachment 2a). While our site is on shore, these targets had high densities within or just above the proposed rotor-swept zone.

Our radar units can record data out to 2 nautical miles (nm) from the unit, which is located on the shoreline of Lake Erie. Thus, we are able to see approximately 2 miles out across the lake. Within this offshore area, we see targets arriving from further out in the lake (Attachment 2a) and often continuing straight in towards land. We see no reason to believe that these migrants would have changed their path just before our radar unit observed them, leading us to believe that the targets have crossed over Lake Erie.

At the Cleveland site the data collected to date also show high migrant use along the shoreline of Lake Erie. However, this does not mean that there is no or low activity over the open water. Our radar units often recorded targets flying in from over the open water, and potentially landing in the near-shore area at dawn. These targets that arrive from over the lake are part of the reason that we find a concentration of migrants in the shoreline area.



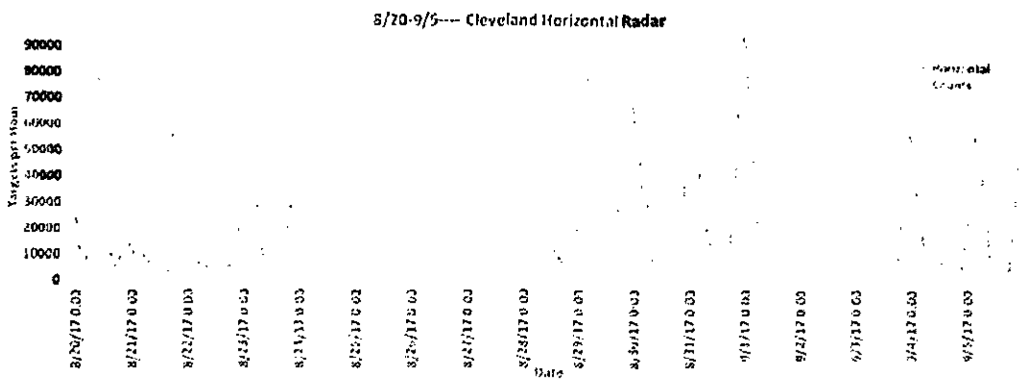


Figure 1. The above figure shows an hourly time series of radar targets on the Horizontal Scanning Radar (HSR) in Cleveland from August 3 to midnight September 6, 2017, with midnight centered on the vertical gray lines of the graph. Note the different scales between the Horizontal Scanning Radar (Figure 1) and Vertical Scanning Radar (VSR, Figure 2). The HSR covers a wider geographic area, but is sensitive to counting the same individual target multiple times or having area blocked by obstacles on the landscape. The VSR, while covering a smaller area, is less likely to have issues with multiple-counting or blockage, and provides a more conservative estimate. Spikes in targets per hour centered around midnight are indicative of migration events. Apparent migration events are indicated on August 13-17, 20, 23-24, August 30-September1 and September 4-6. The HSR was not operational from approximately 1:00 am August 25 until mid-day August 29 and again on mid-day September 2-4. The pulsed nature of these migration events necessitates continuous sampling. Gaps in the data represent time periods when the radar was down due to malfunction or time periods where large amounts of rain or other clutter occurred.

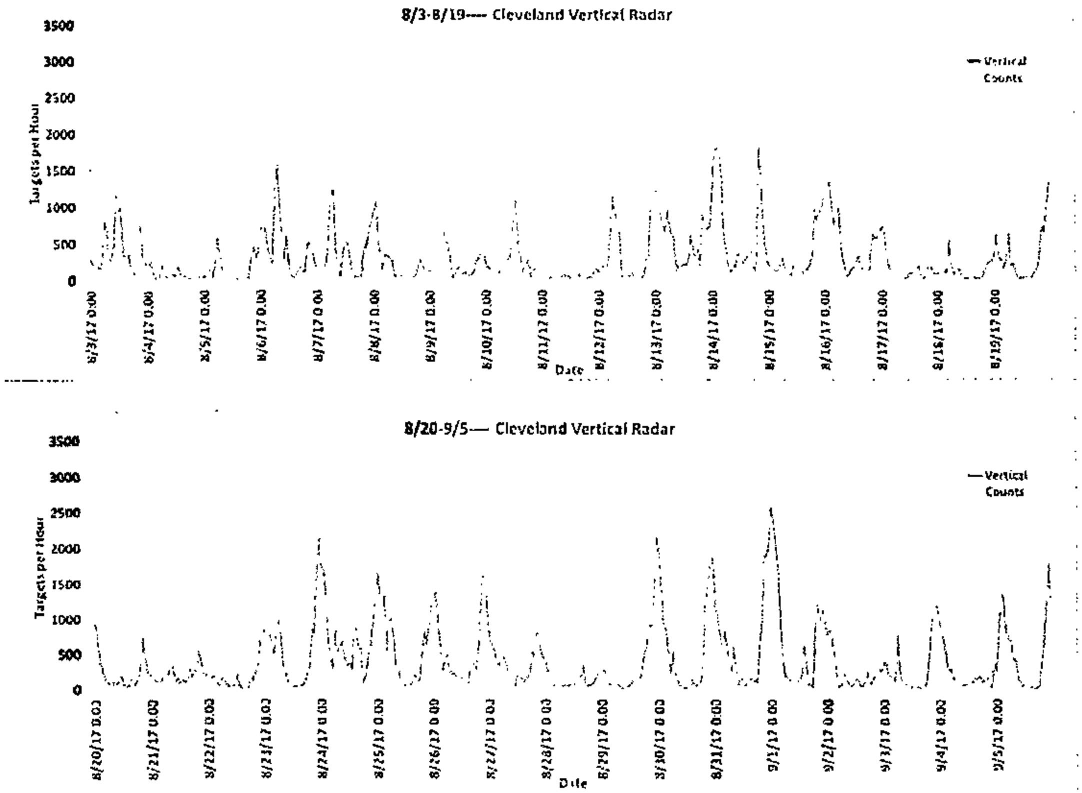


Figure 2. The above figure shows an hourly time series of radar targets on the Vertical Scanning Radar (VSR) in Cleveland from August 3 to midnight, September 6, 2017, with midnight centered on the vertical gray lines of the graph. Note the different scales between Horizontal Scanning Radar (HSR, Figure 1) and Vertical Scanning Radar (VSR). The HSR covers a wider geographic area, but is sensitive to counting the same individual target multiple times. The VSR, while covering a smaller area, is less likely to have issues with multiple-counting, and provides a more conservative estimate. Apparent migration events (indicated by increased targets centered around midnight) are indicated on August 8, August 13-17, August 23-27, August 30-September 2, and September4-6. High numbers of targets centered around midnight indicate nocturnal migration events. Gaps in the data represent time periods when the radar was down due to malfunction or time periods where large amounts of rain or other clutter occurred.

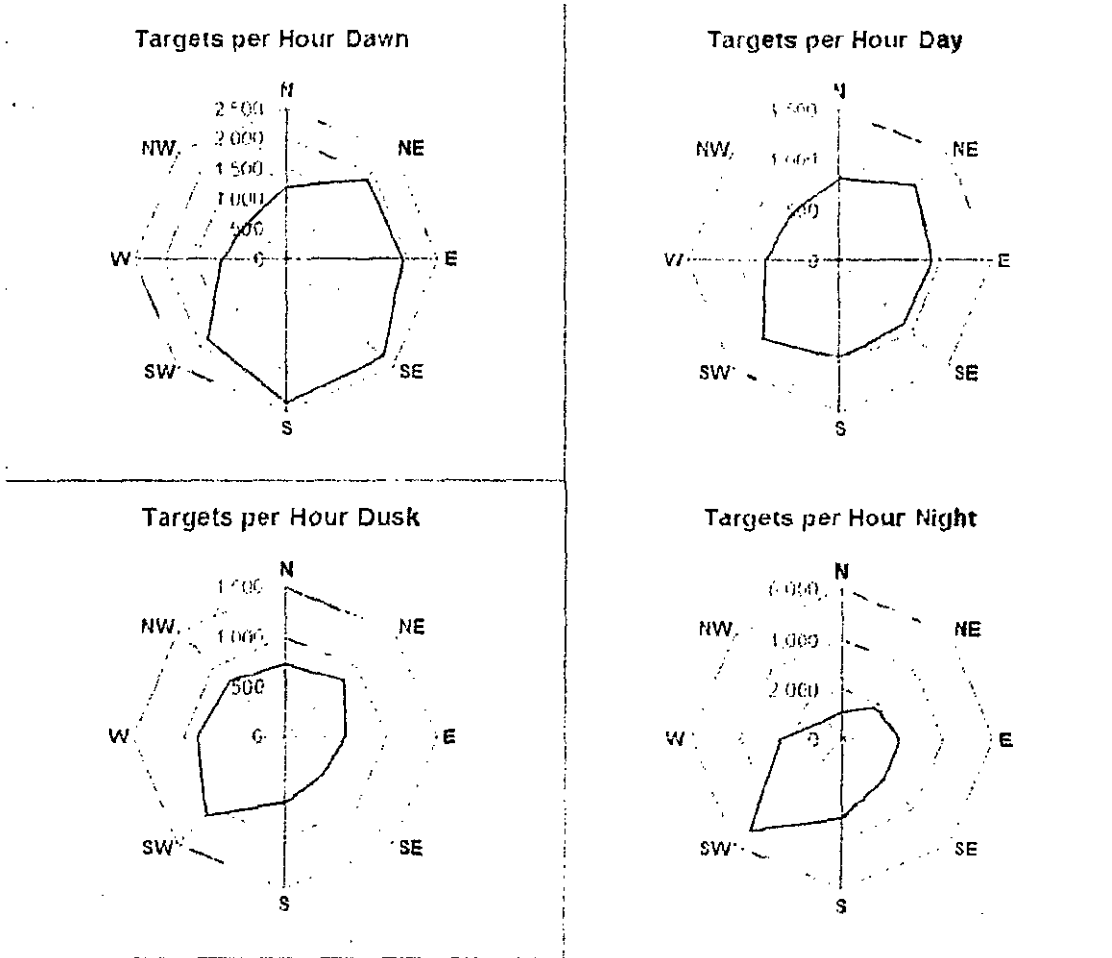


Figure 3. Rose graphs showing the flight direction of migrants during each biological period (dawn, day, dusk, and night) during early fall migration in Cleveland, Ohio. Note the different scales on the four graphs. Night movement shows a strong southwest direction, as well as a substantial southerly component. At dawn, directionality is consistent with migrants over water reorienting towards shore. As the data still constitutes early season movements, we expect there to be more migration nights added to the dataset and these directions may shift as the season goes on.

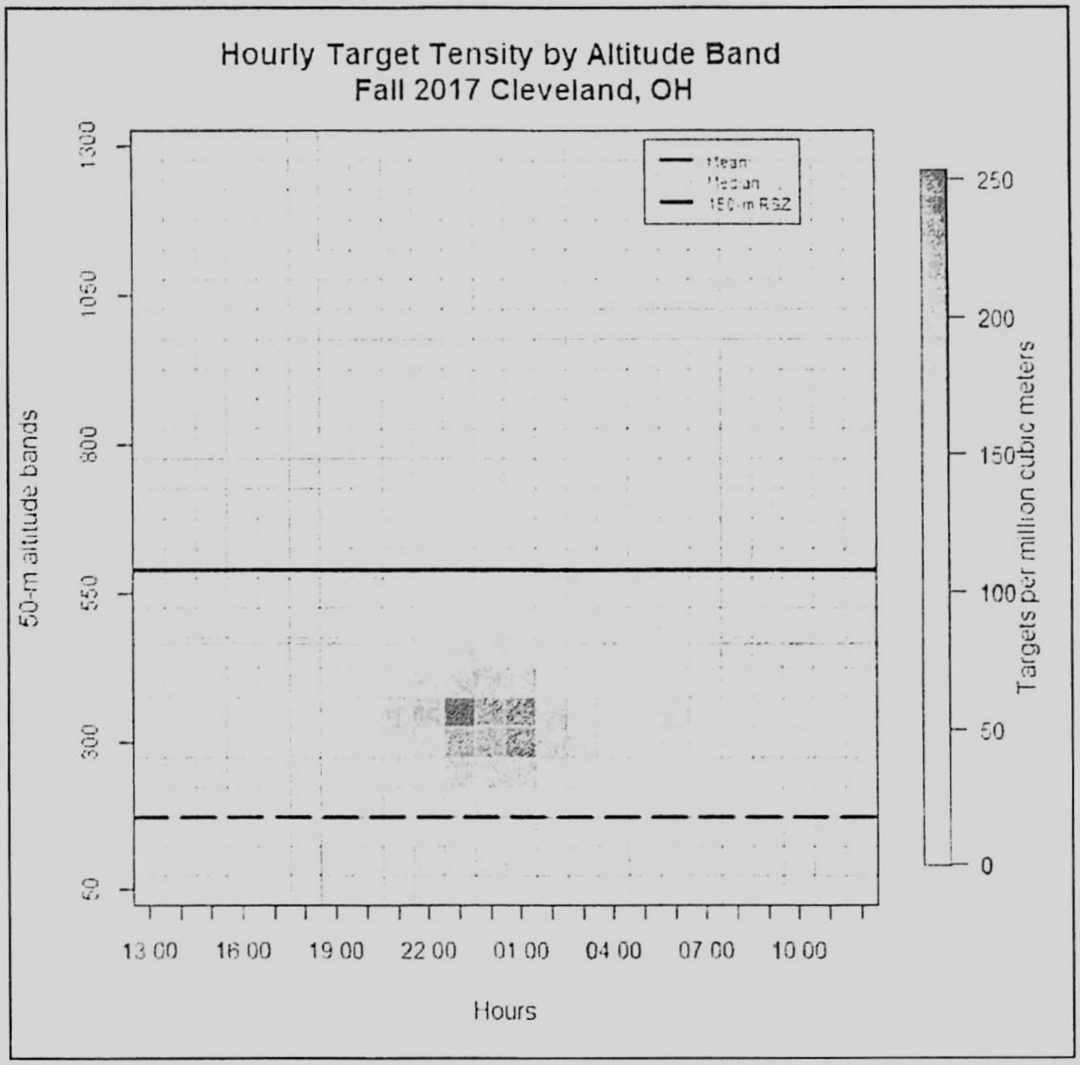


Figure 4: Heat map of target density by altitude and hour for early fall migration in Cleveland, Ohio. Hour is on the x-axis, centered on midnight (0:00), while altitude is on the y-axis, in 50-meter (m) bins. The label for each bin represents the top of that bin, so the 50 m bin is from 0-50 m. The radar data is truncated at 1300 m altitude for clarity, and target density is relatively low at altitudes of 1300-2800 m. Warmer colors indicate higher target density. Mean and median nocturnal flight altitudes are indicated by the dark and light blue lines, respectively. Note that these measures are affected by the upward-skewed distribution of targets, and both lie above the altitudes of maximum density. A rotor-swept zone of 150 meters is indicated by the dashed black line. These data provide a more precise view of migratory activity than the NEXRAD data presented in the EA, since 1) individual targets are tracked rather than reflection densities, and 2) 50 m bins are used rather than 300 m bins. Note also that the highest density is relatively close to the rotors-swept zone, and atmospheric conditions can raise or lower the center of density. In addition, due to clutter issues at our site and narrower beam width at low altitudes, we are likely underestimating the density of migrants at altitudes below 150m.

