Applicant Ex. 31

BEFORE
THE OHIO POWER SITING BOARD

In the Matter of the Application of Icebreaker Windpower Inc., for a Certificate to Construct a Wind-Powered Electric Generation Facility in Cuyahoga County, Ohio.	) Case No: 16-1871-EL-BGN

TESTIMONY OF

Rhett E. Good

Research Biologist/Senior Manager
Branch Manager Indiana Field Office, Bat Practice Group Lead
Western EcoSystems Technology, Inc.

on behalf of
Icebreaker Windpower Inc.

September 6, 2018

1. Please state your name.

Rhett E. Good.

2. Please state your business address.

408 West 6th Street

Bloomington, Indiana.

3. Please summarize your educational background and professional experience.

I received a Bachelor of Science Degree in Biology with a minor in natural resources from Ball State University in 1995, and received a Master's Degree in Zoology and Physiology from the University of Wyoming in 1998. I have been employed by Western EcoSystems Technology, Inc. ("WEST") for the past 20 years as a research biologist, project manager, and senior manager. I have 23 years of experience conducting wildlife research across the United States ("U.S."). I have completed projects for private industry, environmental conservation organizations, and the U.S. Fish and Wildlife Service (USFWS). I served as project manager and field supervisor for a rangewide survey of golden eagles across the western U.S. for the USFWS that resulted in two publications in the Journal of Wildlife Management.[1] Information from the survey is being used by the USFWS to better manage golden eagle populations across the western U.S. I am currently involved in research designed to estimate impacts of wind development to wildlife at several proposed and existing wind-energy facilities in the Midwest. I also served as project manager on a research study of the impacts of the Fowler Ridge wind-energy facility on bats, which was the first facility to find an Indiana bat carcass. The research we conducted was used to determine if feathering turbine blades below raised cut-in speeds would reduce bat mortality. The results of the research were used to develop a habitat conservation plan that included adaptive management and mitigation for bats.[2]

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1 https://onlinelibrary.wiley.com/doi/abs/10.1002/jwmg.704; https://www.jstor.org/stable/4495197?seq=1#page_scan_tab_contents

2 https://www.fws.gov/Midwest/endangered/permits/hcp/FowlerRidge/index.html

I have also served as field supervisor and project manager on studies of wind energy and wildlife interactions at over 100 proposed or existing wind-energy facilities in the Midwest, including 16 projects in Ohio. Wildlife studies that I have been involved with include pre-construction risk assessments and post-construction studies of fatality rates. I have also studied the behavioral responses of shorebirds, songbirds, and waterfowl to wind turbines, to determine if projects could displace wildlife from occupied habitats. I have interacted extensively with agency personnel and have successfully developed and implemented wildlife monitoring protocols that have been approved by the USFWS and state wildlife agencies across the U.S. I have also assisted several wind-power companies with studies of protected bat and eagle use and compliance with the Endangered Species Act ("ESA"), and Bald and Golden Eagle Protection Act ("BGEPA") at wind-energy projects. My resume is attached as Attachment REG-1.

4. What is your current position with WEST?

Senior Manager and Branch Manager of our Indiana Field Office, and our Bat Practice Group Lead.

5. Have you been involved in other cases before the Ohio Power Siting Board ("Board")?

I have completed and supervised pre-construction field studies and risk assessments for the Timber Road II and III Wind Farm, the Hog Creek Wind Farm, the Blue Creek Wind Farm, and the Hardin Wind Energy Center[3] that satisfied the Ohio Department of Natural Resources ("ODNR") and the Ohio Power Siting Board ("Board") requirements for wildlife studies.

6. On whose behalf are you offering testimony in this case?

Icebreaker Windpower, Inc. ("Icebreaker" or "Applicant").

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[3] Timber Road II and III Wind Farm (Case No. 09-908-EL-BGN and 10-369-EL-BGN), Hog Creek Wind Farm (Case Nos. 09-277-EL-BGN and 10-654-EL-BGN), the Blue Creek Wind Farm (Case No. 09-1066-EL-BGN), and the Hardin Wind Farm (Case No. 09-479-EL-BGN).

7. Please describe the history of your involvement with the project.

I began work on the Icebreaker project as a technical advisor. My original role was providing review and input on project reports, and assistance with meetings and planning. I took over as project manager in January of 2018 after Caleb Gordon left WEST.

8. Please describe the studies that you and your firm undertook on behalf of the Applicant.

WEST completed an Assessment of Nocturnal Bird Migration Activity from Weather Radar dated January 23, 2017 ("2017 NEXRAD Analysis") and the Risks to Birds and Bats dated November 29, 2016 ("2016 Risk Assessment") that are attached to Icebreaker's February 1, 2017 application ("Application") in this case as Exhibit J. WEST also completed the Summary of November 2016 Avian and Bat Risk Assessment ("2018 Risk Assessment Summary"), which was filed by Icebreaker on March 22, 2018, as Attachment 2 to the Fourth Supplement to the Application. In addition, WEST performed an acoustic survey for bats ("Bat Acoustic Survey"), [4] an aerial survey for waterfowl and waterbirds ("Aerial Waterfowl Survey") for the project, and completed a Bird and Bat Conservation Strategy ("BBCS"), which is attached as Attachment REG-2.

9. What was your role in the studies conducted for the Application?

I reviewed and provided input to the 2016 Risk Assessment, and was a co-author on the 2018 Risk Assessment Summary, the Bat Acoustic Survey, and the BBCS. I also reviewed and provided input on the Avian and Bat Memorandum of Understanding ("MOU") and Avian and Bat Monitoring Protocol ("Monitoring Protocol").[5]

10. Did you identify any specific threatened or endangered species in the project area?

No threatened or endangered species were recorded or identified in the project area.

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4 The 2017 Final Bat Acoustic Survey Report was filed by Icebreaker on March 22, 2018, as Appendix A to Attachment 4 of the Fourth Supplement to the Application.

5 The Avian and Bat MOU and the Monitoring Protocol were filed by Icebreaker on July 20, 2017, as an attachment to the Second Supplement to the Application.

11. Please state the purpose of your testimony.

The purpose of my testimony is to address: the nature of the probable ecological impact to bats; the Avian and Bat MOU, the Monitoring Protocol, and reports; and the 2018 Risk Assessment Summary. My testimony, together with the other Icebreaker witnesses testifying this this case, will confirm that the Joint Stipulation and Recommendation ("Stipulation"), which was filed in the docket on September 4, 2018, and is being offered in this proceeding as Joint Exhibit 1, supports a finding by the Board that the Stipulation represents the minimum adverse environmental impact, considering the state of available technology, and is in the public interest.

12. What does the word "demonstration project" as applied to Icebreaker mean to you?

I believe it means that the project is small in scale, and its purpose is to determine if offshore development is feasible within the Great Lakes. Regarding wildlife, this project serves as an opportunity to learn about the potential impacts of offshore wind on birds and bats, which is important given that this will be the first offshore wind turbine project developed within the Great Lakes.

13. Please provide a summary of the 2018 Risk Assessment Summary.

The purpose of the 2018 Risk Assessment Summary was to provide a summary of the key findings of the 2016 Risk Assessment and other studies completed since 2016. The 2016 Risk Assessment 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. Studies completed since 2016 that were also summarized included: 1) the 2017 NEXRAD Analysis, which is a site-specific analysis of NEXRAD radar data completed by WEST in January, 2017; 2) WEST's 2017 Bird and Bat Monitoring Annual Report, dated February 20, 2018 ("2017 Annual Report");[6] and, 4) WEST's Draft BBCS, Attachment REG-2.

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[6] The 2017 Annual Report was filed by Icebreaker on March 22, 2018, as Attachment 4 to the Fourth Supplement to the Application.

The 2016 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 2016 Risk Assessment also relied on public 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. Dr. Caleb Gordon is testifying regarding the content of the 2016 Risk Assessment.

The 2018 Risk Assessment Summary also reviewed other studies completed since 2016, to determine if the results were consistent with the conclusions of the 2016 Risk Assessment. The WEST 2017 NEXRAD Analysis was completed to determine how the migration activity of birds compared to areas on-shore and near shore. Due to the nature of NEXRAD radar beams, and the distance of the study sites to the radar stations (roughly 23 kilometers; 14 miles), 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 the nocturnal songbird migration is known to occur. 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. 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.

WEST's 2017 Annual Report presents: the results of the bat acoustic monitoring conducted in 2017; the Aerial Waterfowl Survey results through 2017; 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 ("VBR") 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 2016 Risk Assessment. The results of the bat acoustic survey and the Aerial Waterfowl Survey show a pattern of decreasing use by birds and bats within the project area relative to areas near shore, and no observations of threatened or endangered species or eagles within the project area.

The status of the BBCS was also described within the 2018 Risk Assessment Summary. The BBCS will 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 an additional 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. A draft of the BBCS was submitted to the ODNR and USFWS for review.

14. What degree of confidence do you have in the 2016 Risk Assessment as summarized in the 2018 Risk Assessment Summary?

I have a high degree of scientific certainty in the 2016 Risk Assessment, as summarized within the 2018 Risk Assessment Summary. The 2016 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. Public studies of bird and bat fatality rates at onshore wind energy facilities in the Great Lakes region bracket the range of fatality rates likely to be generated by the project, as stated in the 2016 Risk Assessment.

The USFWS came to a similar conclusion in a letter dated March 12, 2018, during which the USFWS stated "Regarding potential take of federally listed species, [U.S. Department of Energy] has determined that LEEDCo's Project Icebreaker is not likely to adversely affect the Indiana bat, northern long-eared bat, piping plover, rufa red knot, and Kirtland's warbler. The Service concurred with these determinations." The USFWS went on to make an assessment of risk to migratory birds and bats, based largely on the small size of the project "The Service acknowledges that Icebreaker is a relatively small-scale demonstration project consisting of six turbines, and as such has limited direct risk to migratory birds and bats." See Attachment REG-3.

15. Would additional pre-construction radar data change the conclusion of low risk that was determined in the 2016 Risk Assessment?

Additional pre-construction radar collection would not change the conclusion of low risk for the project. Despite the completion of several pre-construction radar surveys and post-construction mortality surveys across the U.S., no one has established a strong link between the number of targets recorded with pre-construction, site-specific radar and post-construction mortality rates. The collection of pre-construction radar will establish a baseline of bird and bat migration rates, which will be used to help determine if birds and bats are attracted to or displaced from the project.

16. Please explain how the Stipulation supports a finding that the project, as supported by the 2016 Risk Assessment, represents the minimum adverse environmental impact.

The 2016 Risk Assessment clearly shows the risk of impacts to birds and bats is lower than wind-energy facilities located on-shore. As I pointed out previously in response to question 14, the USFWS came to a similar conclusion in a letter dated March 12, 2018, Attachment REG-3.

The Stipulation further reduces the potential risk to birds and bats through the commitment to following all of the terms within the Avian and Bat MOU, commitment to implementing a rigorous post-construction monitoring study to document collisions and potential displacement effects, and the commitment to develop and implement an avian and bat impact mitigation plan.[7] Icebreaker has already developed an adaptive management strategy that addresses the primary concerns expressed by the ODNR and USFWS regarding birds and bats. The stipulations proposed require approval of an avian and bat mitigation plan prior to construction by the ODNR, to ensure the measures proposed by Icebreaker to adaptively manage the Project and mitigate potential impacts are sufficient to meet the minimum adverse impact standard. Stipulations also require feathering of the Project during periods of highest risk if Icebreaker has not proposed an avian and bat collision monitoring plan that the ODNR considers sufficient.

17. Did you help Icebreaker draft the Avian and Bat MOU and the Monitoring Protocol?

Yes, I am familiar with monitoring protocols and provided input to the authors during development of the protocols. I also participated in meetings with the ODNR and USFWS where monitoring protocols were reviewed and discussed.

18. In your experience, is it typical to have an MOU and monitoring protocol for birds and bats submitted with an application to construct a wind farm?

No, it is not typical to have an MOU. All projects do have requirements to submit a post-construction monitoring protocol after receipt of a certificate from the Board but prior to start of construction, for review and approval by the ODNR. The commitments by Icebreaker within the Avian and Bat MOU are much greater than I have seen on land-based wind projects in Ohio. The 2016 Risk Assessment and other studies completed by Icebreaker and the Aerial Waterfowl Survey clearly show that Icebreaker presents a lower risk to birds and bats relative to on-shore wind-energy facilities. The additional commitment of the project to the Avian and Bat MOU, and the additional protections

[7] Note the Stipulation provides for the submittal of an avian and bat impact mitigation plan, Icebreaker also refers to the impact mitigation plan as the BBCS.

afforded to bird and bats through the Stipulation requirements, will ensure the project meets the minimum adverse impact standard.

19. Why was the Avian and Bat MOU submitted in this case?

The purposes, as described within the MOU, are: "The Parties are entering into this [MOU] to set forth the agreements that have been reached on the monitoring protocols for avian and bat resources. The purpose of these monitoring protocols will be to help assess, in a scientifically rigorous manner, any impacts that the Project construction and operation may have on avian and bat resources in the Project vicinity or likely to encounter the Project area. The goal of assessing these impacts is: 1) to document existing conditions and patterns of use by the species of concern at the Project site; 2) to document the changing conditions and patterns of use by species of concern and their associated habitats as a result of Project construction and operations at the Project site; 3) to develop and implement effective mitigation and adaptive management strategies to minimize avian and bat resource impacts; 4) to evaluate the feasibility of various monitoring protocols in an offshore setting; and 5) to better understand how future offshore wind projects in Lake Erie or the Great Lakes may affect birds and bats."

20. How was the ODNR involved in the drafting of the Avian and Bat MOU and Monitoring Protocol?

The ODNR was very involved in the development of monitoring methods within the Avian and Bat MOU and Monitoring Plan. Their involvement included in-person meetings and phone calls during which WEST solicited feedback from the ODNR on the purposes of the monitoring, and methods used to complete the monitoring. Feedback from the ODNR was utilized by WEST to develop monitoring protocols that met ODNR stated objectives, and the ODNR reviewed and provided final approval of all monitoring methods prior to their incorporation in to the Avian and Bat MOU.

21. Did ODNR sign the Avian and Bat MOU?

Yes. James Zehringer, Director of the ODNR, signed the Avian and Bat MOU on July 20, 2017.

22. Please summarize the Monitoring Protocol.

The Monitoring Protocol describes the methods to be utilized to assess the potential impacts of the project on birds and bats. The protocol provides a detailed description of survey methods for bats and waterfowl designed to assess potential changes in use by both groups of species pre and post construction. The protocol outlines the framework under which the radar and collision monitoring protocol will be developed. Finally, the protocol outlines the process by which ODNR will review and approve the radar and collision monitoring protocols, and also describes that the project will develop a collision monitoring protocol and a BBCS in consultation with the USFWS and ODNR, which will include an adaptive management strategy for ensuring the project does not result in significant adverse impacts to birds and bats. The Monitoring Protocol is a living document, which is meant to be adaptable to ensure the project takes advantage of advancing technologies for detecting collisions, and is also adaptable to ensure the protocol can be modified if needed depending on the results of the initial monitoring studies. Any modifications to the Monitoring Protocol must be approved by the ODNR as described within the Avian and Bat MOU.

23. Please summarize the studies that are required by the Monitoring Protocol and when these studies are to be conducted.

To date, two studies required under the Monitoring Protocol have been completed: 1) a Bat Acoustic Survey; and 2) an Aerial Waterfowl Survey. The reports for both have been submitted to the ODNR per the Avian and Bat MOU requirements. The Monitoring Protocol also requires the completion of a radar study prior to construction of the project. The protocol requires completion of the same studies after construction, including an acoustic bat study in years 1 and 3 during operation, and completion of the waterfowl survey in years 1 and 4 during operation.

The protocol states that the effectiveness of a radar study will be evaluated after completion of a third party review by Dr. Diehl, and that the radar study may or may not be required depending on the review and determination of the ODNR. The ODNR has since determined that a radar study will be required, and Icebreaker has worked closely with the ODNR to develop a specific radar monitoring protocol. Todd Mabee has submitted testimony regarding the specific Radar Monitoring Protocol.

The Monitoring Protocol also describes that collision monitoring studies will be completed, but does not prescribe the number of years of study that will be completed. The timing and number of years of study will be determined prior to construction, in coordination with the ODNR, after the collision monitoring protocol has been reviewed and approved by the ODNR. The Monitoring Protocol includes a commitment by Icebreaker to use the latest and most appropriate technology for monitoring collisions.

24. While these studies were not performed prior to the drafting of the 2016 Risk Assessment, why are you confident that these baseline studies will not change the conclusion of low risk reached in the 2016 Risk Assessment?

The results of both studies were consistent with previous studies by the ODNR[8] and the Applicant that were used to determine risk to waterfowl and bats[9]. As shown below in Figure 1, the mean relative abundance of waterfowl and waterbirds recorded by WEST was much greater near the shoreline relative to the project area, as evidenced in the figure below (See Attachment REG-4). The project is located 8-10 miles from the shore.

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8 https://wildlife.ohiodnr.gov/portals/wildlife/pdfs/species%20and%20habitats/pelagic2011report.pdf

9 The Applicant's waterfowl and bat studies were included in Attachment 4 to the Application's Fourth Supplement to the Application, which was filed on March 22, 2018.

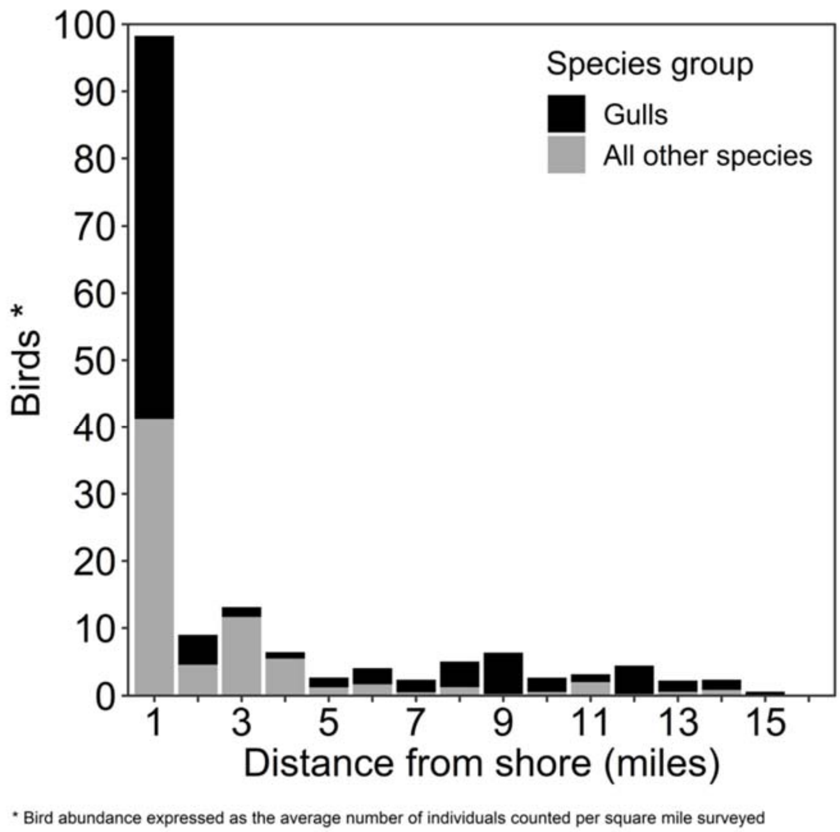

Figure 1. Mean relative abundance (birds per square mile surveyed) for two taxonomic groups (gulls, all other species) in relation to distance from shore (miles), for the 17 regular surveys. Based on reconciled observation data from the aerial avian surveys over Lake Erie 2017-2018, which have not been corrected for detectability. Includes observations made while commuting to the survey area and while surveying transects within the survey area. The nearest proposed Icebreaker wind turbine is located 8 miles from the shoreline.

The ODNR also found the number of birds recorded was much higher near shore relative to the project area during two years of surveys throughout much of Lake Erie, as shown below in Figures 2.[10]

[10] https://wildlife.ohiodnr.gov/portals/wildlife/pdfs/species%20and%20habitats/pelagic2011report.pdf

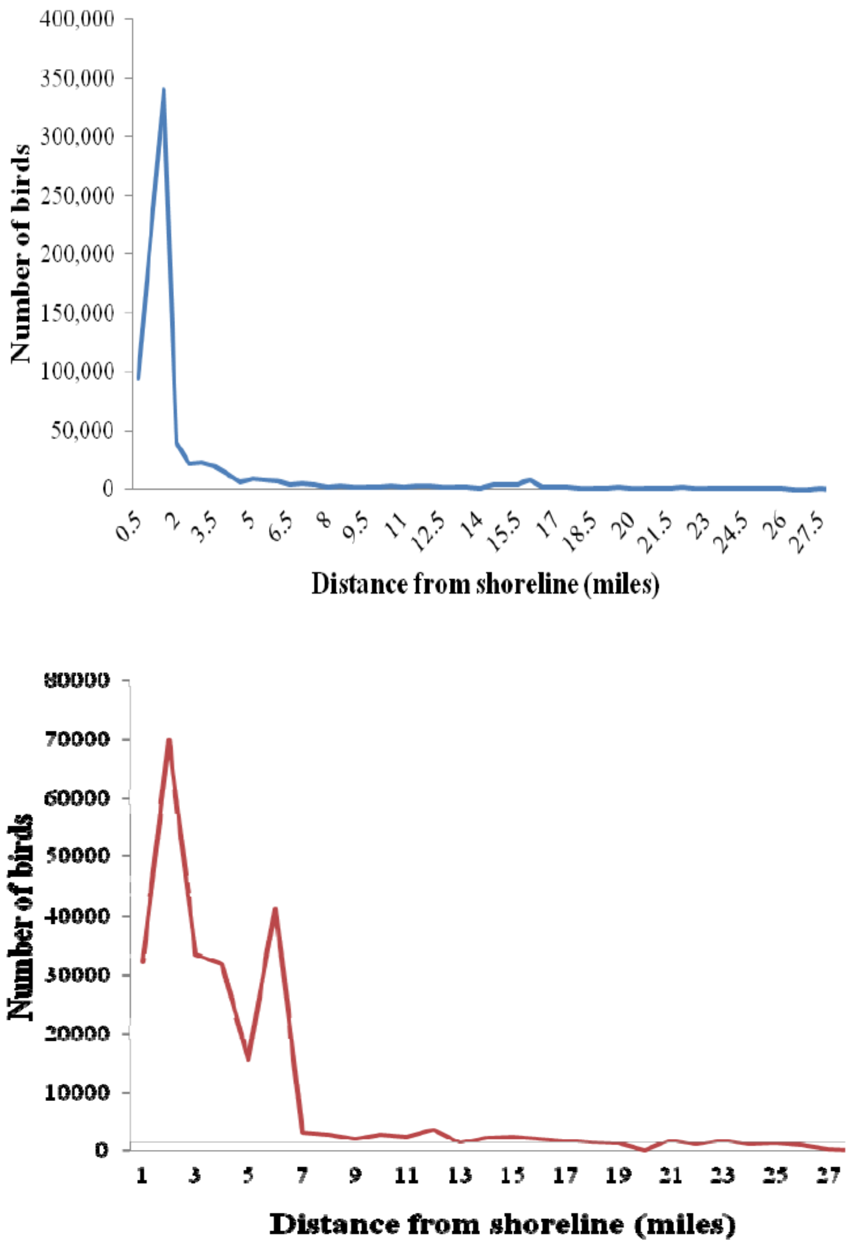

Figure 2. Number of birds as a function of distance from shoreline. The nearest proposed Icebreaker wind turbine is located 8 miles from the shoreline.

In WEST's Bat Acoustic Survey, no threatened or endangered species were recorded and the patterns of bat activity recorded suggest a trend of less activity for stations located farther from shore, as shown below.[11] In Figure 3 below, Stations X7, X3, and crib lower

[11] The 2017 Final Bat Acoustic Survey Report was filed by Icebreaker on March 22, 2018, as Appendix A to Attachment 4 of the Fourth Supplement to the Application.

provide the most equal comparison for determining patterns of use relative to the shore; all three stations were elevated approximately 1-3 m above the water. The station labeled as "crib elevated" was elevated to 50 meters above the water, and is not directly comparable to data collected from the other stations.

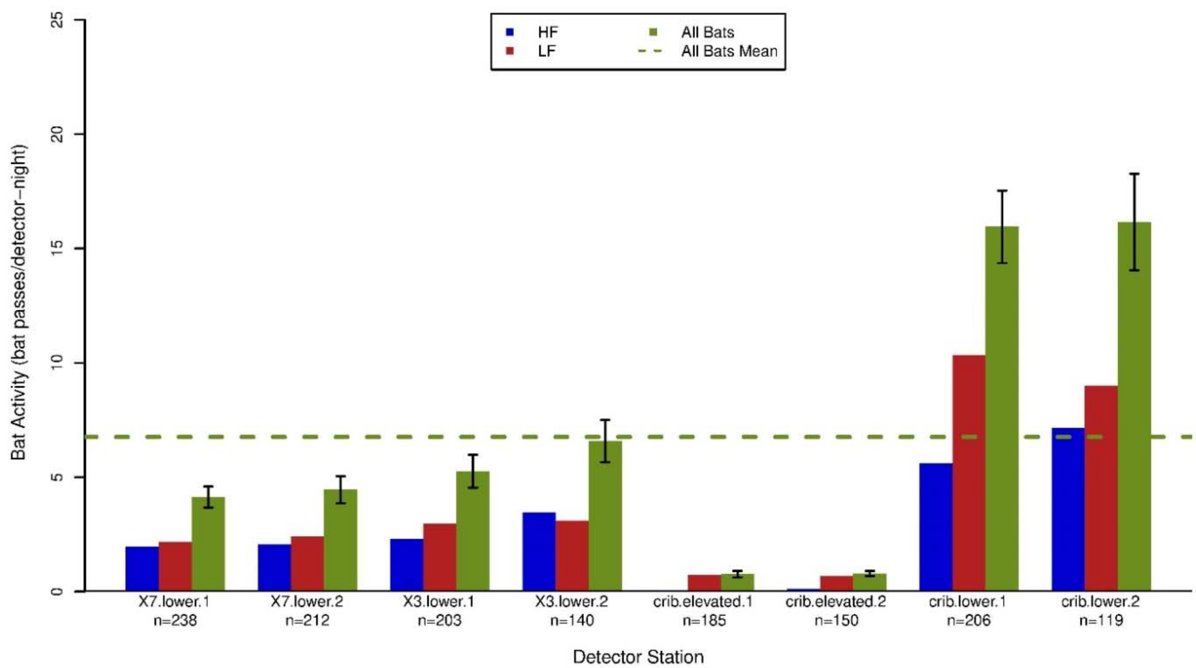

Figure 3. Number of high-frequency ("HF") and low-frequency ("LF") bat passes per detector-night recorded at all detectors and stations at the Icebreaker Wind Project Bat Survey Area from March 21 to November 14, 2017.

X7.lower = buoy lower stations within the project area approximately 9 miles from the shore , X3.lower = buoy's located three miles from the shore. Crib.elevated = detectors elevated to approximately 50 meters above the water located at Cleveland's water intake station (crib) approximately 3 miles from the shore. Crib.lower represents detectors placed 2 meters above the water on the crib approximately 3 miles from the shore.

25. What pre-construction baseline studies have been conducted to date?

To date, the Aerial Waterfowl Survey and the Bat Acoustic Survey have been completed as outlined within the Avian and Bat MOU and the Monitoring Protocol.

26. What pre-construction baseline studies remain to be conducted?

As agreed to within the Avian and Bat MOU and Monitoring Protocol, a radar study will be completed prior to construction to characterize the altitudinal distribution and density of flying birds and bats at the project site, and to characterize behavioral avoidance/attraction effects in flying birds and bats in response to the presence of the project. The ODNR has also requested that bat activity be recorded at raised elevations if an offshore barge is used as a vessel for completing the radar study.

27. When will these pre-construction baseline studies be done?

The radar study and the bat activity study at raised elevations will be completed prior to construction of the project.

28. What is the status of Icebreaker's commitment to employ the best available collision detection technology at the time a decision must be made?

Icebreaker contracted with WEST in 2016 to assist with the development of a collision monitoring protocol, and has been evaluating available technologies and coordinating with the ODNR and USFWS since then. WEST prepared an initial post-construction monitoring plan in 2016. Icebreaker has had discussions with developers of collision monitoring technology to review the status of available technology, and feasibility for employment in offshore settings, including the MUSE system developed by DHI, Dr. Roberto Albertani's detection impact system, ECN's WTBird system, Pacific Northwest National Laboratory's ("PNNL") ThermalTracker and Virtual Bird/Bat Net, and EMPEKO's B-finder system. Recent advances in the use of camera technology for use in wildlife research also show that camera technology has advanced to the point where high definition camera's and advanced machine learning can be used to reliably detect and identify bird and bat flights and collisions. High definition camera's have been utilized to study the behavioral responses of bats to wind turbines and document collisions with success (Horn et al. 2008,[12] Cryan et al. 2014),[13] and can also be utilized to detect bird and bat collisions.

The project recently supported submittals of 3 applications to the DOE to further test and validate collision monitoring technology. WEST submitted initial application for a U.S. Department of Energy ("USDOE") grant to improve the WTBird system. The basic version of the system has been successfully deployed at the offshore wind farm Egmond aan Zee in the Netherlands for two years, during which a number of bird collisions were detected with a high degree of certainty (H. Verhoef, ECN, pers. comm.). The system was primarily designed to detect large birds; the grant money, if awarded would be utilized to modify and validate the system for detection of small bird and bat collisions. WTBird's camera systems would also be improved and validated for detection of small bird and bat collisions, and would be paired with acoustic detectors to obtain additional information on species occurrence.

Icebreaker and WEST also participated in 2 other proposals submitted to USDOE. WEST and Icebreaker are collaborators on the PNNL Virtual Bird/Bat Net, which is a camera-based system that would be designed to detect collisions of birds and bats. PNNL has successfully developed utilized camera-based systems for documenting bird and bat use for pre-construction studies of offshore wind projects. Their system is proposed to be modified to detect collisions at operating offshore wind projects. The project is also participating in Dr. Roberto Albertani's impact detection system grant proposal. His system has previously been shown to successfully detect impacts, and will be further refined to detect collisions of small bird and bats. The USDOE has reviewed concept papers for all three proposals, and encouraged submittal of full proposals for their review.

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12 https://www.bu.edu/cecb/files/2009/08/Horn_et_al_2008.pdf
See video of a collision at
https://www.bu.edu/cecb/bat-lab-update/bats/wind/video/bat-wind-turbine-video-13/

13 Paul. M. Cryan, P. Marcos Gorresen, Cris D. Hein, Michael R. Schirmacher, Robert H. Diehl, Manuela M. Huso, David T. S. Hayman, Paul D. Fricker, Frank J. Bonaccorso, Douglas H. Johnson, Kevin Heist, David C. Dalton, Proceedings of the National Academy of Sciences Oct 2014, 111 (42) 15126-15131; DOI:10.1073/pnas.1406672111

29. When will the decision on the collision detection technology be made?

The decision on collision monitoring technology will be made prior to the construction of the project.

30. Will the Avian and Bat MOU and Monitoring Protocol be amended over time?

The Monitoring Protocol is described as a living document within the Avian and Bat MOU, and is designed to be adaptable and changeable over time, depending on the results of monitoring and development of new technologies. This ensures the project will utilize the best available scientific information to assess impacts of the project to birds and bats, and will also allow the ability to revise monitoring protocols after review of initial monitoring year results. We anticipate the Monitoring Protocol will be amended over time, including the addition of an approved radar and collision monitoring protocol.

31. What process will be used for any revisions to the Avian and Bat MOU and Monitoring Protocol?

Any modifications to the monitoring protocol will require close coordination and approval by the ODNR. The process will involve an annual review of the survey results with the ODNR. Significant findings from the initial year of surveys will be reviewed, and changes to the monitoring protocol will be made, if needed, as described by condition B and C in the Avian and Bat MOU (page 2). Any changes that would be made would first be discussed with ODNR, and the ODNR would need to approve in writing any formal changes to the Monitoring Protocol. The Avian and Bat MOU could be revised in the future, but only after written approval by both the ODNR and Icebreaker.

32. Who will be involved?

ODNR and designated staff will serve as primary reviewers of the survey results. ODNR will work cooperatively with USFWS and other designated technical experts to review reports and ensure the monitoring meets the assessment goals.

33. As you stated previously, you were involved in the drafting of the BBCS. Is it typical to have a BBCS this early in the process?

A BBCS is often prepared after the pre-construction surveys are completed, and after the certificate is issued when the project is planning for construction and operation. BBCS's are living documents that are often modified as new information from pre-construction and post-construction studies become available, and through continued coordination with wildlife protection agencies.

34. Why was it drafted and shared with the agencies now?

The BBCS was drafted to begin coordination with the ODNR and USFWS on adaptive management and mitigation measures proposed by the project to ensure significant impacts do not occur to birds and bats.

35. What permits related to the construction of the project need to be obtained?

The need for wildlife related permits are based on risk. The risk of impacts to federally threatened and endangered species, and eagles, is considered low and the project has not applied for take permits for these species. The USFWS came to a similar conclusion in a letter dated March 12, 2018 (Attachment REG-3), during which the USFWS stated "Regarding potential take of federally listed species, DOE has determined that LEEDCo's Project Icebreaker is not likely to adversely affect the Indiana bat, northern long-eared bat, piping plover, rufa red knot, and Kirtland's warbler. The Service concurred with these determinations." The project has also proposed adaptive management measures to proactively address occurrence of species protected under the ESA and the BGEPA to avoid potential impacts**.** The risk to eagles was demonstrated to be low within the 2016 Risk Assessment, which included an analysis of ice free refuges during the winter, which the USFWS theorized could attract eagles. No eagles were observed during the Aerial Waterfowl Survey within the project during the winter of 2017-2018, further illustrating the project's low risk to eagles.

36. What is the typical process for obtaining these permits, and what is the current status of these permits?

The process includes a determination by the project proponent, typically in coordination with wildlife consultants and wildlife agencies, if a permit is needed based on risk to affected species. The risk of impacts to species protected under the ESA, and the BGEPA from the project are considered low and thus a permit is not warranted based on available information. Potential occurrence of protected species in the future will be addressed through post-construction monitoring and adaptive management measures to further minimize potential risk during operation of the project.

37. Will Icebreaker seek an eagle take permit?

The project has not proceeded with an eagle take permit application because available information suggests the risk to eagles is low. Potential future changes to use of the project by eagles will be addressed through adaptive management.

38. Will the Applicant need to obtain any other permits?

No other wildlife related permits are needed based on available information.

39. What steps has the Applicant taken to date to minimize risk of this project to birds and bats?

The Applicant has utilized siting to minimize risks to birds and bats. The project was moved farther offshore than originally proposed, within an area designated by the ODNR as having limited environmental limiting factors. Use of offshore areas by birds and bats is highest in areas near the shore. Relocating the project farther offshore further minimizes the risk of impacts to both birds and bats.

The project has completed a risk assessment (2016 Risk Assessment and 2018 Risk Assessment Summary) based on the best available science and site specific data that show the current Project location poses a minimal risk to birds and bats.