TrackPlots

Below are a series of 15 minute TrackPlots for the horizontal scanning radar (HSR) that is automatically generated by the radar software. These data have not undergone final editing and they may contain minor errors. Each line represents either a single flying bird, bat, or tight flock of these animals (target) detected by the radar unit over a 15 minute period. The images have been selected to demonstrate migrants engaged in overwater flight during moderate to high periods of migration.

The tracks overlay a satellite photo that accurately shows the location for this portion of Cleveland and Lake Erie with north corresponding to up in the image. The shoreline is shown as a white line overlaying the tracks and the radar location is depicted as a white dot near the center of the image. The color of the track identifies the direction of travel for each target as does the orientation of the line. The color wheel in the upper right of each image decodes the direction of travel with red being south; blue, north; green, east; and violet, west. Collectively, the images demonstrate large numbers of migrants approaching the shoreline from open water that most likely crossed the lake from the north shore. Date and time are embedded in the graphic in the top left corner starting with year, month, date, and beginning time of the recording in military time. The fourteen images below capture migration events with large or predominant lake-crossing components during 12 separate nights (August12-September 17), approximately 1/3 of nights in this timeframe. The image below was recorded on August 12, 2017 starting at 5:15 am (and extending through 5:30 am), Eastern Standard Time.

Figure 5. Moderate migration from offshore. Migration typically is decreasing at this time due to the approach of dawn.

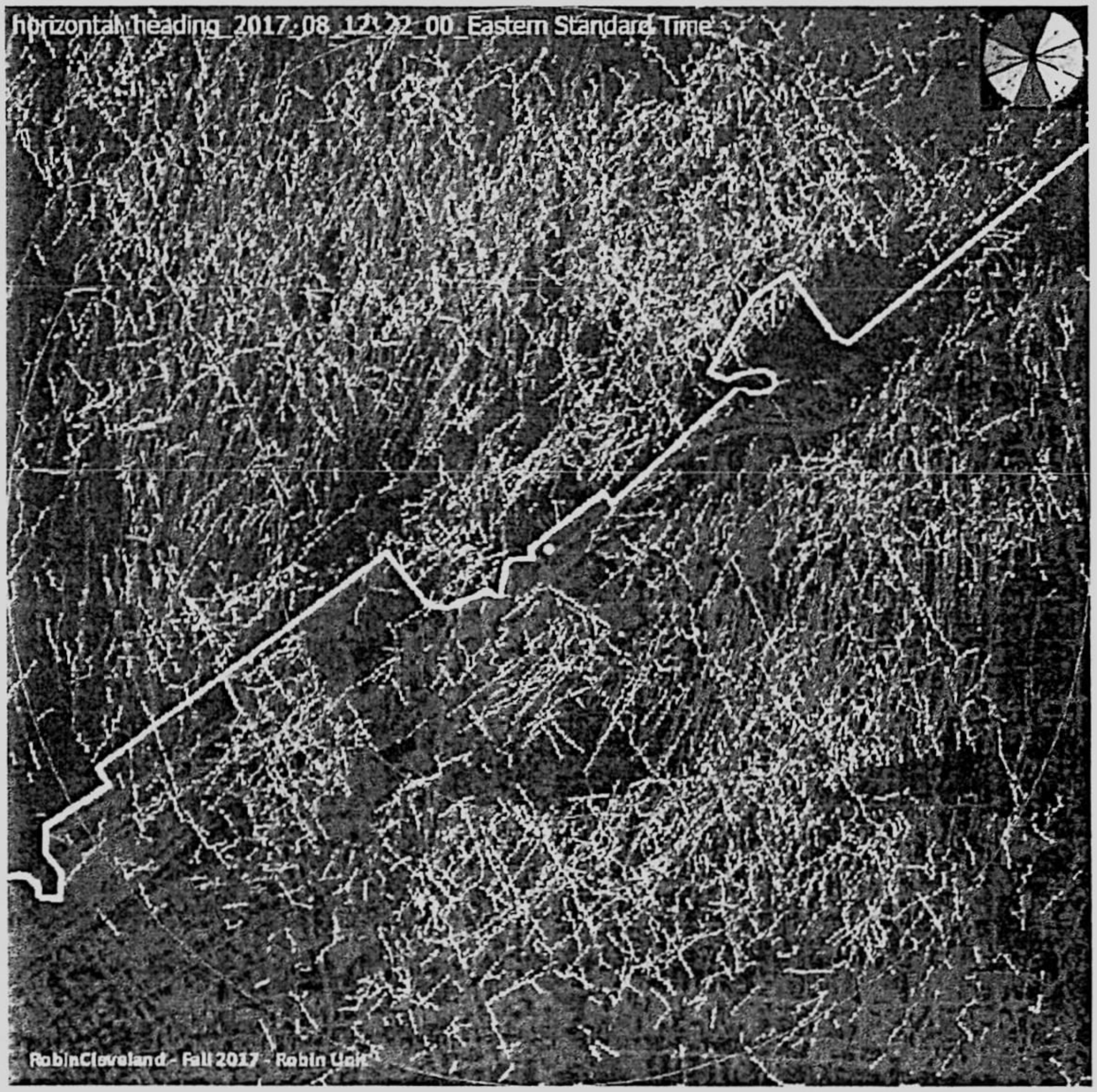


Figure 6. This graph depicts moderate migration coming from off-shore and moving to the south and south-southwest. Migration typically peaks within several hours of midnight, building from just after dusk and tapering off as dawn approaches.

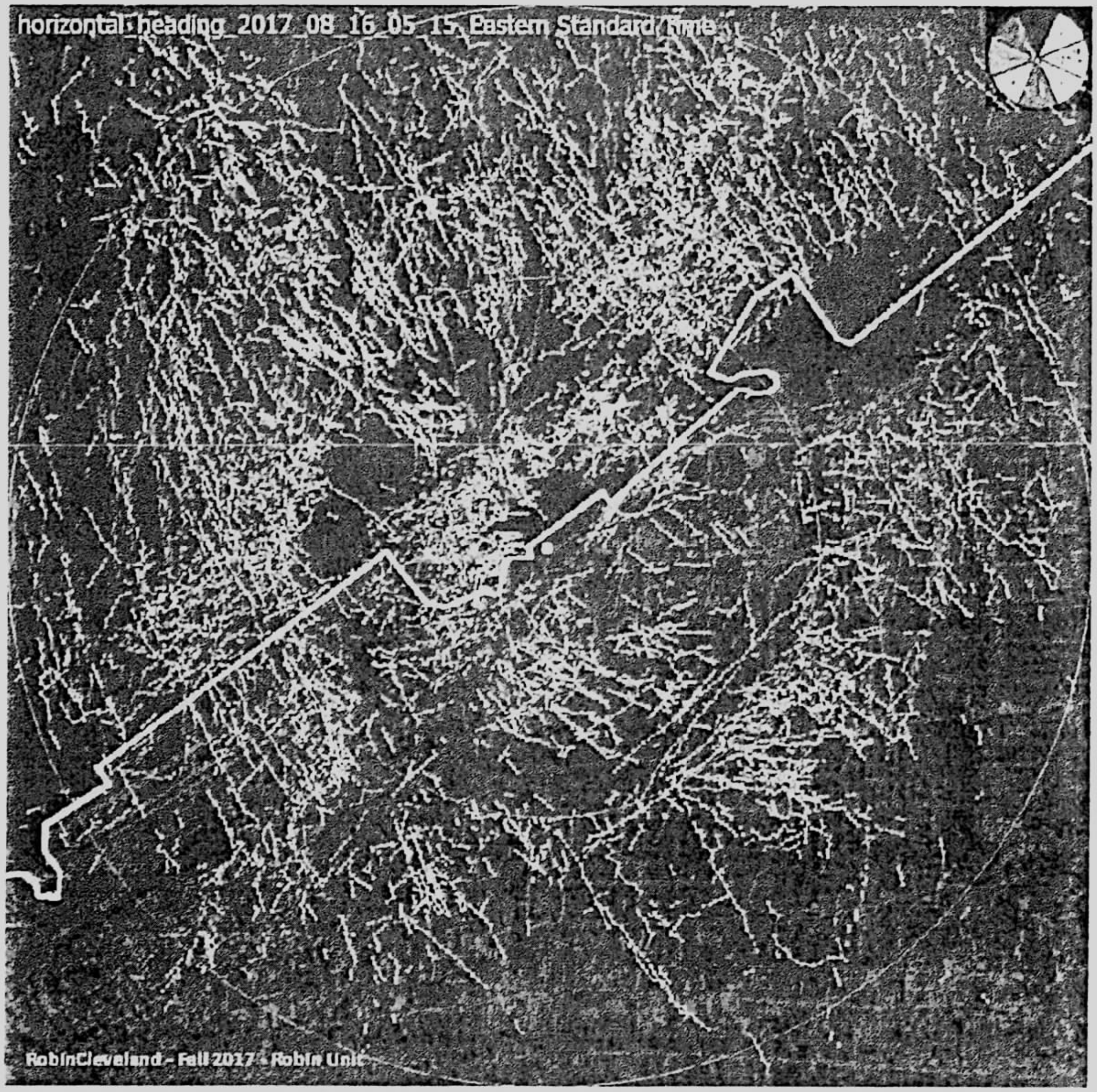


Figure 7. This graph depicts another example of moderate migration. Targets are flying towards shore before dawn.

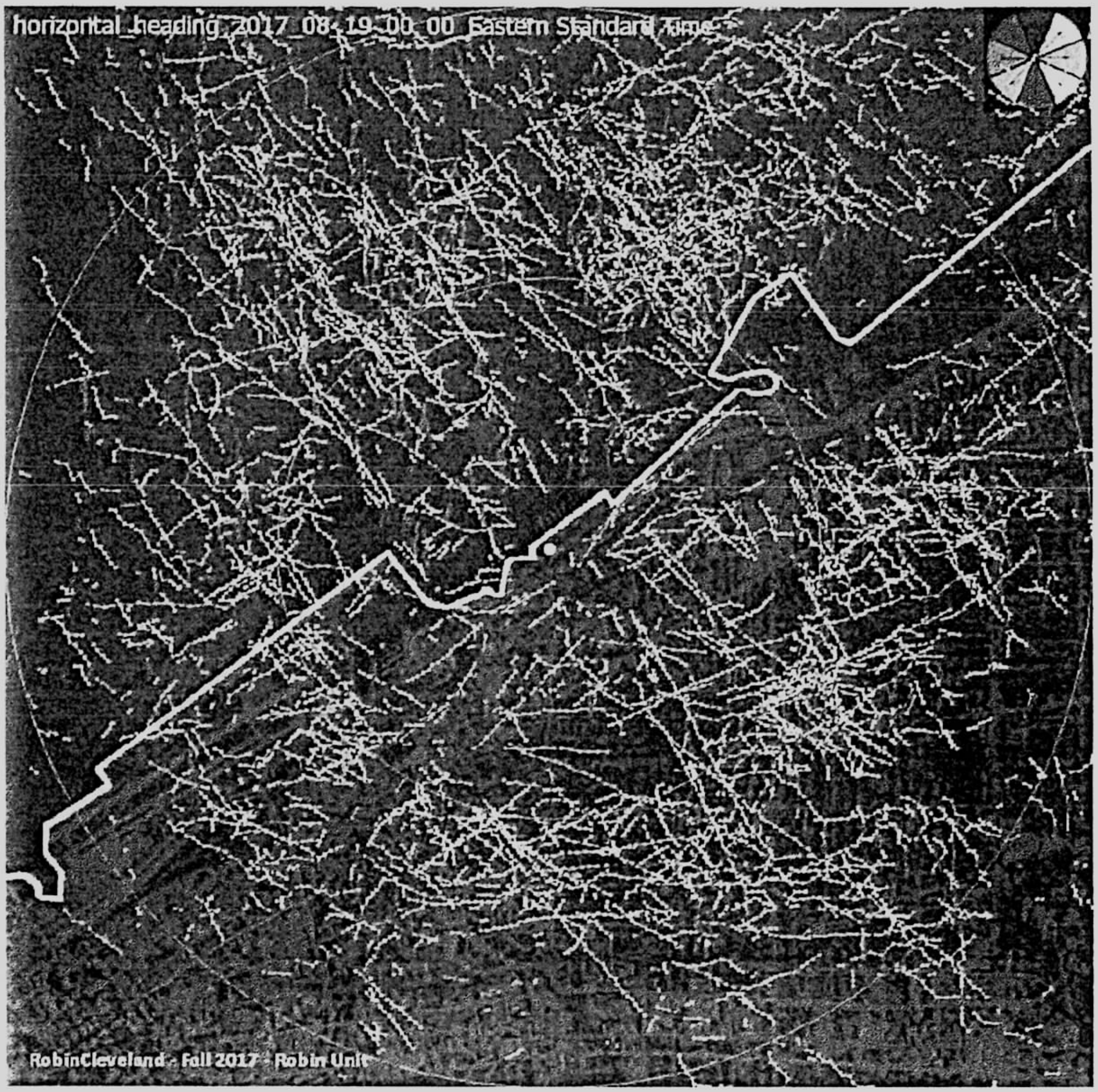


Figure 8. Light to moderate migration across Lake Erie, moving to the southeast and south, as well as parallel to shore to the northeast at midnight.