The project has proposed strong adaptive management measures to further minimize the risk to birds and bats, including restricting operations during the highest periods of use by birds and bats, and adaptive responses to prevent large mortality events and address potential occurrence of eagles, threatened, and endangered species.

The project has signed an Avian and Bat MOU that commits the project to close coordination with the ODNR. The Avian and Bat MOU requires extensive monitoring using methods reviewed and approved by the ODNR, use of monitoring results to determine if significant impacts are occurring, and design of further adaptive management measures to further reduce risk to birds and bats if needed.

40. What steps will Icebreaker take once operations commence to reduce risk of mortality to birds and bats?

The project has committed to feathering turbine blades until winds reach the manufacturers cut-in speed during the late summer and fall migration period, as a measure to reduce bat mortality. This measure was shown to reduce bat mortality at Fowler Ridge by approximately 30%.[14]

The project will implement collision detection technology and other studies to determine if significant impacts are occurring, the results of studies will be reviewed with the ODNR per the Avian and Bat MOU, and additional minimization or mitigation measures may be implemented if significant impacts are occurring.

The project has also proposed adaptive management measures to further minimize potential risks to birds and bats during the first year of operation. Those include reducing operation of turbines to minimize impacts to birds and bats during periods of higher risk, halting the operations of turbines if large mortality events are detected or if significant

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14 https://www.fws.gov/Midwest/endangered/permits/hcp/FowlerRidge/pdf/AppendixA_FowlerRidgeWindFarmFinalHCP062713.pdf

numbers of eagles are recorded near turbines, and immediate coordination with the ODNR and USFWS if protected species are recorded as collisions.

41. Would additional pre-construction radar data change the conclusion of low risk that was determined in the 2016 Risk Assessment?

Additional pre-construction radar collection would not change the conclusion of low risk for the project. Despite the completion of several pre-construction radar surveys and post-construction mortality surveys across the U.S., no one has established a strong link between the number of targets recorded with pre-construction, marine radar, and post-construction mortality rates. The collection of pre-construction radar will establish a baseline of bird and bat migration rates, which will be used to help determine if birds and bats are attracted to or displaced from the Project.

42. Have you reviewed the Staff Report of Investigation that was filed in this docket on July 3, 2018 ("Staff Report")?

Yes. I have reviewed the parts of the Staff Report that address ecological impacts.

43. Staff Report Condition 19 requires that, "[t]urbines shall be feathered completely from dusk to dawn from March 1 through January 1 until the Applicant has demonstrated that the post-construction avian and bat collision monitoring plan is sufficient." What does this provision mean?

This condition means the project will not operate at night until the Applicant can demonstrate the avian and bat collision monitoring plan is considered sufficient by the ODNR and OPSB. The last sentence of the condition, which states "The ODNR may approve modifications to turbine operation for testing purposes." makes it unclear if the ODNR will allow Icebreaker to demonstrate the plan is sufficient unless the chosen system is tested and proven at Icebreaker after the project is operational.

44. Is it possible for the Applicant to demonstrate prior to construction that the collision monitoring plan is sufficient?

Yes it is possible for the Applicant to demonstrate the plan is sufficient prior to construction, and allows for a more scientific approach for demonstrating the validity of the collision monitoring plan. For example, an impact detection technology installed on turbine blades could be tested at turbine test facilities such as the National Renewable Energy Laboratory or other similar facilities that host larger turbines available for engineering tests. Technologies can be tested initially by engineers utilizing objects similar in size to small birds and bats, to determine if impacts from small objects on operating wind turbines could detect small collisions above background vibrations associated with normal turbine operation. Engineers at the National Renewable Energy Laboratory and The Energy Research Centre of the Netherlands have performed similar tests on the WTBird and other impact detection systems. The chosen system would then be validated in field test at a land-based turbine after the system detects sufficient numbers of small bird and bat sized objects with a high degree of certainty during engineering tests. Validation at a land-based turbine would provide a more meaningful and accurate test than attempting to validate the system at an offshore turbine. The number of bird and bat collisions detected by the technology could be validated by concurrently completing a traditional land-based carcass search, and the results compared to ensure the system operates correctly.

Camera systems have already been proven to be capable of detecting bats colliding with turbines at land-based wind turbines[15]. Camera technology has improved significantly since 2008; improved camera technology can reliably be used to detect both bat and bird collisions. Camera systems could also be validated offshore prior to construction through rigorous testing at an offshore barge, running concurrently with a radar and acoustic detectors and comparing the number of targets detected between each type of technology, and comparing the system's ability to identify the types of targets recorded.

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15 (https://www.bu.edu/cecb/files/2009/08/Horn_et_al_2008.pdf). A video of a collision between a bat and turbine blade can be viewed at https://www.bu.edu/cecb/bat-lab-update/bats/wind/video/bat-wind-turbine-video-13/.

Some collision detection technologies, such as WTBird, have already been successfully deployed at offshore turbines in the Netherlands for multiple years. The results of surveys and validation testing completed at offshore wind turbines would provide an additional degree of certainty that a chosen system would be sufficient to detect collisions, and eliminate the need to demonstrate the collision monitoring protocol is sufficient at Icebreaker prior to allowing full operation of the Project.

45. Why is it important that the Applicant be given the opportunity to demonstrate that the collision monitoring plan is sufficient prior to construction?

In addition to what Mr. Karpinski states in his testimony, from a science perspective, a validation test completed at a land-based turbine would provide much better test of the systems effectiveness compared to validation at an offshore turbine. Validation at a land-based turbine would allow the chosen system's results to be compared to proven land-based carcass search techniques and results.

46. Staff Report Condition 19 requires that, until the collision monitoring plan is approved, Icebreaker's turbines must be "…feathered completely from dusk to dawn from March 1 through January 1." What does this phrase mean?

I understand this statement to mean that the turbines would not generate any electricity at night from March 1 through January 1, until the ODNR determines the collision monitoring protocol is sufficient.

47. Why is this provision in Staff Report Condition 19 problematic?

This condition is problematic because it creates a great deal of uncertainty, both scientifically and for financing. Collision detection technologies can be validated with a much higher degree of certainty at land-based turbines compared to testing at offshore turbines because the number of collisions detected by technology can be compared to established land-based carcass survey results. It is my understanding that this condition will also create uncertainty for potential investors. Mr. Karpinski's testimony provides more detail on the reasons for financial uncertainty.

48. In your experience, have you ever seen such a feathering requirement in any wind farm certificate?

I have not seen a similar feathering requirement in my 20 years of experience conducting post-construction monitoring at land-based wind projects, most of which have a higher risk of significant adverse impacts compared to the Icebreaker project.

49. For the Icebreaker project, as proposed in this Application and the Stipulation, do you believe it is necessary to feather the turbines completely as required in Staff Report Condition 19 even without the collision monitoring plan in place?

I do not believe this condition is needed in order to ensure the project meets the minimum adverse impact standard. The 2016 Risk Assessment demonstrated that the project poses low risk of adverse impacts to birds and bats, as I described in my earlier testimony.

We are confident that technology can be used to detect collisions of small birds and bats at Icebreaker. Camera systems have already been proven to be capable of detecting bats colliding with turbines at land-based wind turbines.[16]

As stated previously, researchers are also in the process of developing several different systems that show promise for detecting collisions, including ECN's WTBird system, Dr. Roberto Albertani's detection impact system, PNNL ThermalTracker and Virtual Bird/Bat Net, and EMPEKO's B-finder.

Additional measures committed to by Icebreaker in the event that a collision monitoring system has not been installed at the time of operation will ensure the project meets the minimum adverse impact standard without requiring blade feathering during all nights. If collision detection technologies are not installed when turbines begin operations, Icebreaker has committed to curtail all turbines during periods of highest risk for birds. Turbines will be curtailed during times with low cloud ceiling that would obscure the turbine rotor zone, from 30 minutes prior to sunset to 30 minutes after sunrise, during peak periods of migration in order to minimize the risk of a fallout-type mortality event.

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[16] (https://www.bu.edu/cecb/files/2009/08/Horn_et_al_2008.pdf). A video of a collision between a bat and turbine blade can be viewed at https://www.bu.edu/cecb/bat-lab-update/bats/wind/video/bat-wind-turbine-video-13/.

Icebreaker has also committed to feathering turbine blades below manufacturer cut-in speed during night time hours of the fall migration period to reduce impacts to bats.

50. Staff Report Condition 19 goes on to state that such feathering shall continue until "…the Applicant has demonstrated that the post-construction avian and bat collision monitoring plan is sufficient as determined by the ODNR in consultation with Staff." Is this phrase problematic for the project?

The condition is problematic from a scientific perspective because the provision prevents the project from operating at night until the ODNR determines the plan is sufficient. The provision does not describe what criteria the ODNR will utilize to determine if the plan is sufficient, making it difficult for the Icebreaker to assess the feasibility of meeting this condition. Mr. Karpinski will addressed the impacts this uncertainty may have on the operational and financial side of the project.

51. Does the Stipulation recommend a revision to the feathering requirement in Staff Report Condition 19?

Yes. Stipulation Condition 19 provides more clarity regarding the methods by which the collision monitoring plan can be demonstrated to be sufficient by clarifying that the plan could be proven sufficient prior to construction through lab tests or field validation.

52. Does Stipulation Condition 19 provide for the possibility that the Applicant could also demonstrate the sufficiency of the collision monitoring plan during operation?

Yes, the Stipulation proposed by Icebreaker does provide for the possibility that the plan could be demonstrated to be sufficient either before construction, or during operation of the project.

53. If the Applicant does not demonstrate that the collision monitoring plan is sufficient prior to construction, Stipulation Condition 19 provides that "…ODNR and Staff may require turbine be feathered up to 30 minutes prior to sunset to 30 minutes after sunrise during peak spring and fall migration periods when cloud ceilings are low." Please explain this provision.

The USFWS and ODNR have expressed concern regarding the potential for the elevation of bird migration to be lowered during periods when the cloud ceiling is low, which would theoretically force more birds to migrate at the same elevations of wind turbines, and could also cause them to look for safe places to perch such as the railing around turbines. Preventing turbine operation during periods highest risk for migratory birds, which are periods of low cloud ceiling during peak migration, will further reduce the risk of large mortality events occurring at the project until the collision monitoring plan is proven sufficient.

54. Why is the requirement in Stipulation Condition 19 to feather "up to 30 minutes prior to sunset to 30 minutes after sunrise during peak spring and fall migration periods when cloud ceilings are low" more reasonable and appropriate than Staff Report Condition 19 that requires the turbines to be "feathered completely from dusk to dawn from March 1 through January 1?"

Stipulation Condition 19 is more reasonable and appropriate because it provides the necessary protection to migratory birds during the period of highest risk. Staff Report Condition 19 would prevent the project from operating from March 1 through January 1, until the ODNR determines the collision monitoring plan to be sufficient. March 1 through January 1 includes a long period of time during which the risk of bird and bat collisions are very low. Bird migration does not occur during the summer and winter for songbirds, which are the bird species group most commonly found as casualties at land-based wind turbines. Bat mortality at land-based wind projects is highest during the fall migration period,[17] and bat activity was very low at the Project during the months of March and November (Bat Acoustic Survey), and is not expected to occur in December.

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17 https://pubs.usgs.gov/of/2012/1110/OF12-1110.pdf

Extending the period of feathering outside of the peak migration seasons will result in very little to no conservation benefit to birds or bats, while significantly decreasing the amount of electricity generated. Icebreaker has also committed to feathering turbine blades below manufacturer cut-in speed during the fall migration period to reduce potential bat mortality.

55. Under Stipulation Condition 19, who would determine the sufficiency of the collision monitoring plan?

The ODNR and Staff will determine the sufficiency of the collision monitoring plan.

56. Do you think Stipulation Condition 19 will act to protect wildlife such that the project represents minimum adverse environmental impact, considering the state of available technology, the nature and economics of alternatives, and other pertinent considerations?

I believe Stipulation Condition 19 will protect birds and bats and ensure the project represents the minimum adverse impact standard for the following reasons:

- The 2016 Risk Assessment clearly shows that the risk of direct and indirect impacts to birds and bats is low relative to wind-projects located on land.
- Camera technology has already been demonstrated to be able to detect bat collisions, and other technologies, such as WTBird, have been successfully implemented at offshore wind turbines in the Netherlands. Technology is available to successfully detect bird and bat collisions.
- The Stipulation requires Icebreaker to prove the sufficiency of the plan to the ODNR and OPSB.
- Feathering turbine blades during the peak periods of migration for birds during low ceiling events will significantly reduce potential collision impacts during the periods of highest risk, until the collision monitoring plan has been approved by the ODNR and OPSB staff.

57. Staff Report Condition 24 contemplates that Staff and the ODNR can "prescribe" adaptive management to the Applicant if they determine that the project results in "significant adverse impact to wild animals." Could the term "wild animals" encompass more than birds, bats, fisheries and aquatic resources? Could it include creatures such as mosquitos, moths, and zebra mussels? What other animals might this definition capture?

I am not familiar with the legal definition of wild animals per Ohio statute. A biological definition of wild animals could include birds, bats, fish, mosquitos, moths and mussels.

58. The Staff Report applied this condition to "wild animals," without further definition. If left undefined, what would be the result to the project?

The use of term wild animals implies that the project needs to measure and mitigate for impacts to all species, which could result in extensive monitoring for species that are unlikely to be impacted by the project. The resources that the ODNR and USFWS have expressed concern about that I am involved with are birds and bats. Replacing the term "wild animals" with "birds and bats" would more accurately reflect the concerns expressed by the ODNR and USFWS.

59. Have you reviewed the Board's administrative rules on ecological impacts? What do those rules say?

I have reviewed the ecological portion of the new Rule 4906-4-09 of the Ohio Administrative Code. The administrative rules state that applicants should coordinate with ODNR, USFWS and the Board's Staff to determine if any actions are necessary to avoid impacts to state or federally listed and protected species. If the agencies identify recommendations for avoiding impacts, applicants need to develop a plan to address the recommendations.

Applicants need to develop plans to reduce impacts to birds and bats and applicants need to submit post-construction monitoring plans prior to construction, and develop mitigation plans if significant impacts occur to birds or bats. Applicants also need to report any listed species observed, and develop mitigation plans if construction activities impact listed species.

60. In your experience, does this Condition 24 from the Staff Report appear to go beyond the scope of the Board's rule?

Yes. The condition does go beyond the scope of the Board's rule. The rule does not describe that mitigation will be prescribed to applicants.

61. The Staff Report Condition 24 states that if the Staff and the ODNR find a significant adverse impact to wild animals, "adaptive management shall be prescribed." In your opinion, what sort of measures could possibly be "prescribed" to the Applicant under this condition?

The measures that could be prescribed are broad and depend on the species that are experiencing significant adverse impacts. Based on my 20 years of experience with wind-energy projects, it is my understanding that prescribed adaptive management could include preventing turbines from operating at raised cut-in speeds at night to reduce impacts to bats, installation of deterrents for birds or bats, installation of systems that detect birds or bats and curtail turbine operations when birds or bats are near turbines, management of lights to prevent attraction of birds or bats, halting operation during periods of high risk to birds and bats, decommissioning of the project and removal of turbines, or other measures.

62. Could Staff Report Condition 24 theoretically include feathering, curtailing operations, even dismantling and decommissioning the project?

Yes.

63. What sort of impact on financing would you expect from this Staff Report Condition 24's grant of authority to the agencies to simply "prescribe" adaptive management without further detail or definition? Why?

Dave Karpinski will testify to the financial effect of the condition. However, I understand that the ability to prescribe adaptive management could make entities unwilling to finance the project. To date, I am not aware of a definition of significant impact by the OPSB or ODNR; however, the Board and ODNR could recommend decommissioning and removal of turbines if bird and bat mortality rates (bat or bird mortality per turbine) are slightly higher than expected, even if the level of impact would have no measurable impact on bird and bat populations. This possibility could make institutions unwilling to invest money in a project.

64. Have you encountered land-based projects where the certificate condition states that adaptive management "shall be prescribed?"

I am not aware of any wind project in Ohio where adaptive management for birds and bats could be "prescribed" by the Board or ODNR per certificate conditions.

65. Does this Staff Report Condition 24 indicating adaptive management "shall be prescribed" allow the Applicant to provide input into what the adaptive management might be?

As written, Staff Report Condition 24 does not appear to allow Icebreaker to provide input toward what the adaptive management would be.

66. Stipulation Condition 24 states that, if Staff and the ODNR, in consultation with USFWS, determine the project results in a significant adverse impact to species covered under the Avian and Bat MOU and the Aquatic and Fisheries MOU, the Applicant will develop and submit an adaptive management strategy to Staff and the ODNR to confirm compliance with the condition. What is the purpose of this provision in your opinion?

The purpose is to ensure that significant adverse impacts do not occur to these species.

67. The Stipulation Condition 24 defines "significant adverse impact" as a "biologically significant impact on the population level of any species or the occurrence of a large mortality event as defined in the impact mitigation plan." Do you think this definition is reasonable?

Yes, I believe this is reasonable definition of significant adverse impact. In my experience, wildlife agencies manage game species on a population level, with the understanding that some level of mortality or impact can occur to individuals of a species without having significant impacts to populations.

68. How would you quantify a biologically significant impact on the population level of a species?

The approach to quantifying a biologically significant impact will depend upon the nature of the impact. ODNR will ultimately make this determination. In my opinion, the impact would be assessed by considering the size of the effect (number of animals impacted) relative to the population size. Is the effect significant relative to the species population size? Will the effect significantly affect current trends in the species population?