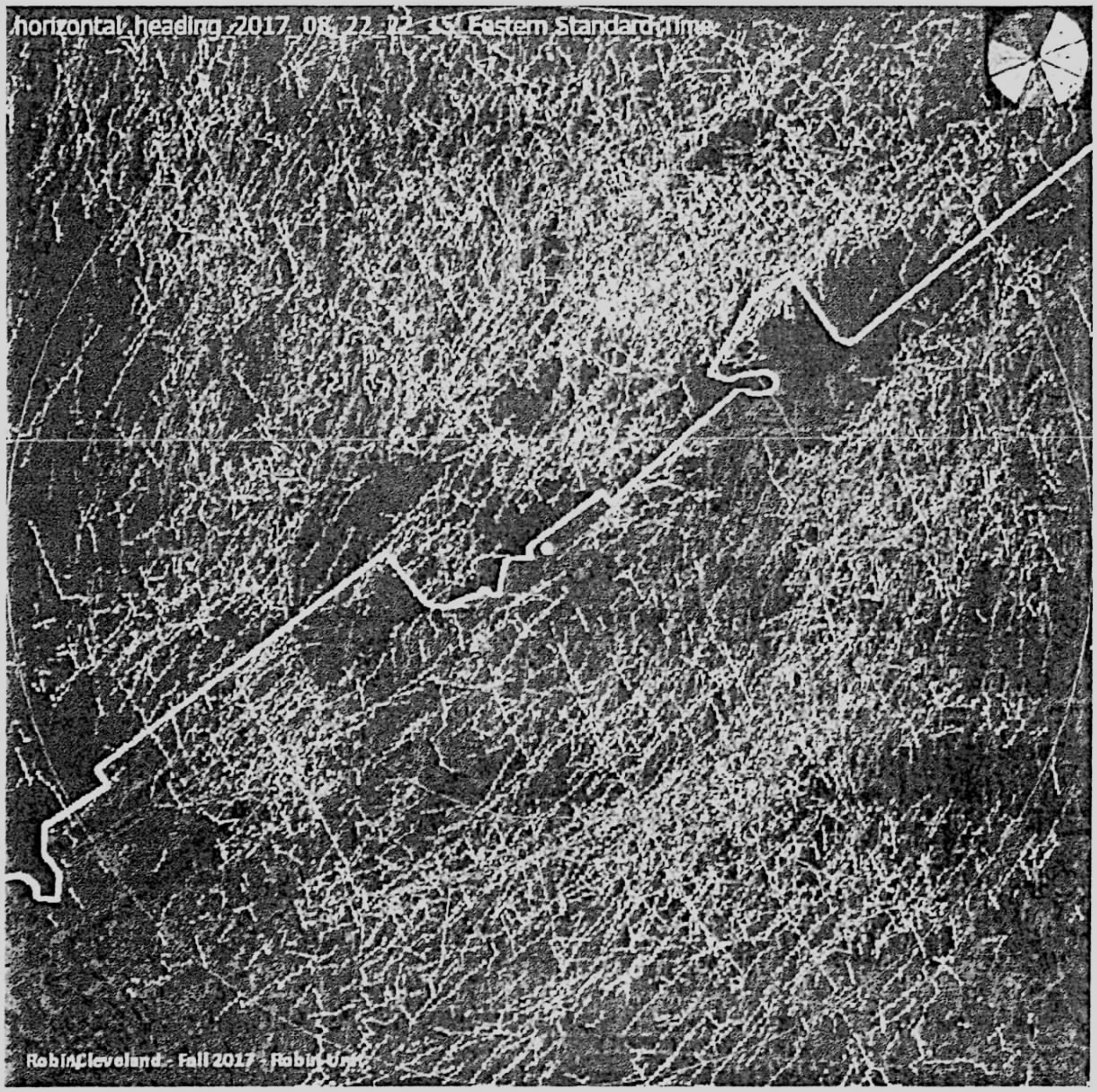


Figure 9. Heavy migration moving primarily in a south and southwest direction as midnight nears.

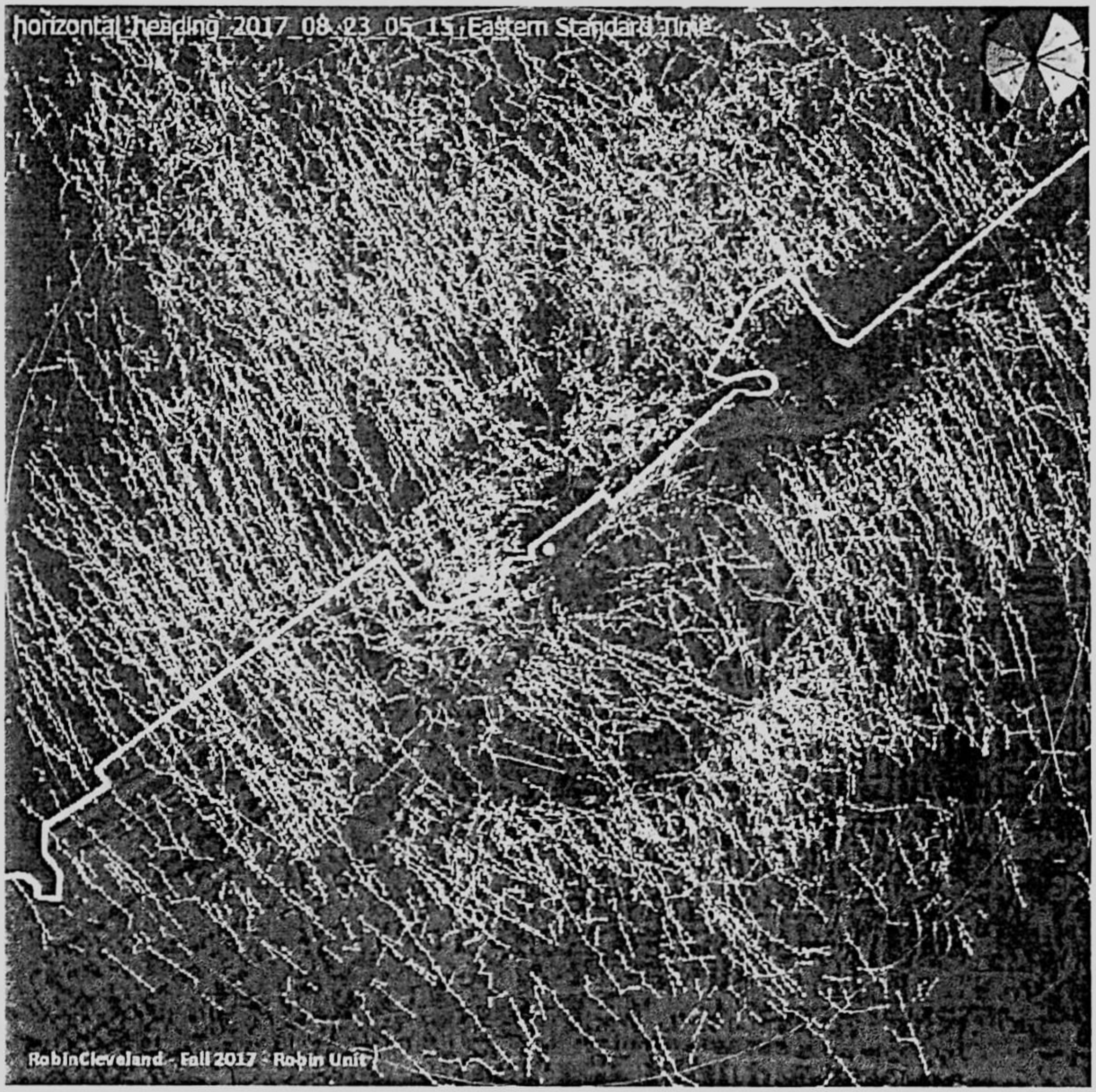


Figure 10. This graph depicts moderately heavy migration near dawn moving predominantly to the south and southeast.

Figure 11. This graph depicts another example of moderate migration before dawn.

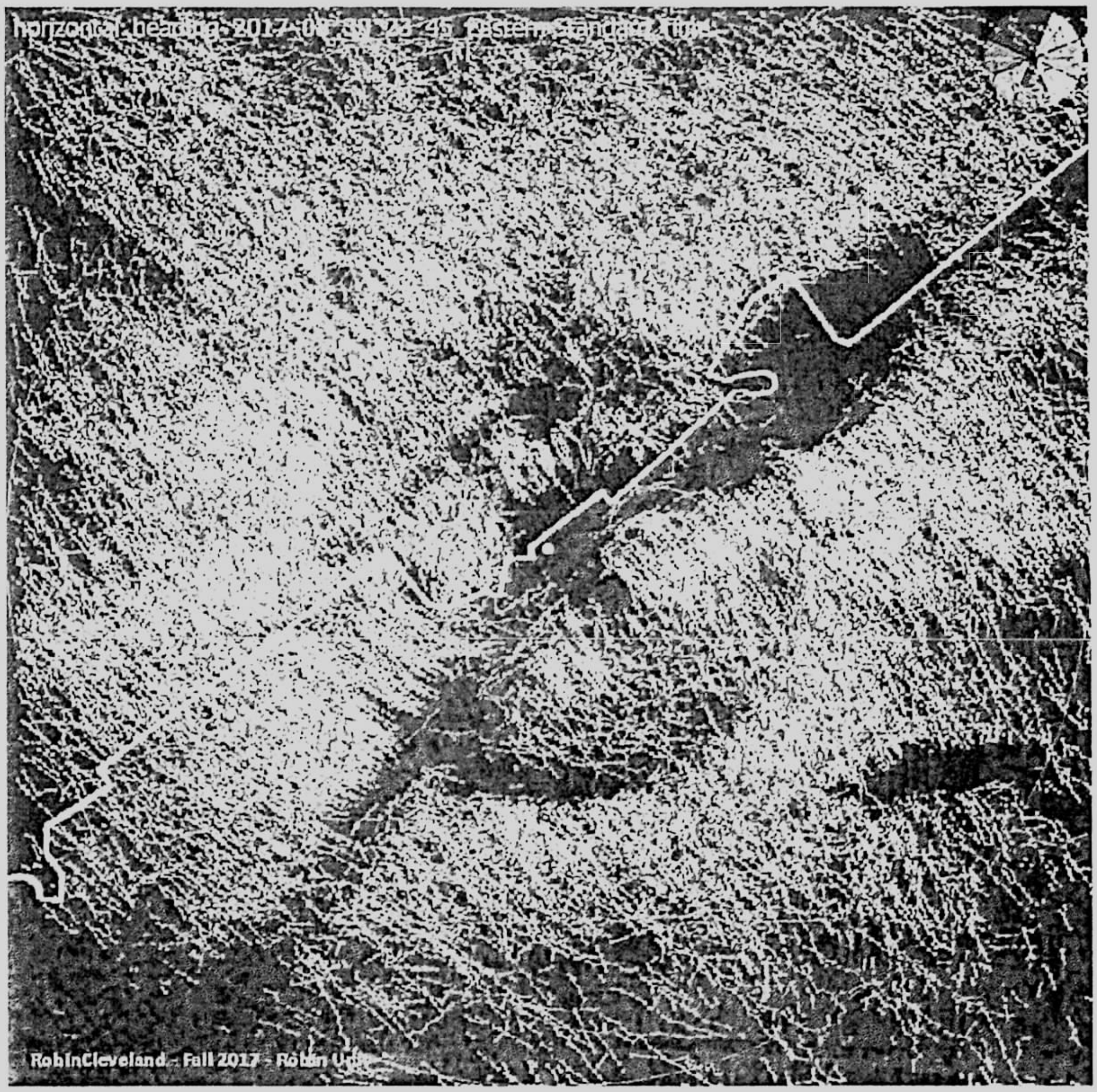


Figure 12. This graph depicts heavy migration just before midnight moving in a southeast direction.

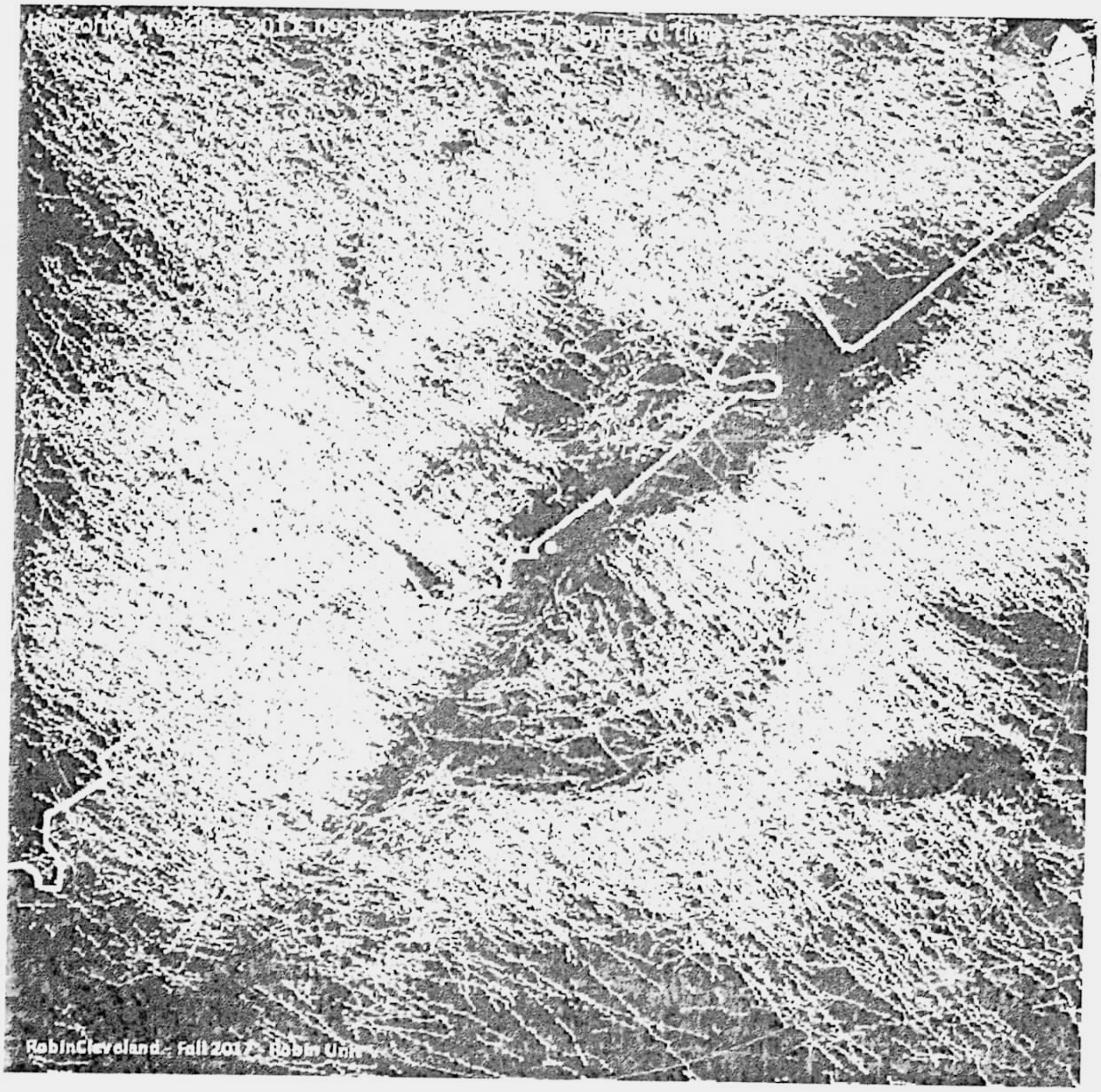


Figure 13. This graph depicts heavy migration an hour after midnight moving toward the southeast and east.

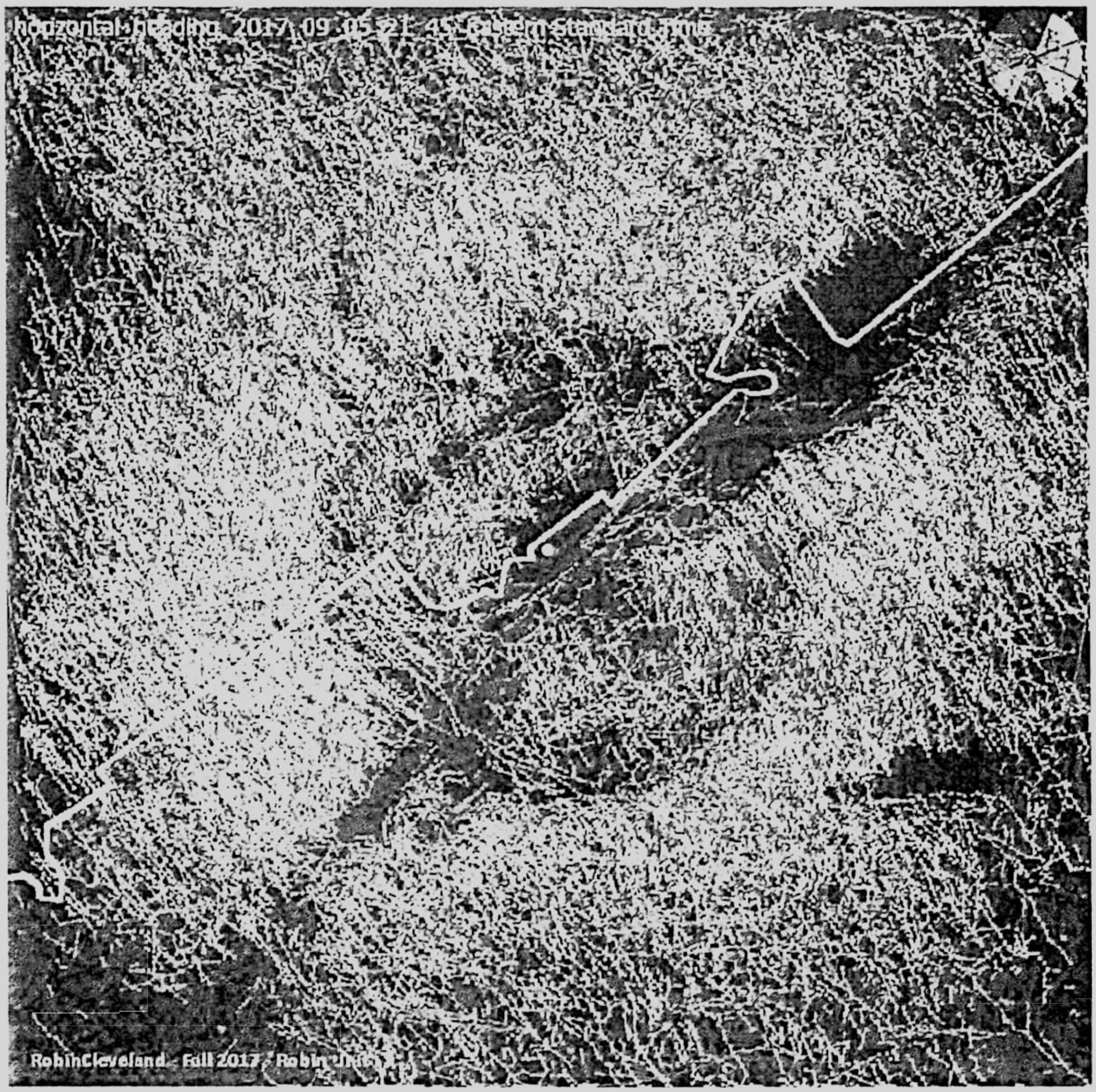


Figure 14. This graph depicts heavy migration in earlier part of the night moving generally southeast.

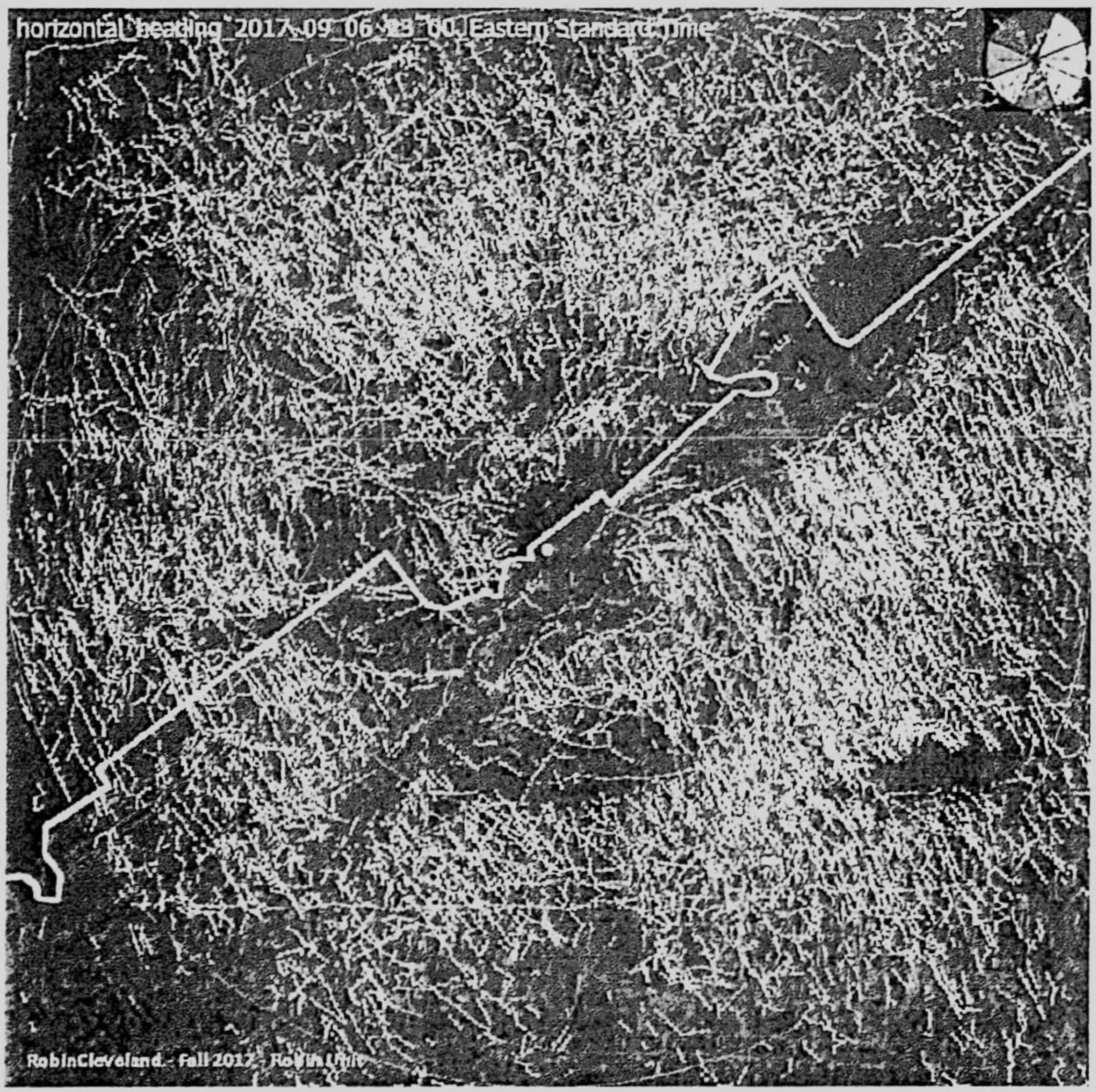


Figure 15. This graph depicts moderately heavy migration near the middle of the night with targets moving primarily south to southeast. Migration is pulsed and intensity varies from night to night.

Figure 16. This graph depicts moderate to moderately heavy migration near the middle of the night.

Figure 17. This graph depicts heavy migration to the southeast although getting closer to dawn. Migration varies by night, by time, and by time of season.

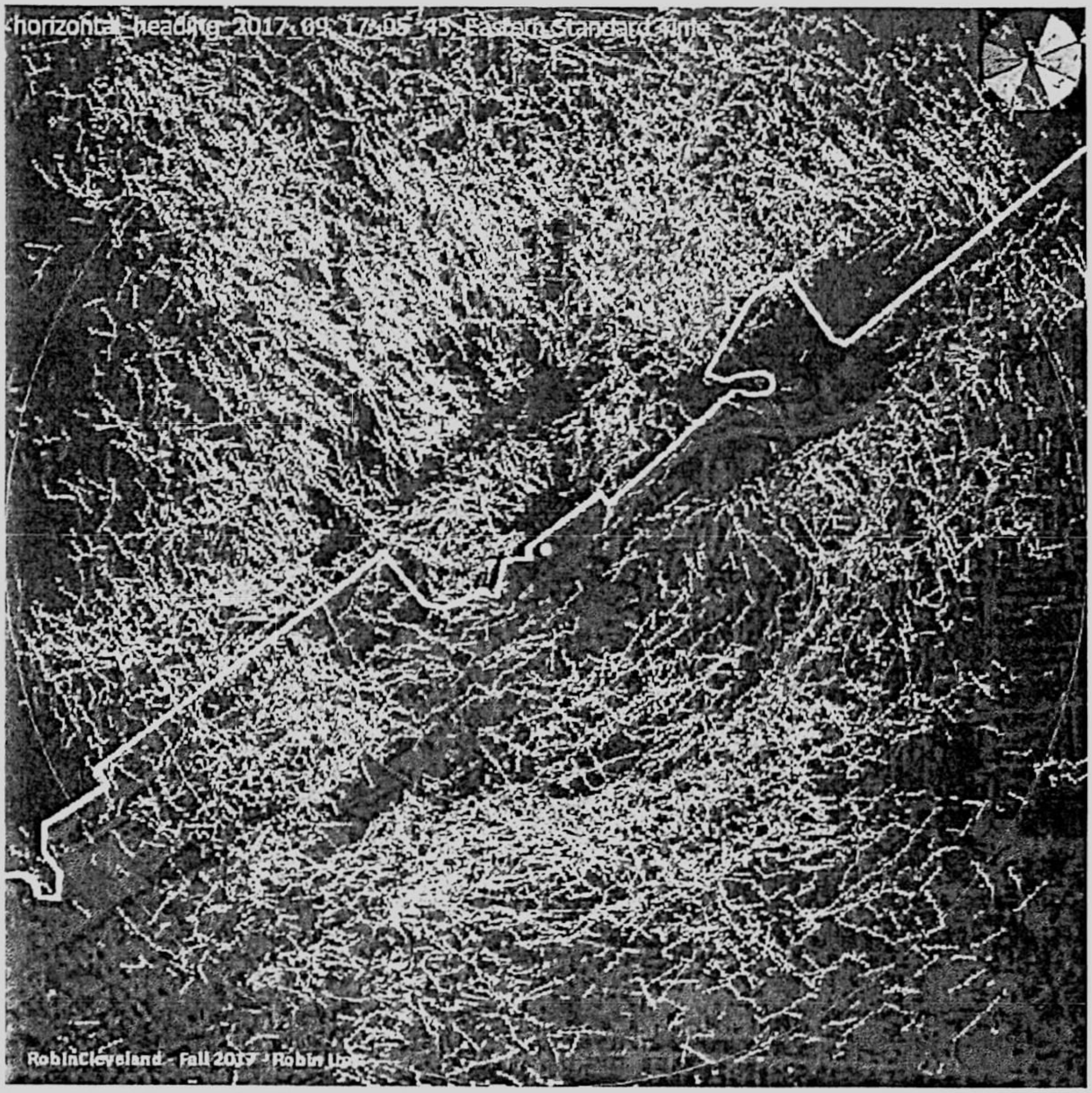
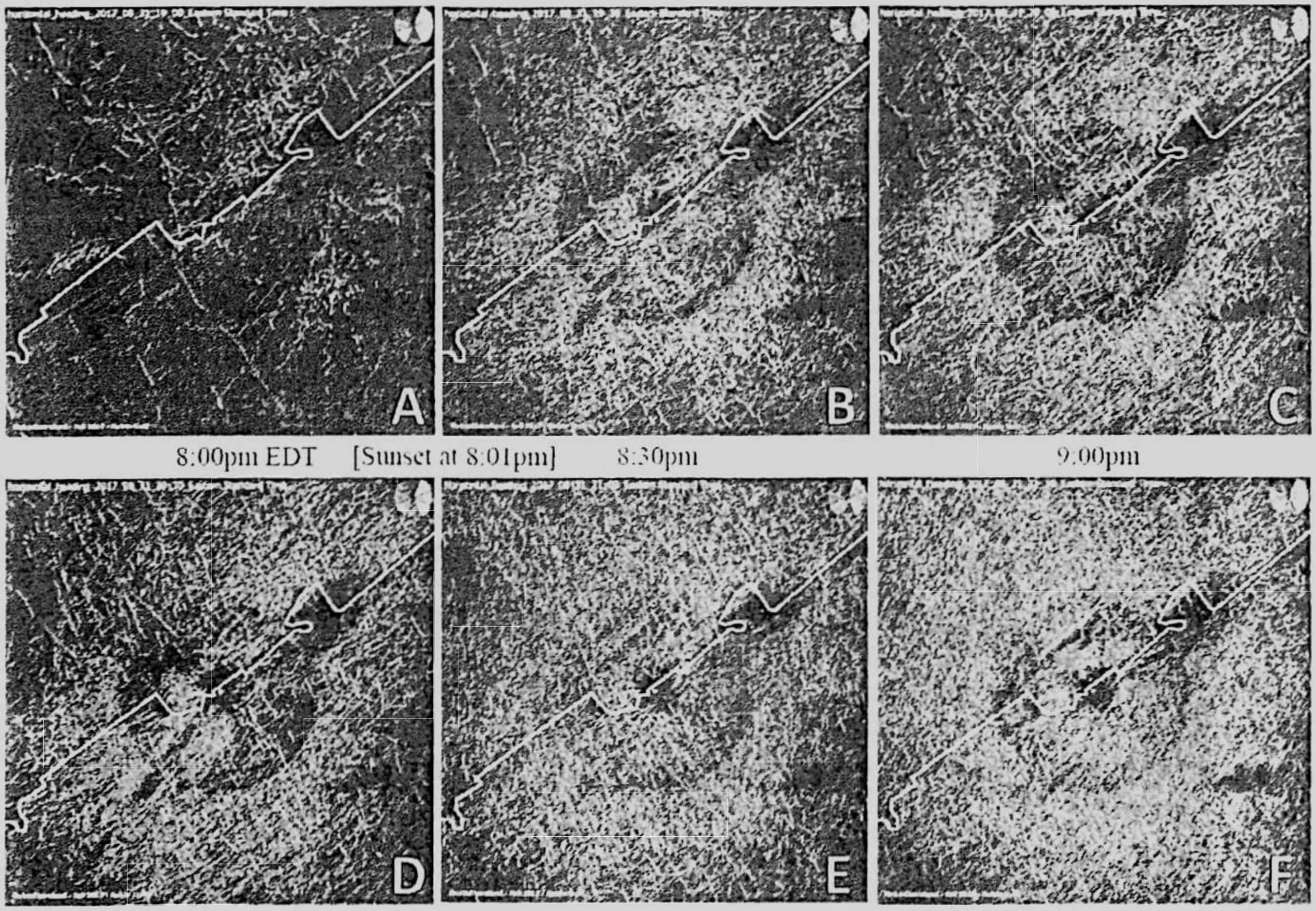