69. How would you quantify a large mortality event?

A large mortality event is defined within BBCS as 50% of the high end of the predicted range of annual bird and bat fatalities in a 24-hour period. The high end of the range of annual bird and bat fatalities is identified in the 2016 Risk Assessment, which equates to 56 individuals per turbine in a 24-hour period (50% of 112, the upper bound). We anticipate that collision detection systems will be installed on a subset of all turbines. Therefore, if any of the collision detection systems installed detect 56 strikes per turbine in a 24-hour period, Icebreaker agrees to curtail all turbines until such time as the wildlife have passed through the area. Large mortality events are expected to only have potential to occur during the night, and if they do occur, would be limited to night time hours. Under the BBCS, turbines will be curtailed from the time the event is detected up to 30 min after sunrise. Icebreaker commits to documenting these events to inform continued development of reliable off-shore wildlife monitoring and strike minimization strategies within the BBCS.

70. The Stipulation empowers Staff and the ODNR to make this determination, just as with the Staff Report. However, in Staff Report Condition 24, "significant adverse impact" is undefined. Do you think defining the term as in Stipulation Condition 24 helps make the project financeable?

I understand that Dave Karpinski is providing testimony on the effects of the stipulation on project financing. However, defining what the impact is would provide more certainty regarding the range of potential outcomes from post-construction monitoring.

71. Similarly, do you think replacing "wild animals" with the species covered under the Avian and Bat MOU and the Aquatic and Fisheries MOU with the ODNR is more appropriate? Why?

Yes, I do think it is more appropriate. The species I am working with that are identified by the ODNR and USFWS as species of potential concern are birds and bats. The use of the term wild animals is very broad, and introduces uncertainty. For example, would the Icebreaker be required to complete monitoring for insects, which could also be considered wild animals?

72. Stipulation Condition 24 states that, upon a staff and ODNR determination of significant adverse impact, the Applicant shall develop and submit a mitigation or adaptive management strategy. How do you envision that process to work?

My understanding of the process would involve an initial meeting with ODNR and staff to review possible mitigation or adaptive management strategies. The applicant would propose initial mitigation or adaptive management strategies based on the best available science from other wind projects, and based on on-site post-construction monitoring surveys. The applicant would solicit feedback from the ODNR and staff, and then provide a final mitigation plan or adaptive management strategy for ODNR and staff approval.

73. What might such a strategy or plan look like?

The plan will depend on the species being impacted. For example, if bat mortality was found to be high enough to result in significant adverse impacts, then Icebreaker may elect to feather turbine blades below wind speeds that represent the highest mortality risk, or they might elect to install a bat deterrent, or a combination thereof. The effectiveness of the measure would need to be measured during post-construction monitoring to ensure the level of impact would be reduced.

74. Do you or your firm have experience developing such strategies, and were they successful?

We do have experience developing such strategies. WEST has developed over 100 BBCSs across the nation, many of which included adaptive management strategies designed to address risk to birds and bats. One project example of a successful mitigation strategy prepared by WEST is Fowler Ridge, where a successful mitigation and adaptive management strategy was developed by WEST staff and implemented that significantly reduced overall bat mortality and reduced risk to endangered species, and also addressed risk to birds.[18]

75. Is it your opinion that significant adverse impacts would be likely or unlikely on this project? Why?

I believe it is unlikely that significant adverse impacts will occur on this project for two main reasons as described within the 2016 Risk Assessment and the 2018 Risk Assessment Summary: 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. Public studies of bird and bat fatality rates at onshore wind energy facilities in the Great Lakes region, as documented within the 2016 Risk Assessment, bracket the range of fatality rates likely to be generated by the Project.

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18 https://www.fws.gov/Midwest/endangered/permits/hcp/FowlerRidge/index.html

As noted previously in my testimony, the USFWS came to a similar conclusion in its letter dated March 12, 2018 (Attachment REG-3). The USFWS went on to make an assessment of risk to migratory birds and bats, based largely on the small size of the Project "The Service acknowledges that Icebreaker is a relatively small-scale demonstration project consisting of six turbines, and as such has limited direct risk to migratory birds and bats."

76. Is it possible that even after adaptive management, significant adverse impacts could persist?

The answer to this question depends on what species is being impacted, and the level of impacts. I think it is unlikely that significant impacts would persist to birds and bats based on my experience working on wind energy projects. For example, feathering turbine blades during periods of lower winds, or installation of deterrents, has shown to be effective for reducing bat mortality at other wind projects. Bird mortality is low at most land-based wind energy projects and for most species and, thus, adaptive management is typically not required. It is unlikely that adaptive management would be required for birds based on the lower risk at the Icebreaker project compared to land-based wind-energy facilities. The Applicant has taken further, pro-active steps to reduce risk to birds, such as feathering turbine blades at night during periods of high risk, including low cloud ceiling events during peak migration periods, and halting turbine operations if large mortality events are detected.

77. How does this Stipulation Condition 24 address threatened or endangered species?

It does not. Those are governed by Stipulation Condition 21.

78. How is adaptive management handled in Ohio for land-based wind projects?

Adaptive management is developed in a collaborative manner by the project operator, in coordination with the USFWS and ODNR. WEST recommends to developers that they pro-actively develop adaptive management measures to avoid or minimize potential impacts to protected species, and coordinate with the ODNR and USFWS, depending on the level of risk at a project.

79. Is it your opinion that the process set out in Staff Report Condition 24 is more rigorous and more robust than those in place for land-based projects?

Yes. I am not aware of any projects where adaptive management may be prescribed by USFWS and ODNR for birds or bats. I am also not aware of any project where a specific wildlife protocol is detailed within the stipulations of approval. Rather, survey protocols and the need for measures to reduce impacts to birds and bats are generally worked out between the developer and the USFWS and ODNR.

80. Is it your opinion that the process laid out in the Stipulation Condition 24 would meet with the statutory standard of minimal adverse impact?

I believe the process exceeds the standard for meeting minimal adverse impact. The risk of significant adverse impacts occurring at the Icebreaker project is low and Icebreaker has further reduced potential risk to birds and bats by developing an adaptive management strategy, as described within the BBCS.

81. Are your opinions and conclusions in your testimony made with a reasonable degree of scientific certainty?

Yes.

82. Does this conclude your testimony?

Yes.

CERTIFICATE OF SERVICE

The Ohio Power Siting Board's e-filing system will electronically serve notice of the filing of this document on the parties referenced in the service list of the docket card who have electronically subscribed to this case. In addition, the undersigned certifies that a copy of the foregoing document is also being served upon the persons listed below via electronic mail this 6th day of September, 2018.

/s/ Christine M.T. Pirik
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Icebreaker Windpower, Inc.
Case No. 16-1871-EL-BGN
Testimony
September 6, 2018

Attachment REG-1

CV/Resume

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PROFESSIONAL EXPERIENCE

1998-Present *Research Biologist/Senior Manager,* Western EcoSystems Technology, Inc., Bloomington, Indiana

1997-1999 *Wildlife Ecology and Management Teaching Assistant,* University of Wyoming, Laramie, Wyoming

1995-1997 *Graduate Research Assistant,* Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, Laramie, Wyoming

SPECIALTY AREAS

Wildlife Research: Mr. Good has over 20 years of experience designing and conducting wildlife research and monitoring studies. Studies Mr. Good has been involved in include research and monitoring of small mammals, bats, big game, songbirds, shorebirds, waterfowl, and raptors. As a part of his Master's Thesis, Mr. Good examined factors affecting the relative use of goshawk kill areas, conducted studies of parental and juvenile behaviors at nests, studied aspects of prey ecology, and examined goshawk food habits in southcentral Wyoming. Mr. Good has also completed assessments of wildlife and threatened endangered species use and risk at various development projects, including airports, solar projects, cellular towers, pipelines, and highway construction. Mr. Good served as project manager and field supervisor for a rangewide survey of golden eagles across the western U.S. that resulted in a publication in the Journal of Wildlife Management. Information from the survey is being used by the U.S. Fish and Wildlife Service to better manage golden eagle populations across the western U.S.

Wind-Energy Research: Mr. Good has served as field supervisor and project manager on over 50 studies of wind energy and wildlife interactions across the U.S., including projects in Michigan, New York, Illinois, Indiana, Missouri, Ohio, Tennessee, Arkansas, Oregon, Washington, Arizona, Wyoming, Colorado, South Dakota, and Montana. Wildlife studies that Mr. Good has been involved with include pre-construction risk assessments for wildlife studies and post-construction studies of fatality rates. Mr. Good has also studied the behavioral responses of shorebirds, songbirds, and waterfowl to wind turbines, to determine if projects could displace wildlife from occupied habitats. Mr. Good research at the Fowler Ridge Wind Farm in Indiana was one of the first in the Midwest to examine if blade feathering reduced bat mortality in the Midwest. Mr. Good has interacted extensively with agency personnel and has successfully developed and implemented wildlife monitoring protocols that have been approved by the U.S. Fish and Wildlife Service and state wildlife agencies across the U.S. Mr. Good has also assisted several wind-power companies with studies of protected bat and eagle use and compliance with the endangered species act and bald and golden eagle protection act at wind-energy projects. Mr. Good has also assisted several companies with understanding and implementing the U.S. Fish and Wildlife Service Land Based Wind Energy Guidelines.

SELECTED PROFESSIONAL PUBLICATIONS

Good, R.E., S.H. Anderson, J.R. Squires and G. McDaniel. 2001. Observations of northern goshawk prey delivery behavior in southcentral Wyoming. Journal of Intermountain Sciences 7(1) 34-40.

Good, R.E., R. Nielson, H. Sawyer, and L. McDonald. 2007. A Population Estimate for golden eagles in the western United States. Journal of Wildlife Management 71(2): 395-402.

Nielson, R. M., McManus, L., Rintz, T., McDonald, L. L., Murphy, R. K., Howe, W. H. and **Good, R. E.** (2014), Monitoring abundance of golden eagles in the western United States. The Journal of Wildlife Management, 78: 721–730. doi: 10.1002/jwmg.704

Good, R.E., W.P. Erickson, A. Merrill, S. Simon, K. Murray, K. Bay, C. Fritchman. 2011. Bat Monitoring Studies at the Fowler Ridge Wind-Energy Facility, Benton County, Indiana: April 13 – October 15, 2010. Prepared for Fowler Ridge Wind Farm. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.January 28, 2011.

EDUCATION

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Biology

SCIENTIFIC ORGANIZATION MEMBERSHIPS

The Wildlife Society

Raptor Research Foundation

ADDITIONAL TRAINING AND CERTIFICATION

Habitat Conservation Planning, 2011, U.S. Fish and Wildlife Service

Indiana Department of Transportation NEPA and CE Training, 2009

Golden Eagle Aging Workshop, 2003, Bill Clark

Wetland Delineation with an Emphasis on Soils and Hydrology, 2002, Wetland Training Institute

Wetland Plant Identification, 2001, Wetland Training Institute

Golden Eagle Aging Workshop, 2003, Bill Clark

American burying beetle survey method and identification training, 2003, Mark Payton, Nebraska Public Power District

Icebreaker Windpower, Inc.
Case No. 16-1871-EL-BGN
Testimony
September 6, 2018

Attachment REG-2

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June 2018

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REPORT REFERENCE

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1 INTRODUCTION

Icebreaker Windpower, Inc. (IWP) has proposed the Icebreaker Wind Project ("Icebreaker Wind" or "Project"), a demonstration-scale six-turbine, 20.7-megawatt (MW) offshore wind energy facility eight to 10 mi (13 to 21 km) from the shore of Cleveland, Ohio (Figure 1). This will be the first freshwater offshore wind project in North America, and possibly only the second offshore wind energy facility in the United States (U.S.). The Project is being developed by IWP, a subsidiary of Fred. Olsen Renewables USA, and funded in part by the U.S. Department of Energy (DOE) under its Advanced Technology Demonstration Program.

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). Europe has been developing its offshore wind resource for 27 years with over 4000 turbines (16,000 MW) deployed to date (http://fortune.com/2018/02/06/europe-wind-energy-capacity/). Twenty years of assessments of utility-scale offshore wind in Europe has documented limited effects of wind development on wildlife (Garthe and Hüppop 2004; Desholm and Kahlert 2005; Desholm 2009; Cook et al. 2014; Furness et al. 2013; Johnston et al. 2014; Vanerman et al. 2015; Dierschke et al. 2016). By constructing a small six turbine demonstration project as the first offshore wind energy development in the Great Lakes, Icebreaker Wind will serve as a platform for gathering valuable information. This information will be useful for natural resource management and decision-making regarding any future offshore wind energy development in the region.

Due to the Project's location, small size, and based on the experience elsewhere with existing wind farms, our conclusion is that Icebreaker poses minimal risk to avian and bat species, as documented in the Icebreaker Risk Assessment (Appendix A). IWP has developed this Bird and Bat Conservation Strategy (BBCS) to describe the measures proposed by the project to further minimize impacts to birds and bats and to address any unforeseen actual impacts that occur. Specifically, this BBCS document was developed to:

1. Document and describe the biological survey work that has been conducted to date at Icebreaker Wind;
2. Describe measures to avoid and minimize potential impacts to birds and bats resulting from the construction, operation, and decommissioning of Icebreaker Wind to ensure that the Project poses the minimum adverse environmental impact;
3. Describe post-construction bird and bat monitoring plans; and,
4. Determine if additional minimization measures are needed to further reduce impacts to birds and bats through use of an adaptive management plan to guide management actions in response to actual post-construction monitoring results.

This BBCS is meant to be a living document, and it is expected that additional information and planned actions may be adjusted over time as we learn more about actual Project impacts.

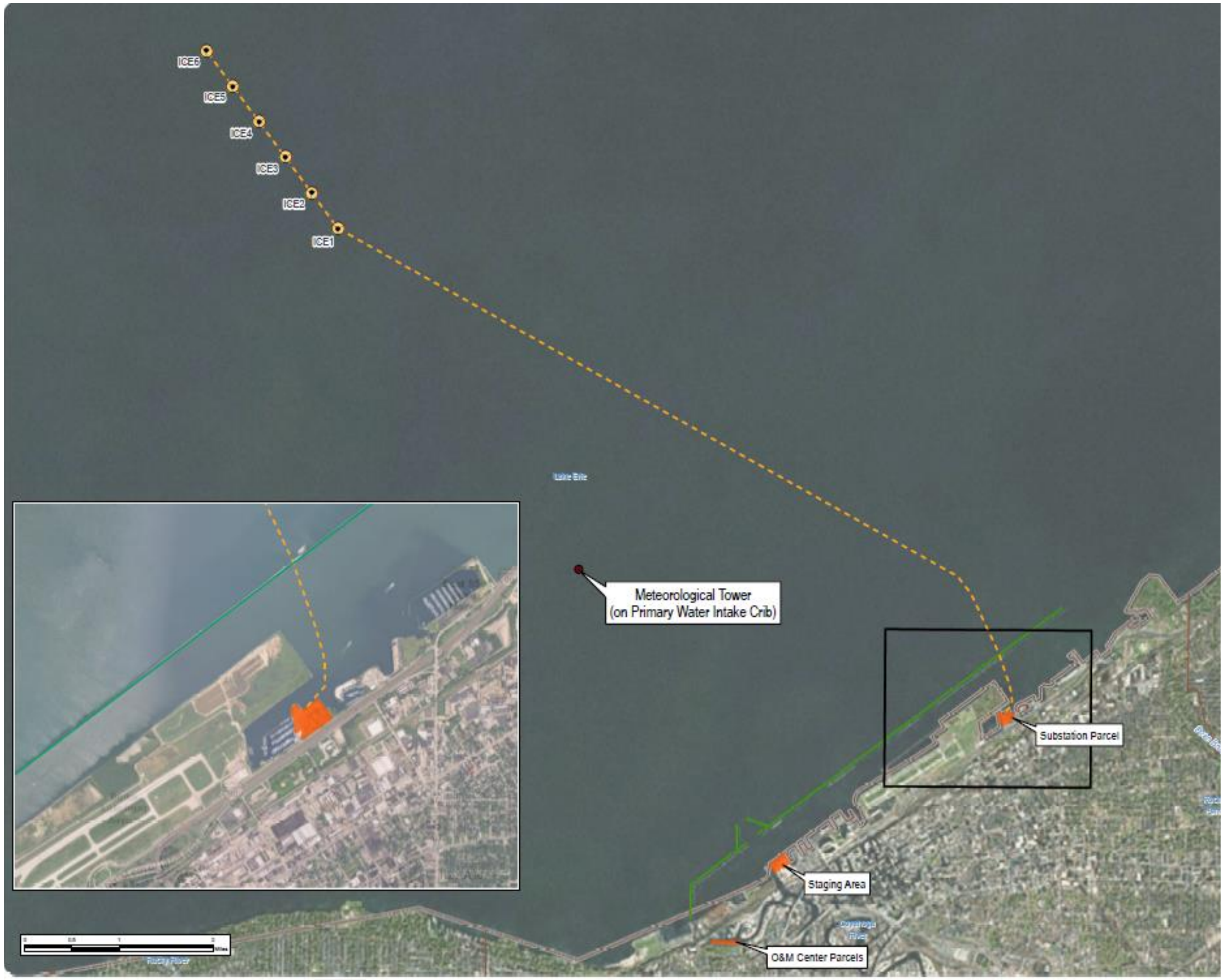

Figure 1. Turbine locations for the proposed Icebreaker Wind Project, Cuyahoga County, Ohio. .

1.1 Project Description and Characteristics

Icebreaker Wind is a demonstration-scale Project located in Lake Erie, eight to 10 mi (13 to 16.1 km) from the shore of Cleveland, Ohio (Figure 1). Icebreaker Wind is planned to consist of six Mitsubishi Heavy Industries Vestas Offshore Wind – Vestas 3.45 MW offshore wind turbines (V126-3.45 MW) that will be installed on Mono Bucket foundations. Other Project-related infrastructure will include buried electric cables, and an onshore substation with a transformer. During construction, approximately 12 acres (ac; 4.9 hectare [ha]) of land will be leased from the Port of Cleveland for storage, staging, and pre-assembly of Project components.