Figure 18. This graph depicts moderately high migration as dawn approaches. Note that while offshore migrants are moving mostly in a southeasterly direction, migrants on the left are tending to turn easterly after reaching shore and migrants on the right are tending to turn south or southwest after reaching shore.

South-bound Target Arrival at Cleveland



8:00pm EDT [Sunset at 8:01pm] 8:30pm 9:00pm

9:30pm 10:00pm 10:30pm

The plots above document the arrival of south-flying targets on the southern shore of Lake Erie (Cleveland radar site) approximately one and a half hours after sunset, and approximately one hour after the onset of migration on the night of August 31, 2017. Each plot represents 15 minutes of target tracking, beginning at the time listed. The white line represents the Cleveland shoreline and the radar location is a white dot at the center of each plot. Color indicates the direction of flight for each target, according to the color wheel at the top right of each plot: blue is north, green is east, red is south, and pink is west. Distance from our Cleveland site to the north shore of Lake Erie is approximately 80 km (50 miles). An average groundspeed of 61 kilometers per hour (17 m/s) has been recorded for migrants crossing large bodies of water (Bruderer and Liechti, 1998). Thus, migrants leaving at dusk should begin to arrive on shore approximately an hour and a half later, almost exactly the time elapsed observed (panels A and D).

A. Low activity at the time of sunset (8:01 pm EDT)
B. Migration begins in the half hour after sunset with flight to the west and southwest, and relatively low activity offshore (upper left of the plot)
C. Migration continues through the next half hour, mostly to the southwest, and heavier over land.
D. At 9:30, southern-moving (red) targets enter, particularly in the offshore portion of the plot.
E. In the next half-hour, south-bound target activity increases dramatically.
F. Heavy migration activity with predominant orientation to the south and southwest is evident throughout the plot.

Bruderer, B., & Liechti, F. (1998). Flight Behaviour of Nocturnally Migrating Birds in Coastal Areas: Crossing or Coasting. *Journal of Avian Biology*, 29(4), 499-507

Message

From:	Beth Nagusky [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=087E4C4A3125490E987CF277B1BFEC83-BNAGUSKY]
Sent:	12/19/2017 2:50:29 AM
To:	Gosse, Jeff [jeff_gosse@fws.gov]
CC:	Seymour, Megan [megan_seymour@fws.gov]; scudder.mackey@dnr.state.oh.us; Lorry Wagner [/o=ExchangeLabs/ou=Exchange Administrative Group (FYDIBOHF23SPDLT)/cn=Recipients/cn=687aa2b5223f454392d0c838241010a9-lwagner]; Christine M. T. Pirik [CPirik@dickinson-wright.com]; Caleb Gordon [cgordon@west-inc.com]; Diehl, Robert [rhdiehl@usgs.gov]; Brown-Saracino, Jocelyn [Jocelyn.Brown-Saracino@ee.doe.gov]; Kate.Parsons@dnr.state.oh.us; *Erin.Hazelton@dnr.state.oh.us; Dave Karpinski [/o=ExchangeLabs/ou=Exchange Administrative Group* (FYDIBOHF23SPDLT)/cn=Recipients/cn=6f6a2cdc3f514f58b83724517ae3e77f-ddavis]; Robert Krska [Robert_Krska@fws.gov]; FW3 ES Radar Staff [fw3_es_radar_staff@fws.gov]
BCC:	Cowan, Ben [BCowan@lockelord.com]
Subject:	Re: Diehl Report Process Moving Forward

Jeff:

Apparently we do have very different understandings of the role Robb was to play in deciding the pre-construction Icebreaker Wind radar issues; our understanding was that Robb s report would be the final word on the issue of the viability of vessel based radar to collect the data the agencies sought, and we believe that understanding is reflected in our Avian and Bat Monitoring Protocol and MOU with ODNR.

In addition, you reference email correspondence and calls with Robb that we were not privy to. As a result, we do not know the nature of your comments and objections to his draft report. Until we see them it is difficult to know whether we can resolve our differences.

We plan to give Robb our comments in writing by COB Tuesday.

Since we envisioned Robb s report as the final word on this subject, we strongly object to anyone attaching comments to the report itself.

Beth A. Nagusky
Director of Sustainable Development
Lake Erie Energy Development Corporation
1938 Euclid Avenue, Suite 200
Cleveland, Ohio 44115
Email: bnagusky@leedco.org
Cell: (207) 592-1961
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From: "Gosse, Jeff" <jeff_gosse@fws.gov>
Date: Friday, December 15, 2017 at 4:27 PM
To: Beth Nagusky <bnagusky@leedco.org>
Cc: "Seymour, Megan" <megan_seymour@fws.gov>, "scudder.mackey@dnr.state.oh.us" <scudder.mackey@dnr.state.oh.us>, Lorry Wagner <lwagner@leedco.org>, "Christine M. T. Pirik" <CPirik@dickinson-wright.com>, Caleb Gordon <cgordon@west-inc.com>, "Diehl, Robert" <rhdiehl@usgs.gov>, "Brown-Saracino, Jocelyn" <Jocelyn.Brown-Saracino@ee.doe.gov>, "Kate.Parsons@dnr.state.oh.us" <Kate.Parsons@dnr.state.oh.us>, "Erin.Hazelton@dnr.state.oh.us" <Erin.Hazelton@dnr.state.oh.us>, Dave Karpinski <dkarpinski@leedco.org>, Robert Krska <Robert_Krska@fws.gov>, FW3 ES Radar Staff <fw3_es_radar_staff@fws.gov>
Subject: Re: Diehl Report Process Moving Forward

Beth,

Your understanding and description is vastly different than ours. LEEDCo suggested Robb as an independent reviewer for the radar study and we said that we would be willing to explore that concept (April 23, 2017). Robb expressed his preference to have both LEEDCo and the agencies each fund half of his requested stipend (Phone call between the Service and Robb, May 3, 2017; email between Dr. Diehl and Beth Nagusky et al., May 2, 2017). The radar section of the Service agreed that we would provide half of that cost provided that we could develop a mutually agreeable written agreement which is required before our contracting division would allow for any payment.

We spent months, beginning this summer, in discussions with Robb and exchanging study and report specifications (emails May 3, 2017, call May 3, 2017, email, June 13, 2017, email June 25, 2017, call October 19, 2017). During all this time in discussions with Robb, he consistently stated his position that the Service and LEEDCo were free to disagree with his recommendations (email between Dr. Diehl and Beth Nagusky et al., May 2, 2017). The concept that he and we both envisioned was that the report would at least note where an entity had disagreement and they would then be free to provide a more complete explanation of their concerns. The written agreement that we had envisioned was never consummated so our position is that there is not and never has been any agreement on this report. Since we first were approached on the concept of funding half of this study, our discussions have been exclusively with Robb so there is no possible way that we had either an agreement or understanding with LEEDCo.

It was Robb that first came up with the concept of putting our comments into an appendix. He expressed this to me in several telephone conversations yesterday (December 14, 2017) along with expressing it to your attorney. Since this was a running conversation, I currently have no clear idea of what Robb will or will not do. The Service does retain the right and option to submit our comments directly to the Ohio Power Siting Board and to other reviewing agencies if they are not included in the report for any reason.

The Service has not ever agreed to abide by whatever Robb recommends and as late as December 14, 2017, he both understood that and said that he welcomed it. Given that the written agreement we had sought was never developed and that some of our long-standing considerations have not been included in the report, the Service will not be a signatory to the report.

Jeff Gosse
Regional Energy Coordinator
U.S. Fish and Wildlife Service, Region 3
Telephone: (612)713-5138
Cell : (612)750-5095
Fax: (612)713-5292

On Fri, Dec 15, 2017 at 11:43 AM, Beth Nagusky <bnagusky@leedco.org> wrote:
Dear VBR crew:
I hope you are all well. Early yesterday Robb issued his draft report on the viability and use of vessel based radar at the Icebreaker project site pre-construction, as he had promised. It is our understanding that, pursuant to our agreement to bring Robb in as the 3d party neutral and to defer to his opinion on this matter, we all now have time to get Robb any comments we have on the draft report. We propose that by COB on Tuesday 12/19 all comments be given to Robb. Robb will then consider all comments received from us and his peer reviewers, and issue his final report on 12/21, as previously agreed upon, so that it can be filed with the OPSB. This process is consistent with our agreement to bring Robb in as the ultimate decider of the radar issue, and with our monitoring protocol and MOU.

We also understand that USFWS has expressed a desire or intent to append its comments to Robb's report, or to file its comments separately, expressing a difference of opinion with certain aspects of Robb's report or its conclusions. We believe that would be inconsistent with our agreement regarding this process; we would like confirmation that FWS will respect that agreement and accept Robb's final report without dissent. Accordingly, once Robb's report is finalized, LEEDCo will prepare the filing for the OPSB, and we propose that it be a joint filing signed by both LEEDCo and the USFWS to confirm for the OPSB that the parties have followed and accept the outcome of the agreed-upon process.
Please confirm that this process is consistent with your understanding of the process at this point and your agreement to accept Robb's final report on the record.

Thanks and have a great weekend,
Beth A. Nagusky
Director of Sustainable Development
Lake Erie Energy Development Corporation
1938 Euclid Avenue, Suite 200
Cleveland, Ohio 44115
Email: bnagusky@leedco.org
Cell: (207) 592-1961
Fax: (216) 965-0629

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Message

From:	Beth Nagusky [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=087E4C4A3125490E987CF277B1BFEC83-BNAGUSKY]
Sent:	12/15/2017 5:43:14 PM
To:	Jeff Gosse [jeff_gosse@fws.gov]; Seymour, Megan [megan_seymour@fws.gov]; scudder.mackey@dnr.state.oh.us
CC:	Lorry Wagner [/o=ExchangeLabs/ou=Exchange Administrative Group (FYDIBOHF23SPDLT)/cn=Recipients/cn=687aa2b5223f454392d0c838241010a9-lwagner]; Christine M. T. Pirik [CPirik@dickinson-wright.com]; Caleb Gordon [cgordon@west-inc.com]; Diehl, Robert [rhdiehl@usgs.gov]; Brown-Saracino, Jocelyn [Jocelyn.Brown-Saracino@EE.Doe.Gov]; Kate.Parsons@dnr.state.oh.us; Erin.Hazelton@dnr.state.oh.us; Dave Karpinski [/o=ExchangeLabs/ou=Exchange Administrative Group (FYDIBOHF23SPDLT)/cn=Recipients/cn=6f6a2cdc3f514f58b83724517ae3e77f-ddavis]
BCC:	Cowan, Ben [BCowan@lockelord.com]
Subject:	Diehl Report Process Moving Forward

Dear VBR crew:

I hope you are all well. Early yesterday Robb issued his draft report on the viability and use of vessel based radar at the Icebreaker project site pre-construction, as he had promised. It is our understanding that, pursuant to our agreement to bring Robb in as the 3d party neutral and to defer to his opinion on this matter, we all now have time to get Robb any comments we have on the draft report. We propose that by COB on Tuesday 12/19 all comments be given to Robb. Robb will then consider all comments received from us and his peer reviewers, and issue his final report on 12/21, as previously agreed upon, so that it can be filed with the OPSB. This process is consistent with our agreement to bring Robb in as the ultimate decider of the radar issue, and with our monitoring protocol and MOU.

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Please confirm that this process is consistent with your understanding of the process at this point and your agreement to accept Robb's final report on the record.

Thanks and have a great weekend,

Beth A. Nagusky
Director of Sustainable Development
Lake Erie Energy Development Corporation
1938 Euclid Avenue, Suite 200
Cleveland, Ohio 44115
Email: bnagusky@leedco.org
Cell: (207) 592-1961
Fax: (216) 965-0629

Message

From:	Gosse, Jeff [jeff_gosse@fws.gov]
Sent:	12/22/2017 4:26:39 PM
To:	Beth Nagusky [/o=ExchangeLabs/ou=Exchange Administrative Group (FYDIBOHF23SPDLT)/cn=Recipients/cn=087e4c4a3125490e987cf277b1bfec83-bnagusky]
CC:	Sean Marsan [Sean_Marsan@fws.gov]; Robert Krska [Robert_Krska@fws.gov]; Elizabeth Rigby [elizabeth_rigby@fws.gov]
Subject:	Re: touching base on icebreaker
Attachments:	Letter to Mr. Diehl 12.21.17 (2).pdf

Beth,

Attached is the letter sent to Dr. Diehl.

Jeff

Jeff Gosse
Regional Energy Coordinator
U.S. Fish and Wildlife Service, Region 3
Telephone: (612)713-5138
Cell : (612)750-5095
Fax: (612)713-5292

On Fri, Dec 22, 2017 at 6:29 AM, Beth Nagusky <bnagusky@leedco.org> wrote:
Hi Robb:

Thanks for sending. I note you did not incorporate our 2 comments on the draft, which related to factual issues: 1) location of project in first para. (central Lake Erie, not western) and 2) top of page 4 regarding the timing for radar surveys (radar was only intended to track passerines and bats — we're doing aerial surveys for waterbirds). Do you want to correct these or let them go? It's not a huge deal but would make your report more factually accurate.

Jeff: Did you submit written comments to Robb on the draft report? If you did, could you please share those comments with us?

Thanks.

Beth A. Nagusky

Director of Sustainable Development

Lake Erie Energy Development Corporation

1938 Euclid Avenue, Suite 200

Cleveland, Ohio 44115

EXHIBIT
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From: "Diehl, Robert" <rhdiehl@usgs.gov>
Date: Thursday, December 21, 2017 at 10:47 PM
To: Beth Nagusky <bnagusky@leedco.org>, Jeff Gosse <jeff_gosse@fws.gov>
Subject: Re: touching base on icebreaker

Hi Beth and Jeff,

Please find attached the final report evaluating vendor proposals for radar monitoring in relation to the Icebreaker Wind project. I leave it to you to forward to the relevant parties on your ends. Naturally, please feel free to contact me if you or your staff or associates have any questions.

Regards, Robb

--
Robb Diehl
Research Ecologist
U.S. Geological Survey
Northern Rocky Mountain Science Center
2327 University Way, Suite 2
Bozeman, MT 59715
USA

Phone: +1 406 994 7481
Fax: +1 406 994 6556
Email: rhdiehl@usgs.gov

United States Department of the Interior

FISH AND WILDLIFE SERVICE

5600 American Boulevard West, Suite 990
Bloomington, Minnesota 55437-1458

IN REPLY REFER TO:

FWS/AES

DEC 21 2017

Dr. Robert Diehl
U.S. Geological Survey
Northern Rocky Mountain Science Center
2327 University Way, Suite 2
Bozeman, MT 59715

Dear Dr. Diehl:

Following are the U.S. Fish and Wildlife Service's (Service) comments on the Evaluation of Icebreaker Wind project vendor proposals for radar-based monitoring of flying animals. We received the draft report on December 14, 2017 and comments were requested by December 20, 2017. Given the short time-frame, this is a summary of our major concerns with the report along with some specific examples.

The Service's Ohio Field Office and Region 3 Avian Radar Team have been involved in discussions with the developer, LEEDCo, over nearly two years to establish appropriate pre- and post-construction studies for assessing risks and impacts of the Icebreaker project to migrating birds and bats. Radar has been proposed as a tool for monitoring bird and bat use of project airspace, due to its ability to monitor nocturnal flight activity over a large area and because the majority of birds and all bats migrate nocturnally. Radar was included as a pre-construction tool for the proposed project as early as 2010, when a biological consultant deployed a radar system on the Cleveland water intake crib. Multiple problems associated with the setup and operation of the radar unit resulted in data that both the Service and the developer consider largely uninformative. The Service began recommending an on-site avian radar study for the LEEDCo project in August 2016. The primary objectives of a radar study would be to 1) document the magnitude of nocturnal migration at the proposed site, 2) determine the proportion of migrants flying within or near the rotor-swept zone, and 3) examine if birds or bats exhibit turbine avoidance or attraction to turbines in a before-after comparison.

For this pilot project, the Service has requested on multiple occasions that all commercial-available options of avian radar be considered to expeditiously and cost-effectively obtain data that address the three study objective. Although many aspects of the study's design have been discussed, one of the main topics of investigation has been how to situate a radar unit within the project area on a platform that would allow for successful operation and data collection. The

Service has recommended that a fixed platform be considered because it would provide the highest probability of any radar system successfully tracking migrants.

Our recommendations for a successful study were outlined to the developer in a letter dated February 28, 2017, and include the following:

- Radar must have a site-specific (within construction site) deployment.
- Radar must be able to detect and track 10-gram sized and larger vertebrates.
- Radar must have the ability to collect data continuously, due to pulsed nature of migration.
- Radar must suppress false detections from insects, wave clutter, and weather (≥80% of surveyed time producing viable data, including during heavy precipitation events.) Additionally, downtime should be non-biased. That is, each biological period (Dawn, Day, Dusk, and Night) should meet the ≥80% threshold. This was not part of the February 28th letter and is added here as a clarification.
- Radar must be able to determine flight altitude of migrants at altitudes near and within the rotor-swept zone to quantify collision risk.
- Radar must be able to determine and quantify behavioral avoidance or attraction to turbines in the open water setting.
- Radar must collect data for both small bird and bat migratory seasons (April-June; mid-August-Mid-November) pre-construction.
- Radar must collect data for several spring/fall seasons post-construction (determining behavioral changes that make collision more or less likely).

The draft report is an insightful and detailed comparison of the options provided by three respondents to LEEDCo's request for information. It also highlights several areas of concern related to operating an avian radar unit on a moving platform. LEEDCo has settled on a plan to use a four-point anchored barge, and has solicited responses from radar vendors for that type of deployment. The three proposals received by LEEDCo represent a limited set of options with known problems related to design, support, and lack of experience in the offshore environment. Unfortunately, the scope of the evaluation is limited to relative comparisons among proposals solicited by LEEDCo.

Chief among our concerns is that the evaluation was limited to options using a non-stable platform. This technique has not been used in a long-duration study and, based on years of experience operating avian radar units in the Great Lakes region, we are concerned about a high rate of failure, resulting in collection of poor data. The draft report identified the rolling and pitching barge as one of the major limitations for all systems evaluated. It is likely that any of these systems would perform better on a stable platform, but this option was not considered. A compounding factor is that windy weather, known to be associated with high numbers of migrants, will likely be especially destabilizing to a barge-based system. This may cause the loss of critical data at times when capturing that data is most important. For that reason, the Service finds it critically important that a system capable of capturing accurate data reliably, even during periods of high wind and waves, be used for the study. The Service is unaware of radar studies that successfully used a floating platform for offshore studies.

The draft report, while stating concerns about a moving platform and weather, has not fully described the ramifications to a radar study. The recommendation in the report is for data collection to be successful during 80% of the time when weather conditions permit. This metric is concerning for the following reasons. First, the biological periods (dawn, day, dusk, and night) have been combined. If data is lost during the most important biological periods (i.e., at night, when most migrants are moving, and at dawn and dusk when migrants may be most vulnerable to collision), an 80% threshold met overall will not be as informative. Second, the "when weather permits" criteria is arbitrary and could result in a lack of informative data. While radars of all types are affected by weather, certain bands (notably S-Band) are less affected by atmospheric moisture than others (X-band). The report's recommendations to use these more susceptible bands do not take into account the additional lost data due to this weakness.

Additionally, since wind can also be considered a weather parameter, losses of radar data due to a rocking barge could cause large losses of data that would be otherwise recorded from a stable platform. Accepting a radar system that collects data "weather permitting" could lead to using a system that is unsuitable for an effective data collection in the project environment, and lead to costly delays.

Poor data quality has important downstream effects on the decision made for this and other projects, including project siting and mitigation. Poor data resulting from a faulty deployment may be interpreted as low migratory activity. All systems proposed by LEEDCo's respondents were engineered for use on land or a stable platform. If low numbers of migrants are recorded, it may not be possible to determine if these results are due to low migration rates or if the system is failing to detect or track migrants due to the movement of the barge.

In addition, software associated with these systems plays an integral part in suppressing false signals (clutter), and with accurate reporting (including sampling corrections for airspace). However, the report does not evaluate the the software, especially under the circumstances of a moving platform. This lack of evaluation makes it impossible to gauge the likely limitations of any system and difficult to anticipate circumstances when the system may be failing to detect or track migrants.

Finally, because the radar is placed offshore in a remote area, it is critically important to be able to monitor the system without personnel on site. While two of the vendors stated that they had remote capabilities, they did not clarify the full extent of what they could monitor and the extent to which they could resolve issues remotely. The Service has repeatedly suggested having remote troubleshooting and monitoring to quickly rectify issues with the system. This measure will save time and money and is crucial for an effective system (in our opinion, based on seven years of experience conducting radar studies around the Great Lakes). Commercial avian radar systems are available that can be monitored and often repaired remotely, send electronic notifications when problems occur, include integrated power supplies, and have been used successfully on fixed platforms in an off-shore environment. However, these were not considered in the draft report.

The Service collected data with one of its avian radar units placed on-shore in the City of Cleveland this fall. Both the southward direction of flight and the delayed arrival times indicated that high numbers of migrants arriving in Cleveland were crossing Lake Erie. (See attachment 2 of USFWS letter "Draft Environmental Assessment for Lake Erie Energy Development Corporation's Project Icebreaker, Offshore Cleveland, OH (DOE/EA-2045)" sent 4-October-2017, attached.) While the location we utilized cannot tell us the flight altitude over the site of the proposed project or be able to serve as a basis for detecting attraction or avoidance to turbines post-construction, we have documented that large numbers of nocturnal migrants cross Lake Erie during fall migration.

The Service's comments and recommendations provided in this and previous letters have been focused on providing guidance that will result in a system and study design that are likely to successfully produce needed information to inform decisions. We appreciate the opportunity to review the evaluation of proposals and provide our recommendations.

Sincerely,

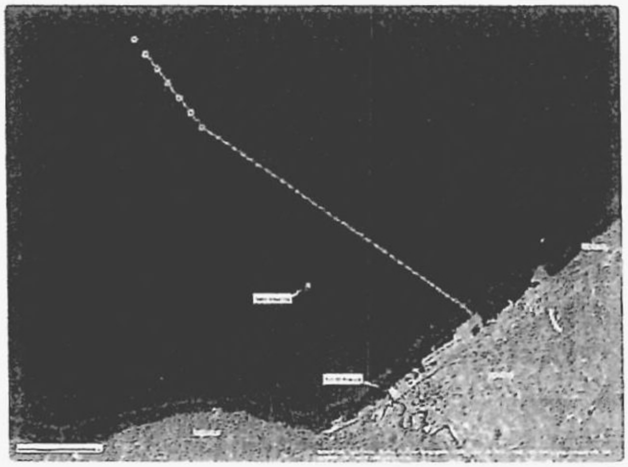
Lori H. Nordstrom

Lori H. Nordstrom
Assistant Region Director
Ecological Services
Midwest Region

cc:
Erin Hazelton
Wind Energy/Wildlife Administrator
ODNR Division of Wildlife
2045 Morse Road
Columbus, OH 43229

Summary of November 2016 Avian and Bat Risk Assessment for the Icebreaker Wind Project

March 20, 2018



Prepared for:

Icebreaker Windpower, Inc.

1938 Euclid Avenue, Suite 200
Cleveland, Ohio 44115

Prepared by:

Caleb Gordon and Rhett Good

Western EcoSystems Technology, Inc.
415 W. 17th Street, Suite 200
Cheyenne, WY 82001

WEST Inc.

TABLE OF CONTENTS

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1 INTRODUCTION

Icebreaker Windpower, Inc. (IWP) has filed an application with the Ohio Power Siting Board (OPSB) to construct the Icebreaker Wind Project (Project), a small, six-turbine, 20.7-megawatt (MW) demonstration offshore wind energy facility eight to 10 miles (mi; 13 to 21 kilometers [km]) from the shore of Cleveland, Ohio. Among other findings, the OPSB must determine that the Project poses the "minimum adverse environmental impact." To this end, in the fall of 2016, Dr. Caleb Gordon and Wally Erickson of Western EcoSystems Technology, Inc. (WEST) completed a risk assessment (RA) to evaluate the likely adverse impact posed by the proposed Project on birds and bats. The RA was submitted with the application for the Project as Exhibit J.

The RA consisted of a review and summary of baseline data and other publicly available data on bird and bat use within, or in the vicinity of the Project area, as well as other information relevant to the assessment of risk, including technical literature on taxon-specific collision susceptibility patterns, and past studies of bird and bat fatality rates conducted at existing wind energy facilities within the Great Lakes region. The surveys that were reviewed are summarized within Table 1.1, and the aerial coverage of these surveys is illustrated in Figure 1.1. A NEXRAD analysis was completed by WEST after submission of the RA; aerial coverage of the WEST NEXRAD analysis is shown in Figure 1.2.

The Risk Assessment concluded that the Project poses low risk of adverse impacts to birds and bats. This conclusion stemmed largely from two principal observations: 1) the Project is small in scale, consisting of six turbines; and 2) site-specific and other studies have documented that the level of use of this area by birds and bats is low compared to bird and bat use of terrestrial or nearshore environments. The RA also relied on previously published studies of bird and bat fatality rates at onshore wind energy facilities in the Great Lakes region to bracket the range of fatality rates likely to be generated by the Project.

Following are summaries of: 1) the RA; 2) a site-specific analysis of NEXRAD radar data completed by WEST in January, 2017; 3) WEST's 2017 Annual Report; and, 4) WEST's Draft Bird and Bat Conservation Strategy (BBCS). The first item was filed with the OPSB; the second was completed several months after the RA was completed and was filed as part of the OPSB application; the third has been shared with the Ohio Department of Natural Resources (ODNR) and US Fish and Wildlife Service (USFWS) and is being filed with OPSB; and, the final item is under discussion with the USFWS.

Table 1.1. Surveys reviewed during the development of the Risk Assessment.