1.2 Key Avian and Bat Regulations

1.2.1 Federal Endangered Species Act

Species at risk of extinction, including many birds and bats, are protected under the federal Endangered Species Act (ESA) of 1973 as amended. The ESA defines and lists species as "endangered" or "threatened" and provides regulatory protection for the listed species. The federal ESA provides a program for conservation and recovery of threatened and endangered species and ensures the conservation of designated Critical Habitat that the United States Fish and Wildlife Service (USFWS) has determined is required for the survival and recovery of listed species. Section 9 of the federal ESA prohibits the "take" of species listed by USFWS as threatened or endangered. Take is defined as follows: "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in such conduct." In recognition that "take" cannot always be avoided, Section 10(a) of the federal ESA includes provisions for "take" that is incidental to, but not the purpose of, otherwise lawful activities. According to Section 10(a)(1)(B), Incidental Take Permits may be issued if take is incidental and does not jeopardize the survival and recovery of the species. Section 7(a)(2) of the federal ESA requires that all federal agencies, including the USFWS, evaluate a project with respect to any species proposed for listing, or already listed, as endangered or threatened and any proposed or designated critical habitat for the species. Federal agencies are prohibited from authorizing, funding, or carrying out any action that will jeopardize the continued existence of a listed species or destroy or modify its critical habitat. As defined in the federal ESA, individuals, organizations, states, local governments, and other non-federal entities are affected by the designation of critical habitat only if their actions occur on federal lands, require a federal permit, license, or other authorization, or involve federal funding. This Project involves receipt of federal funding. As required by law, the Department of Energy (DOE) has completed its Section 7 consultation with the USFWS for Icebreaker Wind. The USFWS has concluded that the Project is "not likely to adversely affect" any federally listed threatened or endangered species and that no designated or proposed critical habitat for these species occurs within the vicinity of the project area (USFWS letter to US DOE, September 14, 2017).

1.2.2 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA;1918) makes it unlawful to pursue, capture, kill, or possess any migratory bird or part, nest, or egg of any such bird listed in wildlife protection treaties between the United States, Great Britain, Mexico, Japan, and Russia (the former Soviet

Union). Unlike the ESA and the Bald and Golden Eagle Protection Act (BGEPA;1940), no permits are available to authorize incidental take of birds under the MBTA (although see, M-37050, "M-opinion" 2017[1] which does not prohibit incidental take). Most birds (except for introduced species and non-migratory game birds) within the U.S. are protected under the MBTA. Birds, occupied nests, and the contents of nests (eggs or chicks) within the Icebreaker Wind Project area are afforded protection pursuant to the MBTA. Due to the potential for resident and migratory birds to be found within the Icebreaker Wind Project area, compliance with the MBTA by minimizing potential impact of this project on migratory birds has been considered in the development of this BBCS.

1.2.3 Bald and Golden Eagle Protection Act

Bald and golden eagles are afforded legal protection under authority of the BGEPA, 16 USC 668–668d. BGEPA prohibits the take, sale, purchase, barter, offer of sale, transport, export or import, at any time or in any manner of any bald or golden eagle, alive or dead, or any part, nest, or egg thereof. Take is defined as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb," 16 U.S. Code (USC) 668c, and includes criminal and civil penalties for violating the statute. Disturb is defined as agitating or bothering an eagle to a degree that causes, or is likely to cause, injury, or either a decrease in productivity or nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior.

In 2009, the USFWS promulgated the 2009 Eagle Permit Rule, which specifically authorizes the non-purposeful (i.e., incidental) take of eagles and removal of eagle nests under BGEPA in certain situations (see 50 Code of Federal Regulations (CFR) § 22.26 2009, USFWS 2009). The permits authorize limited take of bald and golden eagles, authorizing individuals, companies, government agencies and other organizations to disturb or otherwise take eagles in the course of conducting lawful activities.

In 2013, the USFWS finalized the Eagle Conservation Plan Guidelines (ECPG, USFWS 2013; 78 Federal Register (FR) 85: 25758 2013). The ECPG provides a means of compliance with the BGEPA by providing recommendations and in-depth guidance for:

- conducting early pre-construction assessments to identify important eagle use areas;
- avoiding, minimizing, and/or compensating for potential adverse effects to eagles; and,
- monitoring for impacts to eagles during construction and operation.

The ECPG interpret and clarify the permit requirements in the regulations at 50 CFR § 22.26 and § 22.27, and do not impose any binding requirements beyond those specified in the regulations. However, if eagle risk is identified at a project site, developers are strongly encouraged to follow the ECPG. The ECPG describe specific actions that are recommended to achieve compliance with the statutory requirements of BGEPA for an Eagle Take Permit (ETP), as described in 50 CFR 22.26 and 22.27. They provide a framework for assessing and mitigating risk specific to eagles through development of Eagle Conservation Plans (ECPs) and issuance of ETPs for eagles at wind facilities.

[1] https://www.doi.gov/sites/doi.gov/files/uploads/m-37050.pdf

On December 16, 2016, the USFWS issued a revised rule that includes changes to the regulations for eagle incidental take permits and eagle nest take permits. The USFWS also issued a final Programmatic Environmental Impact Statement (PEIS; 2016) analyzing the revisions. The revisions to the 2009 Eagle Permit Rule went into effect on January 17, 2017, and include changes to permit issuance criteria, duration (including a maximum permit term of 30 years), compensatory mitigation standards, and permit application requirements. Additionally, the revised, 2016 Eagle Permit Rule codifies and further defines the USFWS-approved protocols for pre-construction eagle use surveys (referencing the ECPG) and post-permit mortality monitoring. Because Icebreaker Wind poses a very low risk of impact to eagles (Gordon and Erickson 2016), IWP will not apply for a permit. Potential risk to eagles will be addressed through adaptive management (further described below).

1.2.4 State Regulations

Birds and bats, including threatened, endangered, and common species are protected by the state of Ohio. The Ohio Department of Natural Resources (ODNR) has concluded that "A review of the Ohio Natural Heritage Database indicates there are no records of state or federally listed plants or animals within the project area." (ODNR letter to US DOE October 11, 2017). Ohio Revised Code (ORC) 1531.25 allows the Chief of the ODNR Division of Wildlife to adopt rules restricting the take or possessing of native wildlife threatened with statewide extirpation and to develop and periodically update a list of endangered species. ORC 1531.07 prohibits the unlawful taking of nongame birds. ORC 1531.08 prohibits the taking of wild animals, which includes bats. This BBCS addresses measures to reduce impacts to bird and bat species from the Project.

2 PRE-CONSTRUCTION RISK ASSESSMENT

The USFWS Land-Based Wind-Energy Guidelines (WEG; USFWS 2012) outlines a tiered approach to assessing site suitability and risks to wildlife at land-based wind energy facilities. As Icebreaker Wind is an offshore Project, standard practices and methodologies for wildlife studies at land-based wind energy facilities may not be available, practical, or optimal in all cases. Nonetheless, the basic tiered structure of the WEG is at least roughly applicable to the IWP.

All pre-construction studies that were considered as part of the risk assessment are described within Table 1. Information gathered during these pre-construction studies was used during the Project siting process to minimize potential impacts to birds and bats. An ODNR Offshore Wind Favorability Analysis that identified areas in Lake Erie more and less favorable for offshore wind development was also used (ODNR Wind Turbine Placement Favorability Analysis, 2009). The risk of potential impacts to birds and bats is considered low based on the small size of the project, the project location, site specific studies, and existing information available from on-shore and offshore studies, and is more fully described in a comprehensive risk assessment (Gordon and Erickson 2016, Gordon and Good 2018; Appendix A).

Table 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.

3 SUMMARY OF AGENCY CONSULTATIONS

Since the initial stages of Icebreaker Wind, IWP has worked alongside both USFWS and ODNR. Due to the long history of this Project and the various changes it has undergone since its beginning, this BBCS will summarize only the meetings IWP has had since August 2016 with USFWS and/or ODNR, as well as other relevant agencies, in Table 2.

Table 2. Summary of meetings between Icebreaker Windpower, Inc., the US Fish and Wildlife Service, and the Ohio Department of Natural Resources, Wildlife Division, regarding the Icebreaker Wind Project in Cuyahoga County since August 2016.

Date	Description	Location	Companies and Agencies Present
August 17, 2016	• Summary of pre-construction avian and bat surveys, risk assessment, development of a BBCS, and development of a post-construction monitoring plan • Response to 2014 Letters from ODNR and USFWS • Discussion regarding Ohio Power Siting Board (OPSB) Application for a Certificate of Environmental Compatibility and Public Need	Columbus, Ohio	• OPSB • ODNR • USFWS • Icebreaker Windpower • WEST • Paul Kerlinger • Tetra Tech • EDR • Dickinson Wright
September 1, 2016	• Discussion of Existing Radar and Other Bird/bat surveys	Teleconference	• ODNR • USFWS • WEST • Icebreaker Windpower • EDR • OPSB • Tetra Tech
December 6, 2016 December 9, 2016	• WEST's bird and bat risk analysis	Online webinars	• WEST • Dickinson Wright • EDR • Icebreaker Windpower • CH2M HILL • ODNR • OPSB • US Army Corps of Engineers • DOE • USFWS, OH and MN offices • US Coast Guard
December 13-14, 2016	• Role and goal of the DOE Demonstration Project • Questions, monitoring plans, and protocol to address areas that could benefit from additional study (as determined by USFWS and ODNR) • Outline of memorandum of understanding with	Columbus, Ohio	• WEST • Dickinson Wright • EDR • Icebreaker Windpower • CH2M HILL

Table 2. Summary of meetings between Icebreaker Windpower, Inc., the US Fish and Wildlife Service, and the Ohio Department of Natural Resources, Wildlife Division, regarding the Icebreaker Wind Project in Cuyahoga County since August 2016.

Date	Description	Location	Companies and Agencies Present
	ODNR and USFWS regarding pre-construction, construction, and post-construction studies and monitoring • Avian and bat monitoring plans and protocols (including long discussion of pre-construction radar at project site) • Presentation by Dr. Albertani on Collision Detection Technology ("Thunk")		• ODNR • OPSB • US Army Corps of Engineers • DOE • USFWS, OH and MN offices • U.S. Coast Guard
January 5, 2017	• Pre-Application Meeting for OPSB to discuss wildlife surveys	Columbus, OH	• OPSB • WEST • Icebreaker Windpower • Dickinson Wright • ODNR • USFWS, OH office • DOE • U.S. Coast Guard • EDR • Limno Tech
January 5, 2017	• Meeting to Discuss Bird and Bat Pre- and Post-Construction Options Cost Matrix	Columbus, OH And teleconference	• Icebreaker Windpower • WEST • USFWS • Ohio Power Siting Board • ODNR
March 13, 2017	• Call to discuss bat acoustic monitoring at elevated mic from buoy	Teleconference	• USFWS • WEST • Limno Tech • ODNR • Icebreaker Windpower
April 13, 2017	• Review information received from three potential providers of vessel based radar (VBR); discussion of the viability of vessel-based radar with ODNR, USFWS, DOE, and OPSB	Teleconference	• DOE • Icebreaker Windpower • Dickinson Wright • OPSB • USFWS • ODNR

Table 2. Summary of meetings between Icebreaker Windpower, Inc., the US Fish and Wildlife Service, and the Ohio Department of Natural Resources, Wildlife Division, regarding the Icebreaker Wind Project in Cuyahoga County since August 2016.

Date	Description	Location	Companies and Agencies Present
April 17, 2017	• Discuss VBR proposals and viability	Teleconference	• Icebreaker Windpower • WEST • Dickinson Wright • ODNR • OPSB • DOE
April, 2017	• Calls with Robb Diehl, USFWS, DOE and WEST to determine his ability to decide VBR question	Teleconference	• Icebreaker Windpower • WEST • USFWS • DOE • Dr. Robert Diehl
June 9, 2017	• Discuss memorandum of understanding (MOU) regarding the bird and bat monitoring protocol for Icebreaker Wind	Teleconference	• Icebreaker Windpower • WEST • ODNR • OPSB
July 20,2017	• Discuss Aerial Avian Survey Study approach	Teleconference II	• Icebreaker Windpower • WEST • Dickinson Wright • ODNR • USFWS
September 18, 2017	• Discuss interim bat acoustic monitoring results and path forward	Teleconference	• WEST • Icebreaker Windpower • ODNR • LimnoTech • Dickinson Wright
January 9, 2018	• Meet with USFWS to discuss radar approach	Bloomington, MN	• Icebreaker Windpower • WEST • Locke and Lord • ODNR • USFWS
March 2, 2018	• Meeting to review surveys completed in 2017, the annual report, and summarize the risk assessment	Columbus, OH	• Icebreaker Windpower • WEST • Dickinson Wright

Table 2. Summary of meetings between Icebreaker Windpower, Inc., the US Fish and Wildlife Service, and the Ohio Department of Natural Resources, Wildlife Division, regarding the Icebreaker Wind Project in Cuyahoga County since August 2016.

Date	Description	Location	Companies and Agencies Present
			• ODNR • OPSB
April 17, 2018	• Meeting to discuss ODNR expectations of proposed radar protocol	Columbus, OH	• Icebreaker Windpower • ODNR • WEST
May 18, 2018	• Meeting to review proposed radar study methods	Columbus, OH	• Icebreaker Windpower • ODNR • WEST

4 COMMITTED MEASURES TO AVOID AND MINIMIZE WILDLIFE IMPACTS

4.1 Project siting in a low productivity zone

The Project area has been sited far from fish spawning and larval nursery areas, reefs, or shoals that offer enhanced fish habitat, thereby minimizing the attractiveness of the area for fish-eating birds. The proposed turbine locations are sited within Lake Erie's hypoxic zone, an area which offers poor quality habitat for fish and other macroinvertebrates due to low levels of dissolved oxygen (LimnoTech; 2018). This poor quality habitat limits the attractiveness of the area to waterfowl. Pre-construction surveys by LimnoTech also documented far fewer fish available as prey at turbine sites as compared with reference sites (LimnoTech 2018). Siting the Project far from the shoreline and within the offshore waters reduces risk to local birds, as their densities are known to be lower in the offshore environment than in the nearshore environment (Norris and Lott 2011). Aerial surveys by WEST in 2017 and 2018 confirm reduced use of the offshore environment, as compared to nearshore habitat (Gordon et al. 2018).

4.2 Blade-feathering to reduce bat collision impacts

Bat collision impacts at turbines are most frequent on nights when wind speeds are low, especially during the late summer when migrating and swarming bats are most active. To address this concern, IWP has agreed to feather the turbine blades (i.e., adjust the pitch of the turbine blades, which is intended to inhibit the blades from rotating) up to 3.0 meters per second (6.7 mph; manufacturer's cut in speed) between July 15 to October 15. Feathering up to manufacturer cut-in speed (3.5 meters per second or 7.8 mph) was shown to reduce bat mortality by 36% at the Fowler Ridge (Good et al. 2012). Feathering wind turbines blades up to the manufacturer cut-in speed has been recommended by the American Wind Energy Association for reducing bat mortality (AWEA 2015).

4.3 Bird-safe aviation obstruction lighting

IWP will follow lighting recommendations contained within the USFWS 2012 land-based wind energy guidelines. Gehring et al. (2009) found that the use of red or white flashing obstruction lights strongly correlated with a decrease in avian fatalities compared to non-flashing, steady burning lights at tower systems. Gehring et al. (2009) further stated that "[R]emoving non-flashing lights from towers is one of the most effective and economically feasible means of achieving a significant reduction in avian fatalities at existing communication towers." The Project will use variable intensity flashing red lights on turbines, as stipulated by the Federal Aviation Administration for bird safety on the turbines. Navigation obstruction lighting on buoys will be lit as required by the U.S. Coast Guard.

4.4 Platform perching deterrents

IWP will use design measures and anti-perching strategies to avoid attracting birds to the wind turbine generators. The Project area is exclusively offshore waters (18m [26ft] depth) with no platforms or structures other than the turbine platforms on which birds can perch or rest. The upper platforms on the turbines will be approximately 12-15 m (39 – 49 ft) above the water, constructed of grated floors, which will minimize the appeal to birds as long-term perches or nesting substrate. Occasional avian use of the turbine platforms, in particular by gulls and cormorants, is expected, but based on other offshore wind assessments, use may be quite low (Petersen et al. 2006). If present, flushing of birds from structures is likely a lateral and downward movement, away from the rotor-swept zone and therefore minimal risk management may be required. In order to keep birds from chronic use of these platforms, design measures and deterrents will be used if needed, including Mylar reflective streamers (e.g. holographic flash tape), graduating to more structural permanent diversion and exclusion methods such as bird wire or similar on railings (for bird wire example see https://www.birdbgone.com/products/bird-deterrents/bird-wire.html).

5 POST-CONSTRUCTION MONITORING

As Icebreaker Wind is a demonstration-scale Project, it is important to determine the level of impacts that the Project's operation has on birds and bats, including behavior avoidance/attraction effects, displacement effects, and collision mortality effects. Monitoring these impacts on birds and bats is inherently more difficult in the offshore environment due to greater logistical difficulty and additional observer safety considerations relative to land-based wind energy facilities. In addition, many of the most typical methodologies used to study bird and bat collision impacts at land-based wind energy facilities (e.g. systematic carcass searching beneath turbines) are not possible in the offshore environment. Nonetheless, in recognition of the importance of post-construction impact monitoring, IWP has committed to implementing a post-construction monitoring program designed to detect impacts that the Project may have on birds and bats during its operational phase. The pre- and post-construction monitoring program was described in an Avian and Bat Monitoring Plan (Monitoring Plan) attached as Exhibit A to a MOU finalized between IWP and the ODNR on July 12, 2017, and included as a supplemental filing within IWP's application for a Certificate of Environmental Compatibility with the OPSB (Second supplemental filing to case 16-1871-EL-BGN, filed July 20, 2017). The MOU and Monitoring Plan (including updates to date) are included as Appendix B, and the reports derived from the monitoring efforts to date are included in Appendix C.