A summary of the surveys reviewed, the type of information obtained, the entities who performed the work, and the geographic scope of the survey elements during the development of the WEST Bird and Bat Risk Assessment (Gordon and Erickson 2016).

Survey Technique (years of survey data analyzed)	Entity Who Performed Survey	Species Identification	Spatial Distribution	Temporal Distribution	Flight Ecology	Site-specific Data?
NEXRAD radar analysis (2003-2007)	Geo-Marine	no	yes	yes	yes	yes
NEXRAD radar analysis (2013-2016)	WEST	no	yes	yes	yes	yes*
Bird Acoustic Survey (2010)	Tetra Tech	yes	yes	yes	no	near (Crib)**
Bat Acoustic Survey (2010)	Tetra Tech	yes	yes	yes	no	near (Crib)
Merlin Radar Survey (2010)	Tetra Tech	no	yes	yes	yes	partial***
Boat-based Bird Surveys (2010)	Tetra Tech	yes	yes	yes	yes	near
Bird and Bat Fatality Surveys at 42 (birds) and 55 (bats) Wind Energy Facilities in the Great Lakes Region (years vary by project)	Various	yes	yes	yes	no	no
Aerial Bird Survey (2009-2011)	ODNR	yes	yes	yes	no	yes

*Finalized after the RA was completed

**Survey results successfully collected for spring migration period

***The maximum extent of the radar range overlapped with the southern end of the current turbine layout.

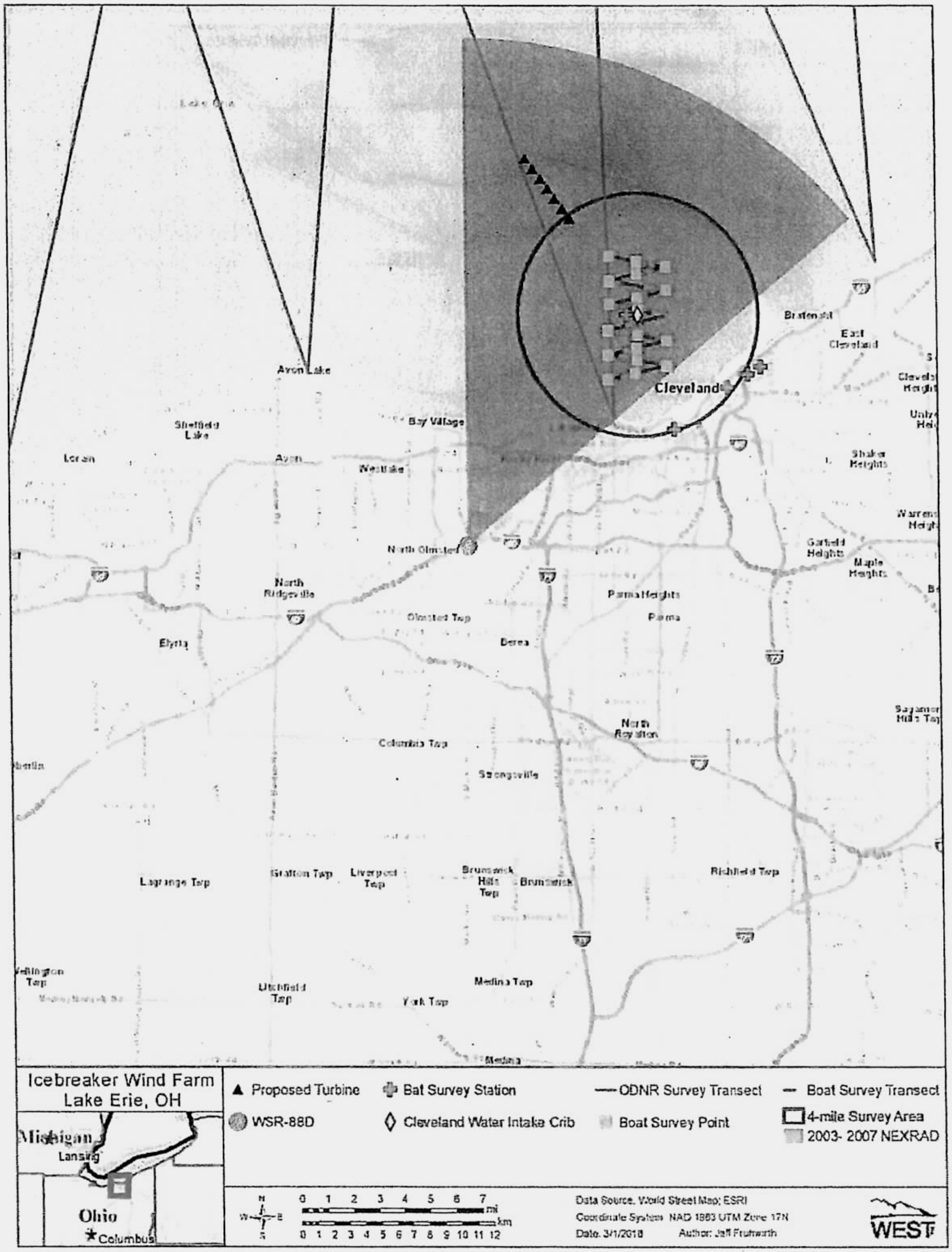


Figure 1.1. A map showing the coverage of the field surveys used to inform the risk assessment.

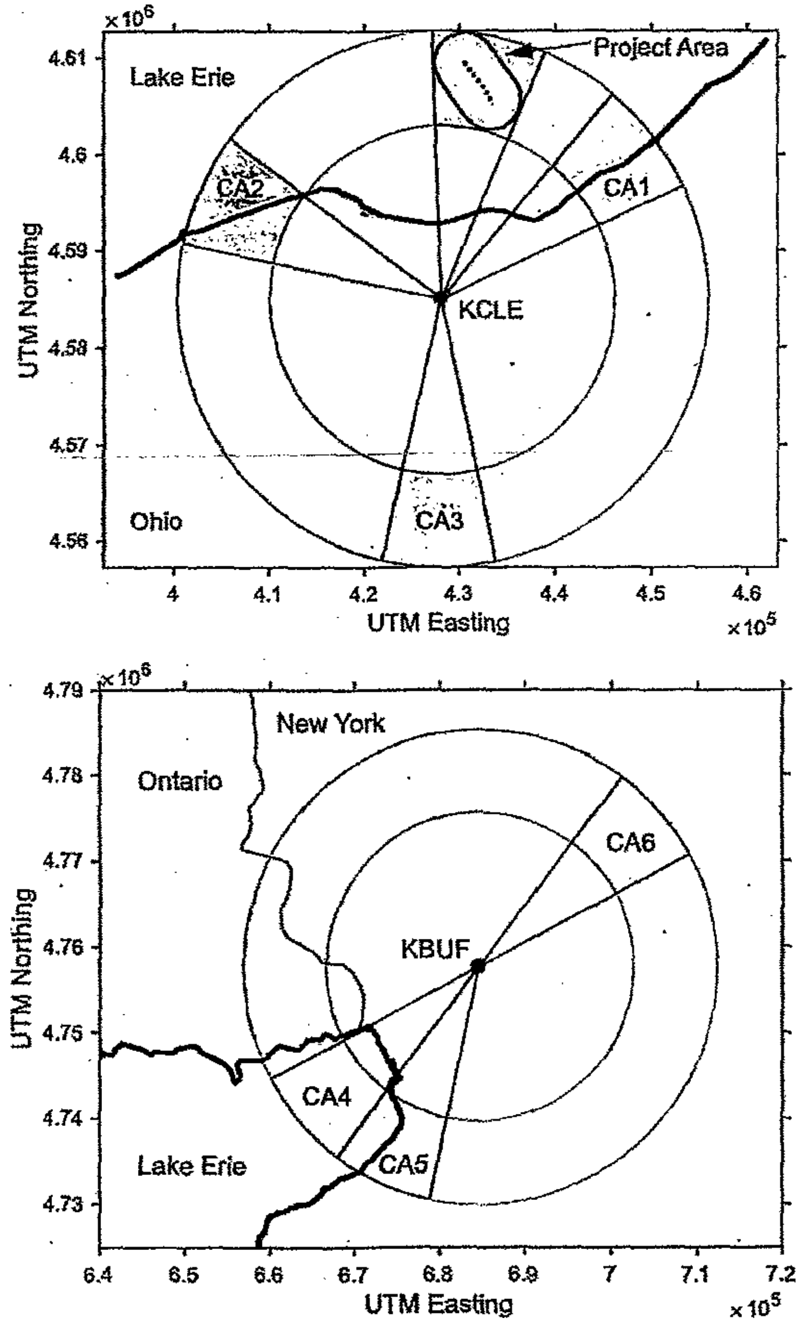


Figure 1.2. A map showing the coverage of the 2017 WEST NEXRAD analysis.

2 DOCUMENT SUMMARIES

2.1 WEST Risk Assessment

The WEST RA examined the potential project impacts on bird and bat species, including displacement, behavioral attraction and avoidance, and collisions.

2.1.1 Displacement Effects

A displacement effect is defined as the transformation of the Project area from suitable habitat to less suitable habitat by virtue of Project construction or operation.

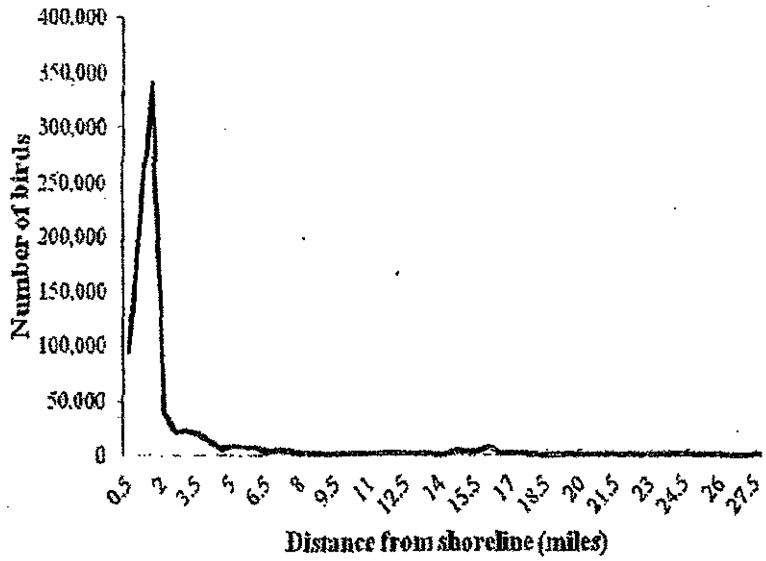
Results of Aerial Surveys

Baseline data gathered by the ODNR in 2009-2011 indicated very low use of the offshore environment of Lake Erie in the vicinity of the Project area by diurnal waterbirds (Figure 2.1). Only six species of birds (including ring-billed gull (*Larus delawarensis*), herring gull (*Larus argentatus*), Bonaparte's gull (*Chroicocephalus philadelphia*), common loon (*Gavia immer*), horned grebe (*Podiceps auritus*), red-breasted merganser (*Mergus serrator*)) were documented regularly within the vicinity of the Project area, all of them in very low abundance.[1]

Conclusion (Displacement Effect)

Displacement effects are not likely because there are very few waterbird species or individuals to displace, as waterbirds do not regularly occur within the Project area. If any displacement effect were to occur, it would have minimal adverse impact on waterbird species, as very few individuals of waterbird species would be affected.

[1] IWP is currently conducting Aerial Waterbird/Waterfowl Surveys. Survey results to date confirm the ODNR survey results showing low usage of the Project area by waterbirds and waterfowl. An Interim Aerial Waterbird Survey Report was provided to ODNR and USFWS as part of the IWP's 2017 Annual Report.



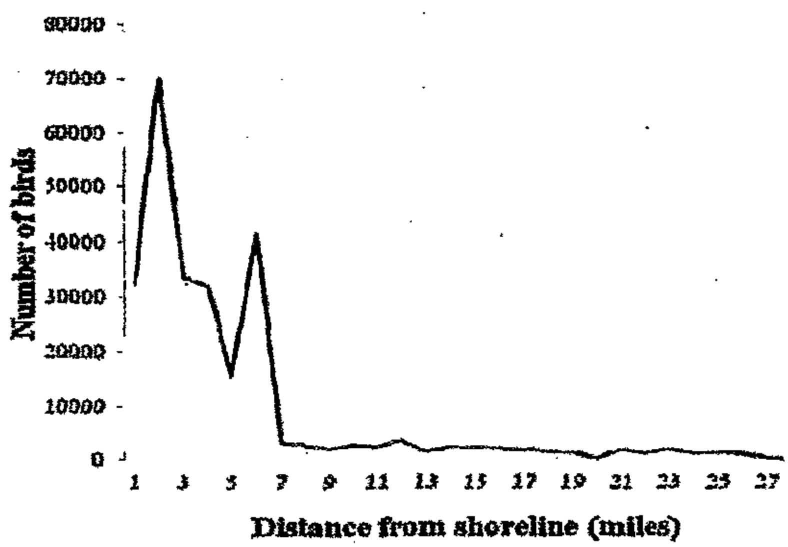


Figure 2.1. Number of birds as a function of distance from shoreline. The nearest proposed Icebreaker wind turbine is located 8 miles from the shoreline ODNR 2009-11.

2.1.2 *Behavioral Avoidance or Attraction Effects*

Behavioral attraction is defined as attraction to the Project area by bird or bat species that would otherwise utilize the area less frequently or not at all. Behavioral avoidance is defined as the avoidance of the Project area by species using the area strictly for transit. Researchers have shown that tree bats are attracted to on-shore wind turbines. Bird response to turbines has been more variable. .

Aerial Surveys, NEXRAD; Acoustic and Boat-Based Surveys

Very few bird species or individuals currently utilize the Project area for foraging, feeding, or roosting. It is possible that some species may be attracted to the site for such activities after Project construction. Data from NEXRAD radar analysis (birds) and offshore acoustic studies (birds and bats) indicate that some bats and many nocturnally migrating birds regularly transit the Project area during migratory periods, though in both cases, exposure data indicate that the volume of such activity is lower than over terrestrial nearshore areas.[2] The extent to which nocturnally transiting bird and bat migrants may exhibit either avoidance or attraction to the facility is impossible to predict with pre-construction data.

Studies from European offshore wind facilities have shown that certain bird species tend to avoid flying through offshore wind farms or turbine strings, most notably migrating sea ducks, for whom the additional energy expenditure of flying around the facilities has been shown to be negligible. Certain other species have demonstrated attraction to European offshore wind facilities, most notably certain cormorants and gulls that may benefit from the availability of perching structures and/or the attraction of prey species by virtue of "artificial reef" effects. It is not known whether such effects are adverse or beneficial to the affected species.

Conclusion (Avoidance/Attraction Effects)

The Project has the potential to generate both behavioral avoidance and attraction effects in some groups of birds or bats, which may be either adverse or beneficial, but *are not expected to be substantial for any species.* The pre- and post-construction monitoring outlined in the Memorandum of Understanding (MOU) between the Ohio Department of Natural Resources (ODNR) and IWP, and the associated Monitoring Plan (MP), will allow evaluation of whether behavioral avoidance and/or attraction effects are evidenced at the Project.

2.1.3 *Collision Effects*

Birds and bats are known to collide with wind turbine blades causing injury or death. Collision rates and taxonomic patterns have been well-characterized for birds and bats at land-based wind energy facilities in the Great Lakes region and elsewhere in the US using bias-corrected carcass searching studies conducted during projects' operational phases. Less is known about collision rates at offshore wind energy facilities. The Great Lakes are distinct from marine

[2] WEST's Bat Activity Monitoring Report concludes that the 2017 survey effort results are consistent with the RA conclusions

environments, and some uncertainty exists in the expected per turbine rate of bird and bat fatalities; however the small size of the project, and lower expected exposure limits the total impact of the project compared to on-shore facilities. In Table 2.1. below, evidence from technical literature and site-specific information are integrated into the risk summaries for each of the major taxonomic or functional groups of birds and bats potentially exposed to wind turbine collision risk from the Project.

<u>Conclusion (Collision Effects)</u>

The collision risk from the Project is expected to be low. This conclusion is based both on the small size of the Project as well as the lower expected rate of exposure of birds and bats at the Project relative to on-shore facilities, as documented through the two NEXRAD radar analyses and the acoustic monitoring.

Table 2.1. Summary of collision risk assessment for specific bird and bat taxa or functional groups

Bird or Bat Group	Primary Evidence	Collision Risk Conclusion
Eagles and other raptors	• the Project **does not contain suitable nesting habitat** or substrate for any eagle or other raptor species • the Project **does not contain suitable foraging or feeding habitat** for any species in any season • the Project **is likely to receive very little raptor migratory passage**, as it is located in one of the widest sections of Lake Erie, and not in the vicinity of any islands or peninsulas that could attract migrating raptors, which are known to concentrate along shorelines and to minimize over water flight distances during migration in the region • **No eagles or other raptor species have been observed within the Project area** or vicinity in any of the surveys that were reviewed for the RA	**Low risk for all species during all seasons**
Waterfowl and other waterbirds	• **Very few (six) species occur regularly within the Project area** or immediate vicinity • **All of the species that do occur regularly** within the Project area or immediate vicinity **occur there in very low abundance** • An extensive aerial survey effort in Lake Erie documented a pattern of extreme bird concentration within the first several (up to seven) miles from shore; **bird abundance in the zone where the Project is located (eight to 10 miles from shore) is consistently several orders of magnitude lower than it is closer to shore** • **European studies have documented a strong tendency for waterfowl to avoid collisions** with offshore wind turbines • **US studies have documented low waterfowl collision rates** at land-based wind energy facilities located in close proximity to large waterfowl concentration areas	**Low risk for all species during all seasons**
Nocturnally migrating songbirds and similar birds	• The Project **does not contain suitable breeding, wintering, or migratory stopover habitat** for any species of bird in this category • **>100 species** of songbirds and other similar birds (e.g. cuckoos) **migrate at night in a broad-front pattern** over most of the US, including the Great Lakes region, including over the open water environment of Lake Erie and the Project area • In spite of this nearly ubiquitous exposure, **collision fatality rates for this group are consistently low across the country and within the region, and not likely to impact the population of any species.** A survey of 42 publicly available, bias-corrected bird fatality studies at wind farms in the Great Lakes region revealed that **bird fatality rates ranged from less than one to roughly seven birds/MW/year for all species combined, most of which are nocturnal migrants**	**Low risk for all species during spring and fall migrations. No risk at other times.**

Table 2.1. Summary of collision risk assessment for specific bird and bat taxa or functional groups

Bird or Bat Group	Primary Evidence	Collision Risk Conclusion
	• Using the range of bird fatality rates within the region, and the installed capacity of the Project (20.7 MW), **the total predicted bird fatality rate for the Project is likely to be between 20 and 150 bird fatalities per year** • *Site-specific NEXRAD analysis*[3] *revealed that nocturnal migrant* **passage rates over the Project area are one third to one half of what they are in comparable areas along the central Lake Erie shoreline** or over land in the vicinity of Cleveland, and **one eighth of what they are over the eastern Lake Erie basin and shoreline**. • **<u>If this site-specific exposure data for nocturnal bird migration is applied to the bird fatality rate prediction, it would suggest that the Project's bird fatality rate is likely to be on the low end of the spectrum of what has been observed elsewhere in the region (e.g. from 10 to 70 total bird fatalities/year)</u>**	
Bats	• The Project **does not provide suitable roosting habitat for any species of bat**. • Several migratory bat species are known to sometimes transit, and possibly forage over open water environments of the Great Lakes and may encounter the Project area • A baseline bat acoustic study showed that **bat acoustic activity was substantially (roughly 10x) lower offshore than in terrestrial environments** near Cleveland • In spite of the availability of this information on exposure from the acoustic baseline study, it was not considered to provide a strong indication of site-specific bat risk, as **the relationship between pre-construction bat acoustic activity and post-construction bat fatality is known to be complex**, *and dependent on behaviors* that are not well characterized in the offshore environment • A survey of 55 publicly available, bias-corrected bat fatality studies at wind farms in the Great Lakes region revealed that bat fatality rates ranged from less than one to roughly 30 bats/MW/year for all species combined • Using the range of bat fatality rates within the region, and the installed capacity of the Project (20.7 MW), **<u>the total predicted bat fatality rate for the Project is likely to be between 20 and 600 bat fatalities per year</u>**	**Low-moderate risk for migratory species**

[3] This statement refers to the conclusion from the WEST 2017 NEXRAD analysis, which was completed subsequent to the WEST RA. In the RA, a similar conclusion was reached regarding exposure of nocturnal migrant birds from NEXRAD data based on a study by Diehl et al. (2003). The WEST NEXRAD analysis was similar to Diehl et al.'s but it was based on more data, more recent data, and the study area was selected specifically to encompass the Project site and directly comparable areas.

2.2 WEST 2017 NEXRAD Analysis

WEST's January 2017 NEXRAD Analysis presents the results of an analysis of nocturnal migrant bird patterns inferred from NEXRAD weather radar data, intended to provide a robust comparison of nocturnal migrant bird passage rates over the Project area compared with nearby shoreline, terrestrial, and other open water environments (Figure 1.2). Data from peak spring and fall migration periods were analyzed for a three year period (2013 – 2016) for the Project area and six comparable sites, using analytical techniques that have been developed and refined over five decades of NEXRAD radar ornithology designed to identify and isolate migratory bird signals. Due to the nature of NEXRAD radar beams, and the distance of the study sites to the radar stations (roughly 23 km; 14 mi), the altitudinal ranges sampled at the study sites ranged from 114 to 963 meters above ground level, overlapping the upper portion of the rotor swept zone of the turbines that would be installed (146 meter maximum blade tip height), and encompassing the altitudes at which most of nocturnal songbird migration is known to occur.

Conclusion:

For the seven sites analyzed, the Project area contained the lowest migratory bird passage rate in each year, in each season, and at both beam angles (altitudes) analyzed (Figure 2.2). Overall, averaging all years and seasons, the migratory bird passage rate at the Project area was roughly one third that of the comparison site over land south of Cleveland, less than half that of the two shoreline comparison sites in the central Lake Erie basin, and roughly one eighth that of the shoreline and over water sites in the eastern Lake Erie basin. The conclusion of this study was that the Project area had consistently lower densities of nocturnal migratory bird passage compared to shoreline or terrestrial sites within the region.

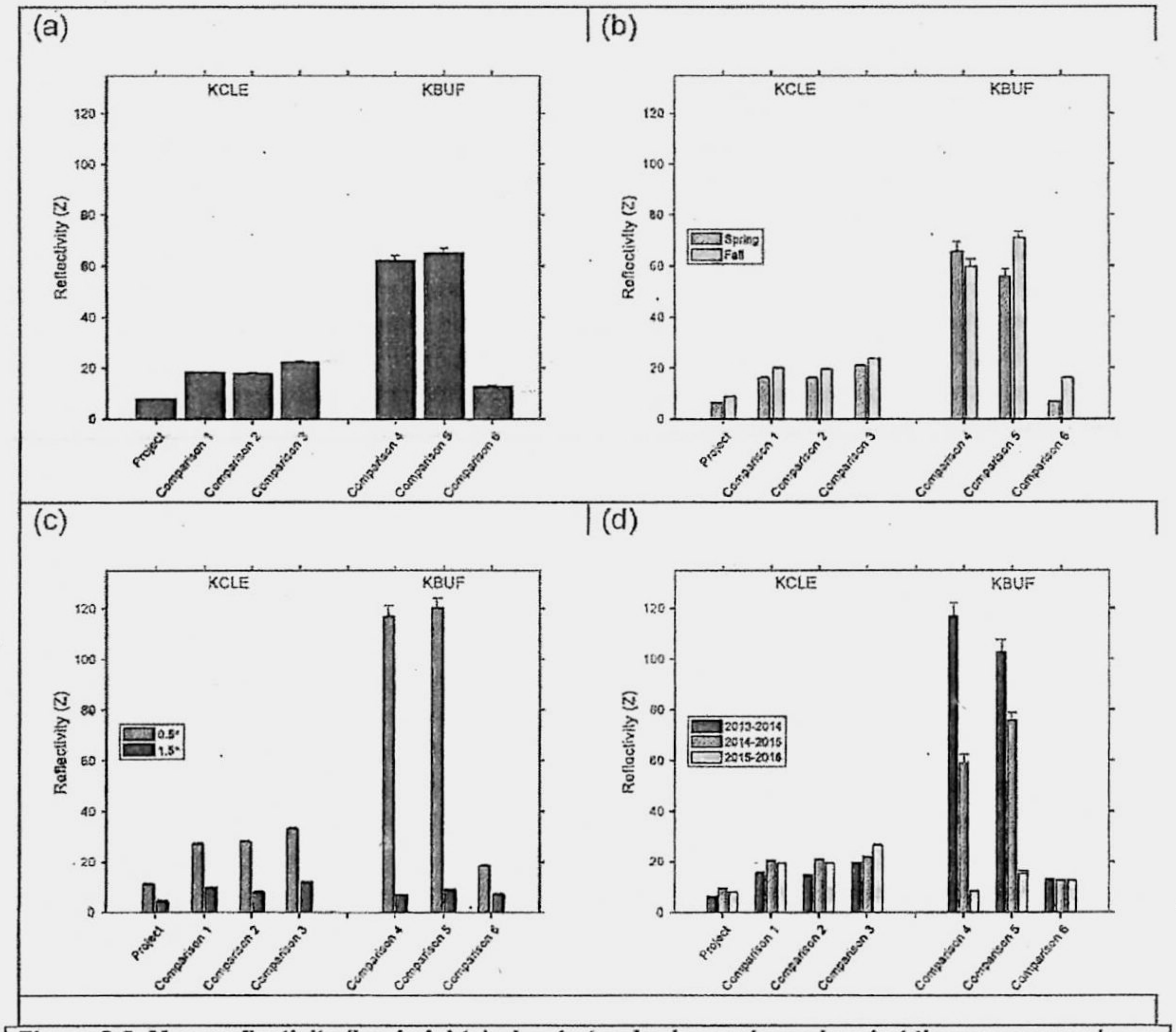


Figure 2.2. Mean reflectivity (bar heights) plus 1 standard error (error bars) at the seven sample areas:
(a) degrees overall – averaged across season, year, and elevation
(b) by season – averaged across year and elevation
(c) by elevation – averaged across season and year
(d) by year – averaged across season and elevation.

2.3 WEST Annual Report

WEST's Bird and Bat Monitoring Annual Report, dated February 20, 2018, presents the results of the Bat Acoustic Monitoring conducted in 2017; the Aerial Waterbird Survey results to date; the ongoing research into collision monitoring technologies in preparation for selection of the best and most practical technology available at the time the selection decision must be made; and results of the evaluation of vessel based radar to collect baseline data prior to construction for comparison to post-construction data to assess any actual avoidance/attraction and behavioral effects. **While not presented as the basis for making a determination regarding**

the Project's environmental risk, the survey results to date are consistent with the conclusions of the RA.

2.4 Draft Bird and Bat Conservation Strategy

The BBCS is currently being prepared to ensure that the Project avoids, minimizes, and mitigates any adverse environmental impacts that could result from the Project. The BBCS draft contains complete, or near-complete, versions of most of the typical elements of a BBCS (a summary of the Project and bird and bat risk assessment, description of the impact avoidance/minimization/mitigation measures to which the Project team has already committed, and a record of agency coordination). It will also include adaptive management strategies to further reduce any unforeseen adverse environmental impacts to birds and bats. **As such, a BBCS that has been approved by wildlife agencies will provide a mechanism to ensure that the Project poses the "minimum adverse environmental impact."**

During the fall of 2017, WEST completed the first draft of the BBCS for the Project. IWP submitted this draft to the USFWS for its review, and received emailed comments back from the USFWS on November 21, 2017. The IWP team held a teleconference with USFWS in early December to discuss comments on the draft BBCS. The BBCS is a living document, and will be continually updated, as specific impact thresholds and adaptive management measures will be dependent upon the precise nature of the post-construction monitoring methods and data. A final BBCS that has been agreed to by the Applicant and wildlife agencies can be made a condition of the Project's permit, to be submitted prior to construction

3 CONCLUSION

The Risk Assessment concluded that the Project poses low risk of adverse impacts to birds and bats based on 1) the Project is small in scale, consisting of six turbines; and 2) site-specific and other studies have documented that the level of use of this area by birds and bats is low compared to bird and bat use of terrestrial or nearshore environments. Subsequent studies completed for Icebreaker further support this assessment.