Each of the elements of IWP's post-construction bird and bat monitoring program are presented in summary here, as they are described in detail within the Monitoring Plan (and subsequent correspondence between IWP and ODNR in the case of the aerial waterfowl survey). However, it must be noted that some elements of the monitoring program were intentionally left for future discussion at the time the Monitoring Plan was developed, in recognition of evolving technology and pending discussions among Project stakeholders regarding the most appropriate monitoring methods (e.g. radar survey), and advancements in technologies intended to provide a robust method for monitoring bird and bat collisions at offshore wind energy facilities. For this reason, the IWP post-construction monitoring program as presented herein should be regarded as a living document, as is the entire BBCS, with some specific methodological detail regarding some of the monitoring elements left for future revisions of these documents as Project-related discussions and development of monitoring technologies advance. Furthermore, IWP may elect to employ monitoring methods in addition to those specified in the Monitoring Plan if such methods are deemed to add sufficient value with regard to achieving the monitoring objectives of the Project.

IWP will also develop a wildlife incident reporting system. The goal of the system will be to train on-site wind-technicians to identify and document bird and bat carcasses and any live eagles observed. The system will be used to help inform adaptive management strategies through the operational life of the Project.

The individual elements of the Monitoring Plan are summarized below.

5.1.1 Bat Acoustical Monitoring

5.1.1.1 Objectives

The primary monitoring objectives of the bat acoustic monitoring element are as follows:

- Characterize the exposure of bats to potential impacts from the Project, pre- and post-construction
- Characterize the potential behavioral responses of bats to the presence of the Project
- Characterize bat species composition, activity, and seasonal patterns between the Project site and off site

The pre-construction bat acoustical survey was completed in 2017, with the exception of additional monitoring from a tall pole (20 m; 65 ft) that will be placed on the vessel deployed for the baseline radar survey prior to construction. Methods and results of the 2017 acoustic bat activity surveys are described in the report to the ODNR (Mattson, Good, and Gordon 2018) and included in Appendix C.

5.1.1.2 Overview of Post-Construction Bat Monitoring Protocol

After construction, in years one and three, post-construction survey efforts will follow the same protocol as pre-construction survey efforts, and bat acoustic monitors will be deployed following the existing MOU between IWP and ODNR:

- On three turbines (at least one on an end) with high (nacelle or tower) and low (turbine platform) detectors
- On the mile seven buoys[2] near the water level and at 10 m (33 ft) height
- On the Crib at the same locations as pre-construction monitoring
- Review results of acoustic monitoring with ODNR, Division of Wildlife within three months of deployment to evaluate effectiveness of protocol
- Submit annual report and copy of raw data three months after the completion of the first monitoring season (post-construction) and determine applicability of year three acoustic monitoring

[2] The mile seven buoys are actually approximately nine miles off shore, or almost in the middle of the wind project string.

5.1.2 Aerial Avian Surveys

5.1.2.1 Objectives

The study plan for the Aerial Waterfowl and Waterbird Survey (Aerial Survey) was finalized through communication between IWP and ODNR, with input from USFWS, and the details of the final Aerial Survey, as approved by ODNR on August 16, 2017, are summarized here. Pre-construction aerial avian surveys commenced on October 16, 2017 for the 2017-2018 fall/winter/spring period at transects within and near turbine locations (Figure 2), and ended in late May, 2018. The Aerial Survey was intended to meet the two objectives identified previously in the Monitoring Plan, as follows:

- Characterize avian species, specifically waterfowl and waterbird species, numbers, distribution, and use of Project area
- Characterize whether or not any waterfowl or waterbird species are displaced from the Project area due to the presence of wind turbines

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 (Norris and Lott 2011). Based on the ODNR surveys, only six species of birds (including ring-billed gull (*Larus delawarensis*), herring gull (*L. 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 (Norris and Lott 2011).

The data from the 2017-2018 aerial surveys are currently being analyzed. Methods and results of the 2017-2018 pre-construction aerial avian surveys will be included in Appendix C following completion of the pre-construction assessment, anticipated in August 2018. The raw data collected to date are consistent with the results of (Norris and Lott 2011), and suggest that waterfowl use of the IWP is low relative to areas closer to the shoreline (J. Stucker, WEST, pers. comm.).

5.1.2.2 Overview of Post-Construction Aerial Avian Survey Protocol

After construction, in years one and four, post-construction survey efforts will follow the same protocol as pre-construction survey efforts, following the existing MOU between IWP and ODNR, and methods described in the Survey results, included in Appendix C. A key objective of this survey effort is to detect displacement or attraction effects in any bird species resulting from the construction and operation of the Project. This analysis will be performed in two ways: 1) before - after analysis; 2) gradient analysis (post-construction only). We note that displacement analyses will only be possible after post-construction data is collected during years one and four of Project operations.

Figure 2. Location of the aerial survey area and survey transects for the Icebreaker Wind Farm.

5.1.3 Radar

5.1.3.1 Objectives

The primary objectives of radar monitoring include:

- Characterize the altitudinal distribution and density of flying birds and bats at the Project site, pre- and post-construction
- Characterize behavioral avoidance/attraction effects in flying birds and bats in response to the presence of the Project

5.1.3.2 Overview of Pre- and Post-Construction Radar Monitoring Protocol

The ODNR and USFWS have asked that IWP collect baseline data using radar prior to construction to be able to portray the altitudinal height and distribution of nocturnal migrants over the Project site. This spatial distribution data would be compared to the data collected in post-construction radar surveys to determine if the Project has an avoidance or attraction effect. Following extensive discussions with ODNR and USFWS, the IWP team proposed conducting radar monitoring from a large barge (vessel based radar, or VBR) at the Project site as a practical solution for satisfying the agencies' informational objectives.

The IWP team and the agencies designed a Request for Information, which was sent to several firms with the capability to conduct VBR surveys. Responses were received and reviewed by IWP and the agencies. Ultimately, a third party radar expert, Dr. Robert Diehl of the US Geological Survey (USGS), was asked to review the three proposals received. Dr. Diehl submitted a final report in late December, 2017, after incorporating reviews of an earlier draft by two pre-eminent radar ornithology experts. The report contains a large amount of technical complexity, and provides commentary on several technical challenges associated with the proposed work. The report indicated a preferred vendor and design choice from among the proposed approaches, along with specific technical recommendations for improving it beyond what was originally specified in the proposal.

The IWP team discussed approaches for radar monitoring with the USFWS at a meeting on January 9, 2018. On March 12, 2018 the USFWS issued a letter to the ODNR outlining their appreciation of IWP's efforts to address USFWS requests regarding radar monitoring methods, and the USFWS stated that a VBR study would contribute meaningfully to migratory bird and bat data for the Project. IWP and WEST are currently developing a radar protocol in coordination with the ODNR. After the radar protocol document is completed, the radar protocol section of the monitoring protocol document will be updated in accordance with the MOU.

5.1.4 Collision Monitoring

5.1.4.1 Objectives

The primary objective of the collision monitoring element is as follows:

- Detect post-construction collisions of birds and bats with wind turbines and identify to guild (if determined possible) as per MOU.

IWP recognizes that greater understanding regarding the potential for birds and/or bats to collide with Project infrastructure during the Project's operational phase is of primary importance for the Project and for the Monitoring Plan. IWP also recognizes that the well-established mortality monitoring methods used at land-based wind energy facilities cannot be performed at an offshore facility such as the Project. Currently, several technologies to monitor for bird/bat collisions at offshore wind facilities that are emerging and appear promising are being evaluated and considered by IWP, with the ultimate goal being selection of the most viable system at the time a decision is required to be made. The technologies being considered include: impact detections systems (e.g. "Thunk Detector (OSU); and WT Bird (ECN)); exposure (risk) detection systems (e.g., B-Finder, MUSE System (DHI) Thermal Tracker System (BRI-PNNL), and Identiflight System (RES-Boulder Imaging). Impact detection systems currently seem most promising for assessing robust annual collision mortality rates. These systems are continuing to evolve with the ultimate goal of detecting smaller nocturnal migrants.

While no other offshore wind farm in the U.S. has committed to conduct extensive collision monitoring, IWP has committed to consult with the ODNR, OPSB, and other agencies and stakeholders to design a post-construction mortality monitoring plan using innovative collision detection technologies that are economically and logistically feasible for this demonstration Project. In addition, human observers will be used in the first years following construction. The commitment made by IWP at the present time is to continue to evaluate developing technologies and available options and to implement a robust collision-monitoring program during the Project's operational phase, with the specific technology, protocol, and sampling parameters to be determined through continued consultation with wildlife agencies, experts, and other stakeholders. Depending on the limitations of the technology, additional methods may be warranted to supplement the data collected to provide post-construction collision information, specific to the project size, offshore location, and other factors specific to the unique needs of the Project. The specific collision technology, protocol, and sampling parameters will be identified in the post-construction protocol and, upon approval by ODNR in writing, will be incorporated into this document as an amendment.

6 ADAPTIVE MANAGEMENT

Within the WEG, the Department of the Interior defines adaptive management as "an iterative decision process that promotes flexible decision-making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Comprehensively applying the tiered approach embodies the adaptive management process" (USFWS 2012). The WEG further notes that adaptive management (AM) at most wind facilities is unlikely to be needed if they are sited in accordance with the tiered approach. IWP recognizes the Project is the first of its kind in the Great Lakes, and that there is additional value in applying AM to its Project monitoring and operational activities.

IWP is committed to taking an AM approach, in which steps to minimize and mitigate demonstrated adverse impacts on birds and bats contributes to knowledge of environmental impacts of offshore wind in the region. This will help to inform future risks and appropriate monitoring. IWP has already committed to measures to avoid and minimize risk (Section 4), but recognizes that AM measures may also be necessary to further minimize adverse impacts if fatalities are significantly higher than those predicted over the course of the post-construction bird and bat monitoring effort.

Since the BBCS is a living document, as the post-construction monitoring approach is refined during the operational phase, the specific conditions and operational and management actions will be adjusted in response to what has been learned. Changes to this section will be ongoing over the life of the project, particularly during the initial post-construction monitoring, and will involve periodic consultation with management agencies through frequent formal and informal reports.

Following are sources of potential concern raised by the ODNR and USFWS, and IWP's AM plan for addressing those concerns. The AM triggers and responses are outlined in Table 3, and more fully described below.

Table 3. A summary of adaptive management measures IWP will utilize to address unanticipated wildlife impacts.

Concern	Trigger	Response	Duration
6.1.1 A large mortality event for nocturnal migrating songbirds prior to installation of mortality detection technology	Low cloud ceilings during peak spring and fall migration periods	All turbines will be curtailed from 30 minutes prior to sunset to 30 minutes after sunrise	From COD to the date of installation of operating mortality detection technology
6.1.2 A large bird or bat mortality event after post-construction mortality detection technology has been installed	Documentation of greater than 50% of the upper end of predicted bird and bat mortality rates within a single night	All turbines will be curtailed from the time of the observance of the event to 30 minutes after sunrise	From the start to the end of the post-construction monitoring study
6.2.1 Concentrations of eagles near turbines	Direct observation of concentrations of eagles near wind turbines	Turbines within 1 km of eagle concentrations will be curtailed until eagles have left the area	Life of Project
6.2.2 Mortality of a threatened or endangered species, or eagle	Discovery of an Ohio or federal threatened or endangered species, or eagle carcass	IWP will coordinate with ODNR and USFWS on appropriate response	Life of Project

6.1 Unexpected Wildlife and Wildlife Habitat Conditions

The IWP is not expected to result in higher bird or bat mortality than has been observed at on-shore turbines in the Great Lakes region. Furthermore, no other off-shore assessments of post-construction collisions or mortality are available to help define adaptive management triggers. The triggers described below are designed to prevent large scale mortality events and/or mortality of eagles during the first years of operation and post-construction monitoring.

The extensive post-construction monitoring studies specified and committed to in the Monitoring Plan, MOU and BBCS, will help refine the best management practices employed at the facility over the long term. While IWP intends to install collision detection technology prior to the start of commercial operations, we cannot rule out that there may be a period after the commencement of turbine operation but prior to the installation of collision technology on turbines. If this were to be the case there may be a need for measures to avoid or reduce impacts during this period. IWP has committed to minimization measures, including feathering during times of increased bat activity (section 4.2), bird-safe aviation obstruction lighting (section 4.3), and platform perching deterrents (section 4.4) to minimize collision risk for birds and bats using the Project. The primary concerns expressed by the USFWS and ODNR are the potential for a rare, large mortality event of songbirds during migration, high bat mortality, and potential for use of habitats, particularly ice and open water edges, by eagles near turbines. Thresholds and measures for an adaptive response to address these concerns are described below:

6.1.1 A large mortality event of nocturnal migrating songbirds prior to the installation of mortality detection technology

- If collision detection technologies are not installed when turbines begin operations, IWP commits to curtail all turbines during times with low cloud ceiling that would obscure the turbine rotor zone, from 30 minutes prior to sunset to 30 minutes after sunrise, during peak periods of migration in order to minimize the risk of a fallout-type mortality event.
- Low cloud ceilings are defined as less than 150m (<492 ft) as defined by Aviation Weather Center (NOAA) for KBKL at Cleveland Burke Lakefront airport, the closest waterfront airport to the Project area.
- Peak migration periods are defined as May 1 – 31 and September 1 – 30. IWP commits to maintain curtailment until low ceiling conditions dissipate, or 30 minutes after sunrise.
- IWP commits to documenting the frequency of these events and operational response.

6.1.2 A large mortality event after post-construction mortality detection technology has been installed

- The WEST Icebreaker risk assessment predicted the mortality range to be 1-2 birds / MW / year (3.5–7 birds per turbine per year), and 1-30 bats / MW / year (3.5 – 105 bats per turbine per year) (Gordon and Erickson 2016). The range of combined bird and bat wildlife fatalities[3] is anticipated to be 7 – 112 individuals per year per turbine, or 42-672 individuals per year for all six turbines.

- Large mortality events of wildlife during migration are unexpected, but should be considered in the adaptive management scenarios. IWP has defined a large mortality event as 50% of the high end of the range of annual wildlife fatalities in a 24 hour period (as defined below) identified in the IWP Risk Analysis. Accordingly, a large mortality event that would trigger the responses identified below is 56 individuals per turbine in a 24 hour period (50% of 112, the upper bound).
- IWP anticipates that collision detection systems will be installed on a subset of all turbines. Therefore, if any of the collision detection systems installed detect 56 strikes per turbine in a 24 hour period, IWP agrees to curtail all turbines until such time as the wildlife have passed through the area. Large mortality events are expected to only have potential to occur during the night, and if they do occur, would be limited to night time hours. Turbines will be curtailed from the time the event is detected up to 30 min after sunrise. IWP commits to documenting these events to inform continued development of reliable off-shore wildlife monitoring and strike minimization strategies.
- If monitoring or operations staff observe 56 or more wildlife carcasses at a turbine in a 24 hr period, IWP agrees to curtail all turbines until such time as the carcasses can be documented (e.g. photograph, direct visual observation), and conditions (environmental or migrant front) have changed through the area. Large mortality events are expected to only have potential to occur during the night, and if they do occur, would be limited to night time hours. Turbines will be curtailed from the time the event is detected up to 30 min after sunrise. IWP commits to documenting these events to inform continued development of reliable off-shore wildlife monitoring and strike minimization strategies.
- Wildlife strike reports will be provided to ODNR and USFWS within 24 hours if the event involves more than five strikes at a single turbine in a 24 hour period.

6.2 Unexpected Eagle or Eagle Habitat Conditions

The Project, while not typical of occupied eagle habitat for nesting or foraging, does have limited potential for use of the area. Environmental conditions involving eagles or adaptive management measures will be considered to further avoid, minimize, or compensate for unanticipated and significant Project impacts to eagles. Thresholds for considering an adaptive response will include:

6.2.1 Concentrations of eagles near turbines

- Direct observation of concentrations of eagles using areas within 1000 m of the turbine array would increase proximal risk of an eagle strike. The two anticipated conditions when this is more likely to occur includes during migration periods, particularly fall, or

[3] For these assessments, birds and bats have been generalized to "wildlife" due to the fact that mortality monitoring is anticipated to be primarily impact sensor determined, and it may be challenging to distinguish a bird from a bat based solely on the impact.

episodes of extensive ice coverage when wintering eagles may congregate in close proximity to a turbine.

- If a direct observation of an eagle concentration (greater than five eagles in a group) is made within 1000 m (3000 ft) of any turbine, the turbines within one km of eagle concentrations will be curtailed immediately to minimize collision risk. In addition, the situation will be directly or remotely monitored to evaluate continued risk if concentrations of eagles are observed simultaneously by wind technicians, or during wildlife surveys, such as the waterfowl survey or post-construction monitoring.
- Operations will resume once eagles have left the area. IWP will report to USFWS, and apprise agencies (USFWS and ODNR) of operational or management measures to monitor use and minimize risk.
- Repeated occurrence of concentrations of eagles within 1000 m (3000 ft) of turbines in the first two years of Project operation may necessitate increased monitoring efforts or technologies and operational strategies to further minimize risk to eagles.

6.2.2 Mortality of a threatened or endangered species or eagle;

- If a threatened or endangered species or eagle carcass is discovered within the Project area, the USFWS and ODNR will be notified immediately. IWP will review the circumstances of the mortality with the USFWS and ODNR within 24 hours to determine what measures will be used to avoid future mortality.
- IWP will work directly with ODNR and USFWS to document conditions, including weather and operations, preceding discovery of the carcass, and any collision monitoring data, and to determine if changes to turbine operation are warranted to avoid future mortality.

The first full year of post-construction monitoring studies will provide the most valuable basis for determining if changes to minimization measures are needed for future years of operation, or if mitigation is needed to offset impacts. Longer term changes to the operation or mitigation to offset impacts of the IWP may be needed if:

- Species protected under the ESA or BGEPA occur as fatalities
- Bird and bat mortality rates are significantly higher than the range of mortality rates recorded at on-shore wind-energy facilities and potentially threaten the viability of bird and bat populations

The specific, longer term potential changes to the operation of IWP or implementation of off-site mitigation will depend on the circumstances surrounding the mortality rates or events, and will consider industry best practices in consultation with ODNR and USFWS. IWP may apply for an eagle take permit or incidental take permit for threatened and endangered species in the event that eagle or threatened and endangered species fatalities occur at the Project, or if new data become available that makes it likely that an eagle or threatened or endangered species mortality would occur in the future.

IWP will review the post-construction monitoring results with the USFWS and ODNR annually per the MOU and Monitoring Plan to determine if longer term changes to project operation, or additional mitigation to offset impacts, are needed.

7 REPORTING and DATA AVAILABILITY

IWP will submit quarterly and annual wildlife reports per the MOU and operating permits to the OPSB, ODNR and USFWS detailing bird and bat monitoring efforts (radar, acoustic surveys, aerial surveys, bird and bat mortality rates), including details on the effectiveness of various technologies and approaches for advancing our understanding of wildlife in the off-shore wind environment. IWP will make the reports available for public distribution, including the release of technical reports and the publication of peer-reviewed scientific articles describing the results of post-construction monitoring.

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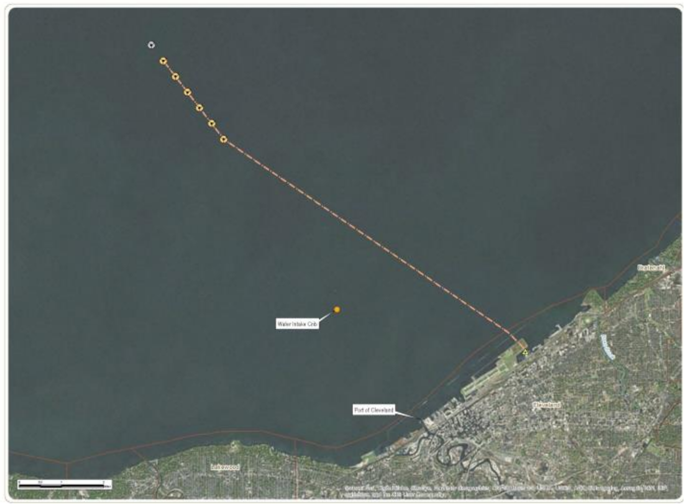
Appendix A. Icebreaker Wind Risk Assessments

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

March 20, 2018



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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.

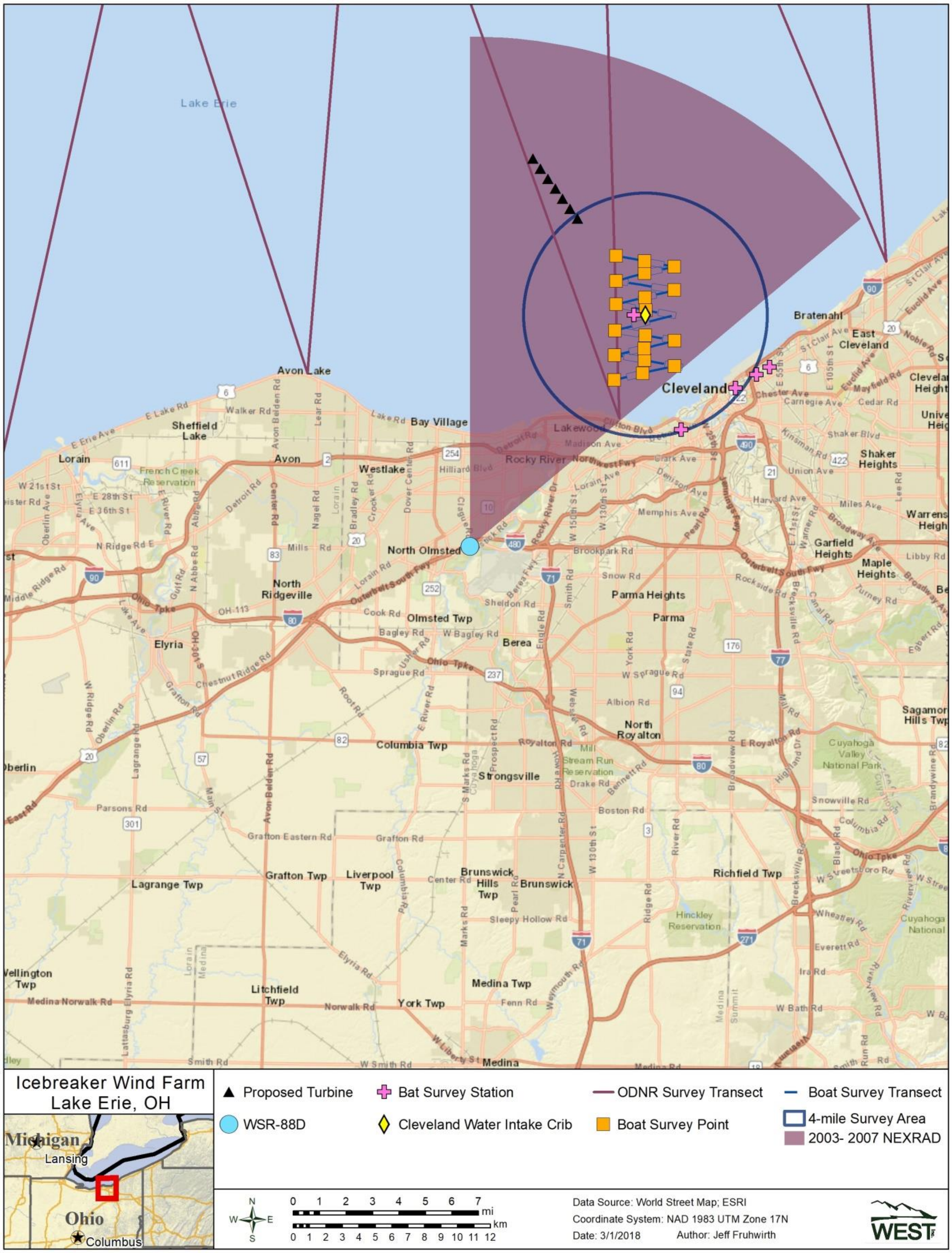

Figure 1.1. A map showing the coverage of the field surveys used to inform the risk assessment.

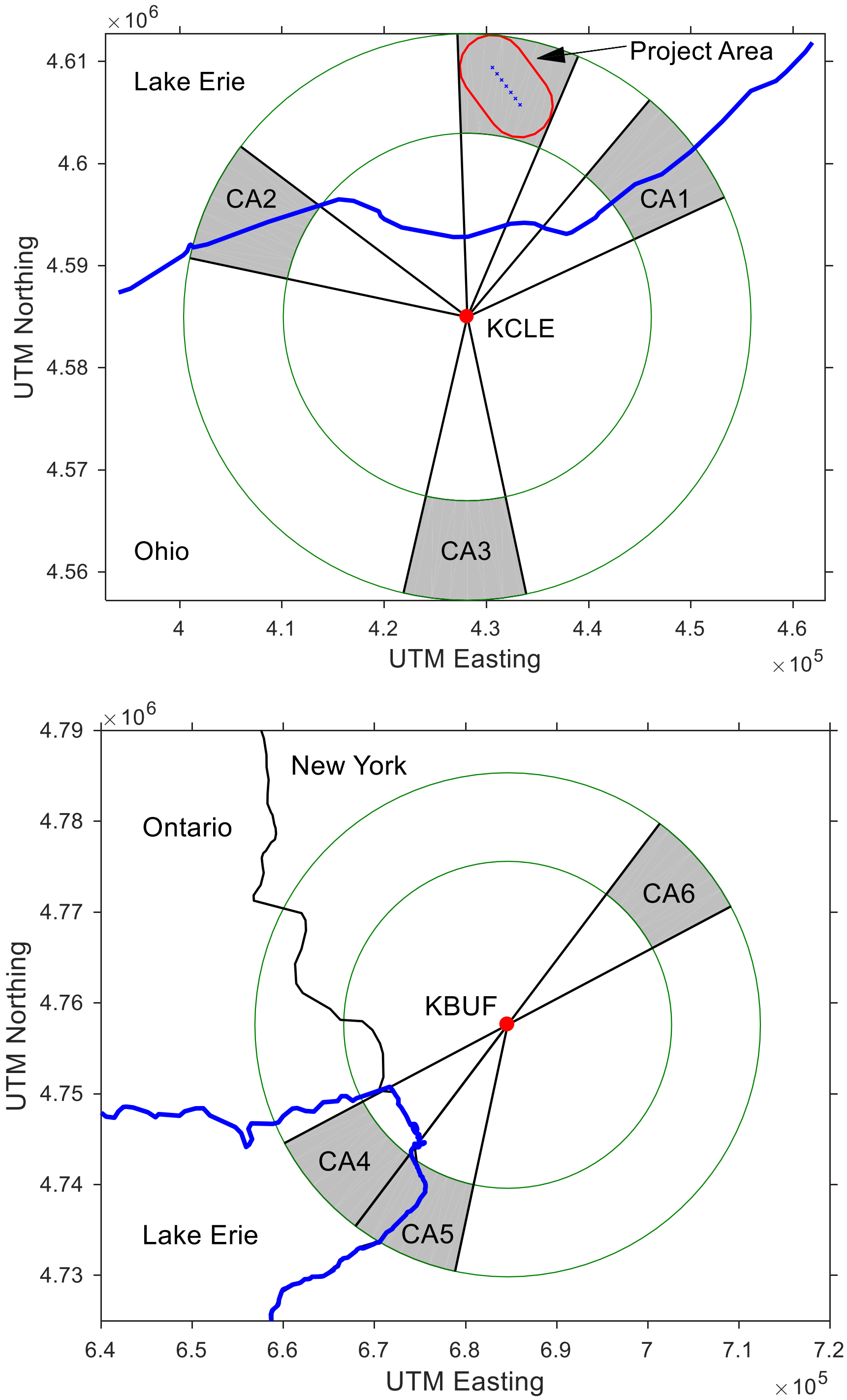

Figure 1.2. A map showing the coverage of the 2017 WEST NEXRAD analysis.

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.

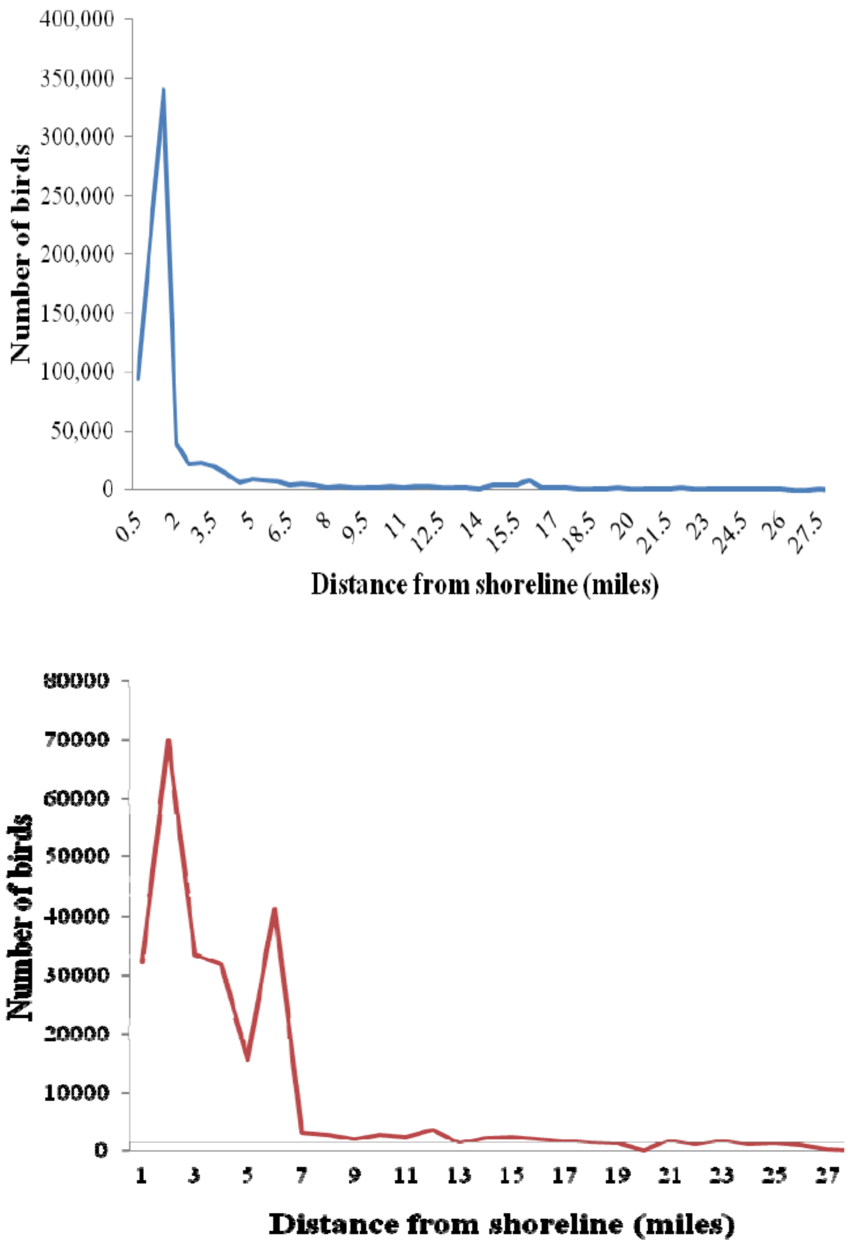

Figure 2.1. Number of birds as a function of distance from shoreline. The nearest proposed Icebreaker wind turbine is located 8 miles from the shoreline ODNR 2009-11.

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.

<u>Aerial Surveys, NEXRAD; Acoustic and Boat-Based Surveys</u>

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.

<u>Conclusion (Avoidance/Attraction Effects)</u>

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

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[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**. • **<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>** • 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, <u>overlapping the upper portion of the rotor swept zone of the</u> 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.

<u>**Conclusion:**</u>

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.

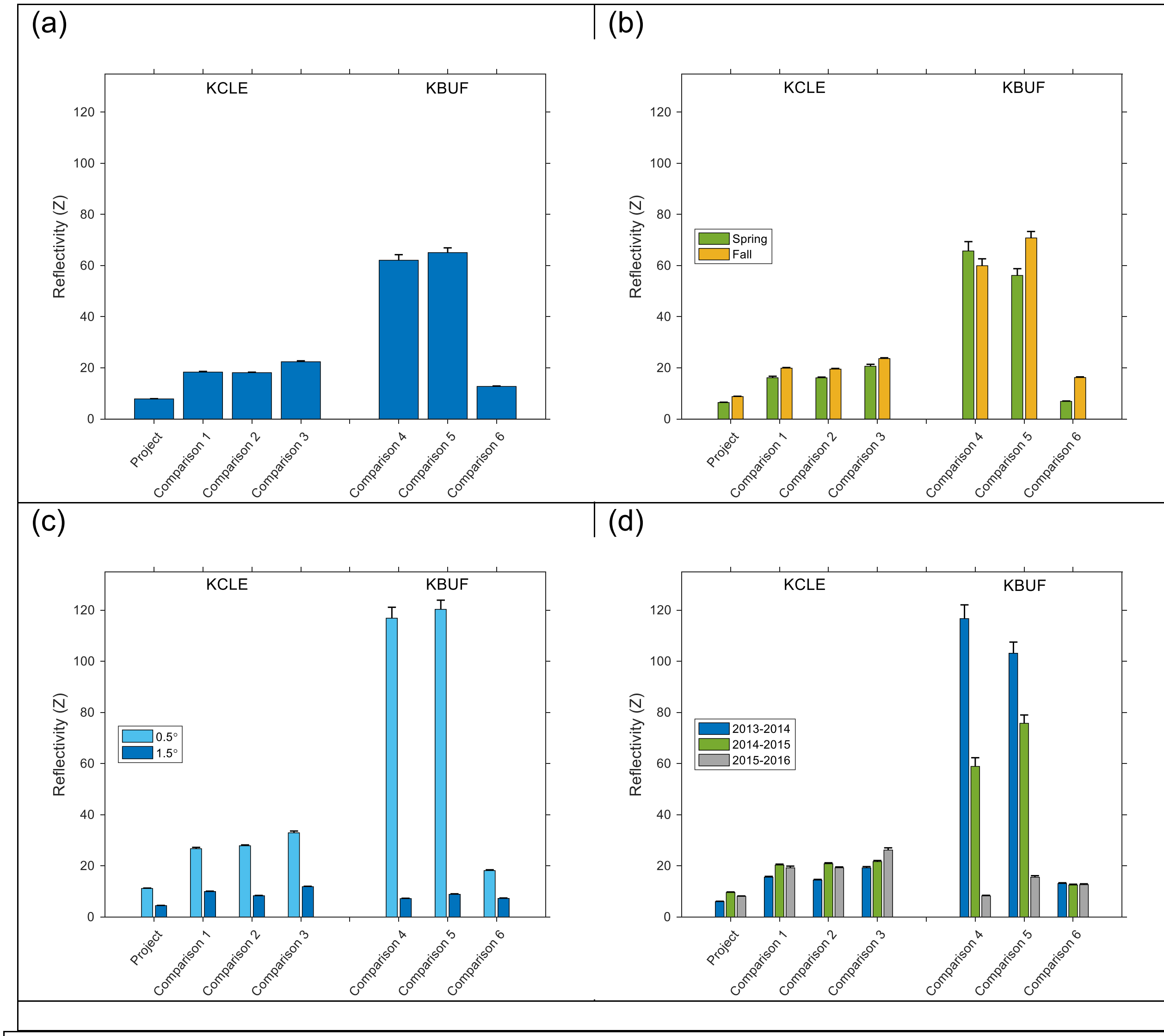


Figure 2.2. Mean reflectivity (bar heights) plus 1 standard error (error bars) at the seven sample areas:
(a) degrees overall – averaged across season, year, and elevation
(b) by season – averaged across year and elevation
(c) by elevation – averaged across season and year
(d) by year – averaged across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

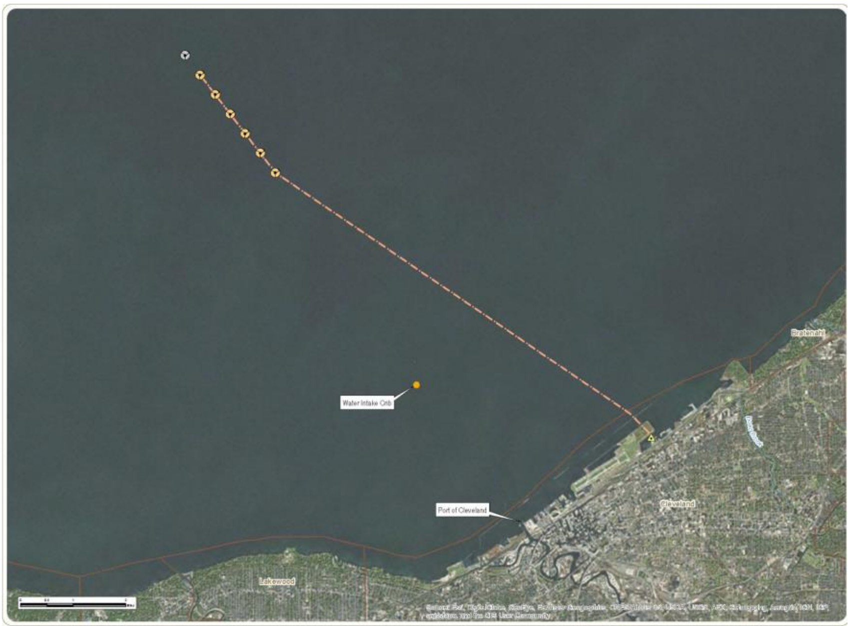
The BBCS is currently being prepared to ensure that the Project avoids, minimizes, and mitigates any adverse environmental impacts that could result from the Project. The BBCS draft contains complete, or near-complete, versions of most of the typical elements of a BBCS (a summary of the Project and bird 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.

ICEBREAKER WIND: SUMMARY OF RISKS TO BIRDS AND BATS



Prepared for

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November 29, 2016

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.

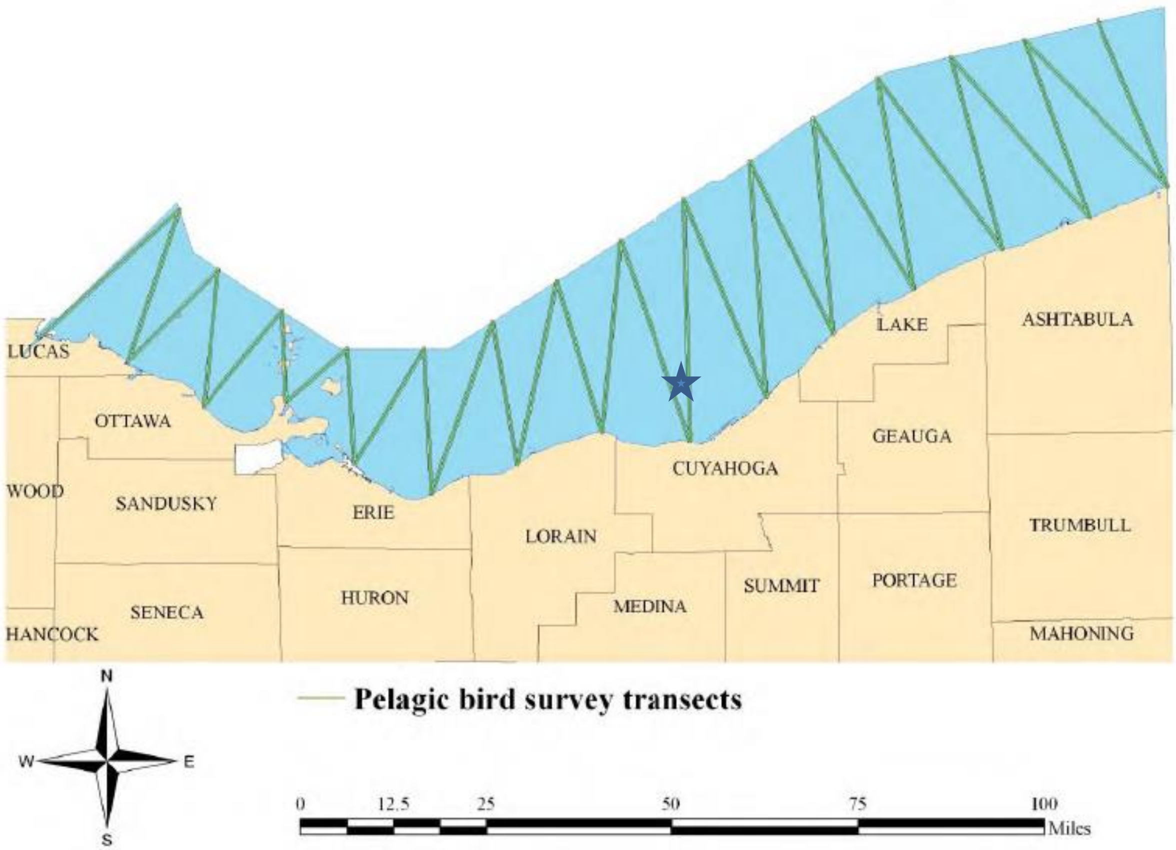

Figure 1. Aerial flight transect pattern flown during the Norris and Lott (2011) pelagic bird surveys in Lake Erie during 2009-2011. The approximate proposed location of Icebreaker Wind is shown by the blue star (Figure reproduced from Norris and Lott 2011).

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.

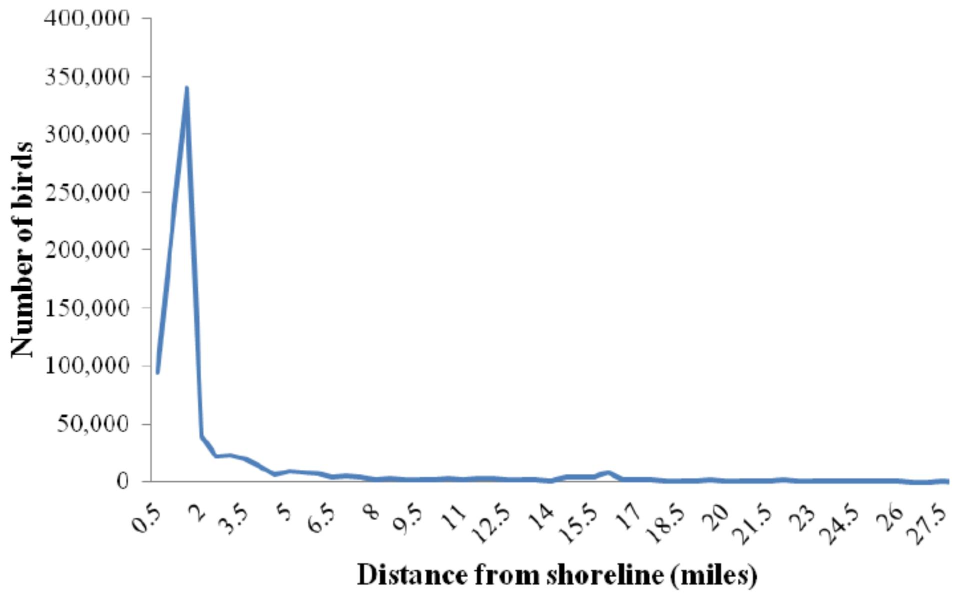

Figure 2. Total bird observations in relation to distance from shoreline along the southern shore of Lake Erie as recorded in Year one (fall 2009 – spring 2010) of the aerial pelagic bird survey effort conducted by the Ohio Department of Natural Resources. (Figure reproduced from Norris and Lott 2011).

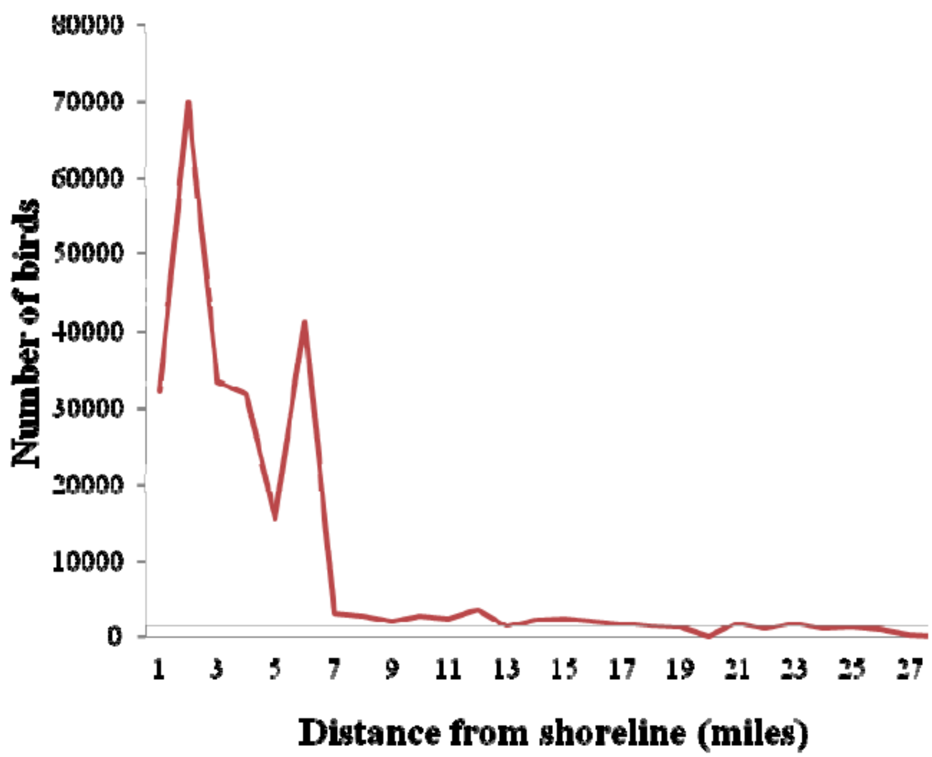

Figure 3. Total bird observations in relation to distance from shoreline along the southern shore of Lake Erie as recorded in Year two (fall 2010 – spring 2011) of the aerial pelagic bird survey effort conducted by the Ohio Department of Natural Resources (Figure reproduced from Norris and Lott 2011).

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.

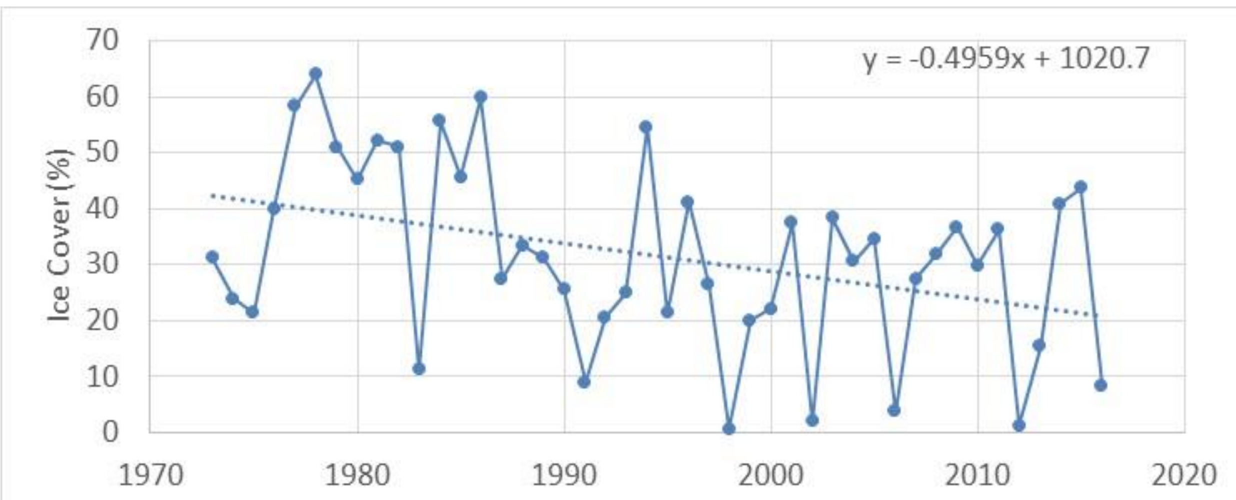

Figure 4. Mean annual winter ice cover on Lake Erie from 1973 to 2016, according to the US National Oceanographic and Atmospheric Administration (NOAA)/Great Lakes Environmental Research Laboratory (GLER; adapted from Wang et al. 2012, and J. Wang, NOAA Great Lakes ice climatologist, pers. comm., November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

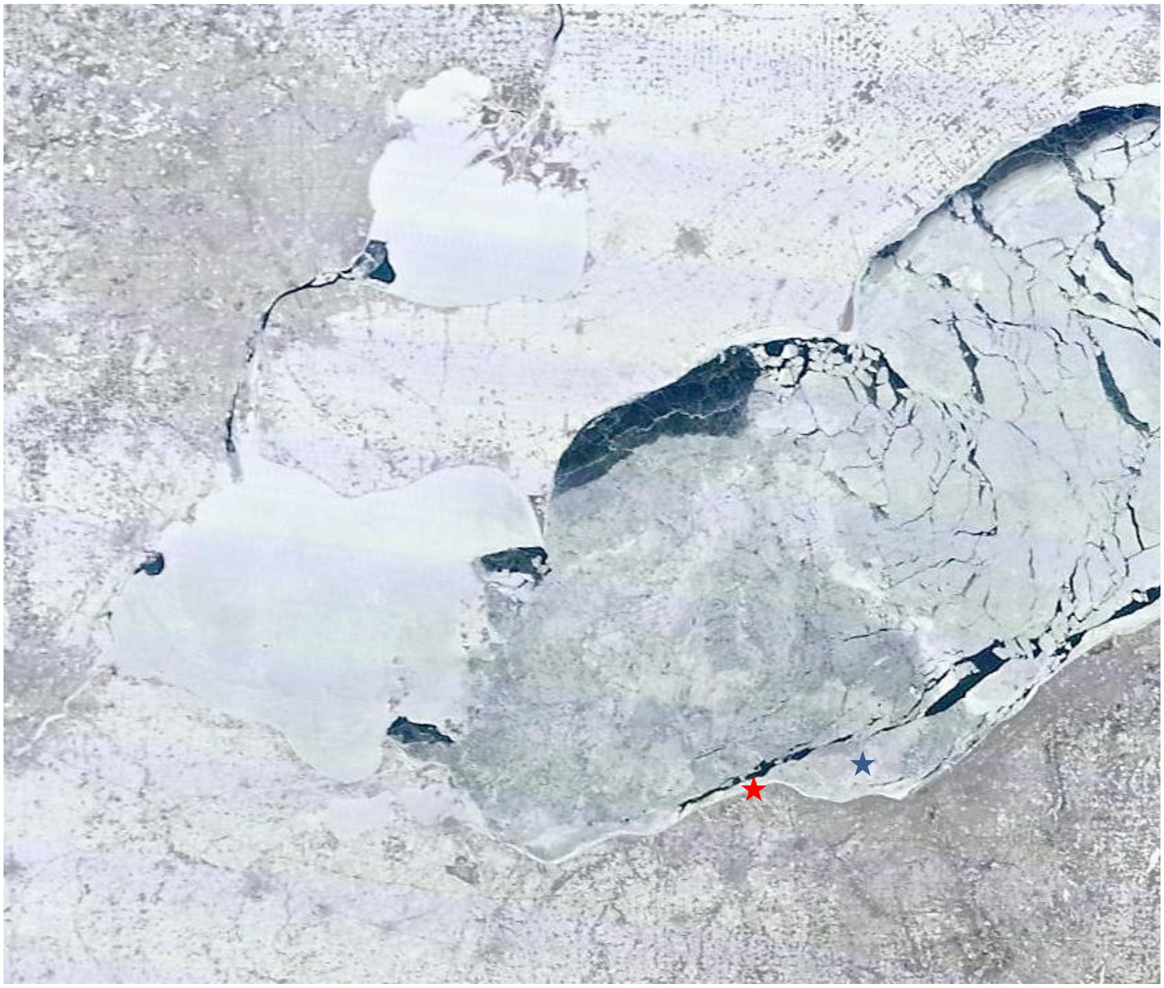

Figure 5. MODIS Terra true color image of western and central Lake Erie, on March 6, 2014, corresponding to the day with maximum ice coverage recorded in 2014 of 96.5% (Source: J. Wang - NOAA/GLERL). 2014 was an exceptionally severe winter, ranked as the coldest on record for the Great Lakes region since 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.

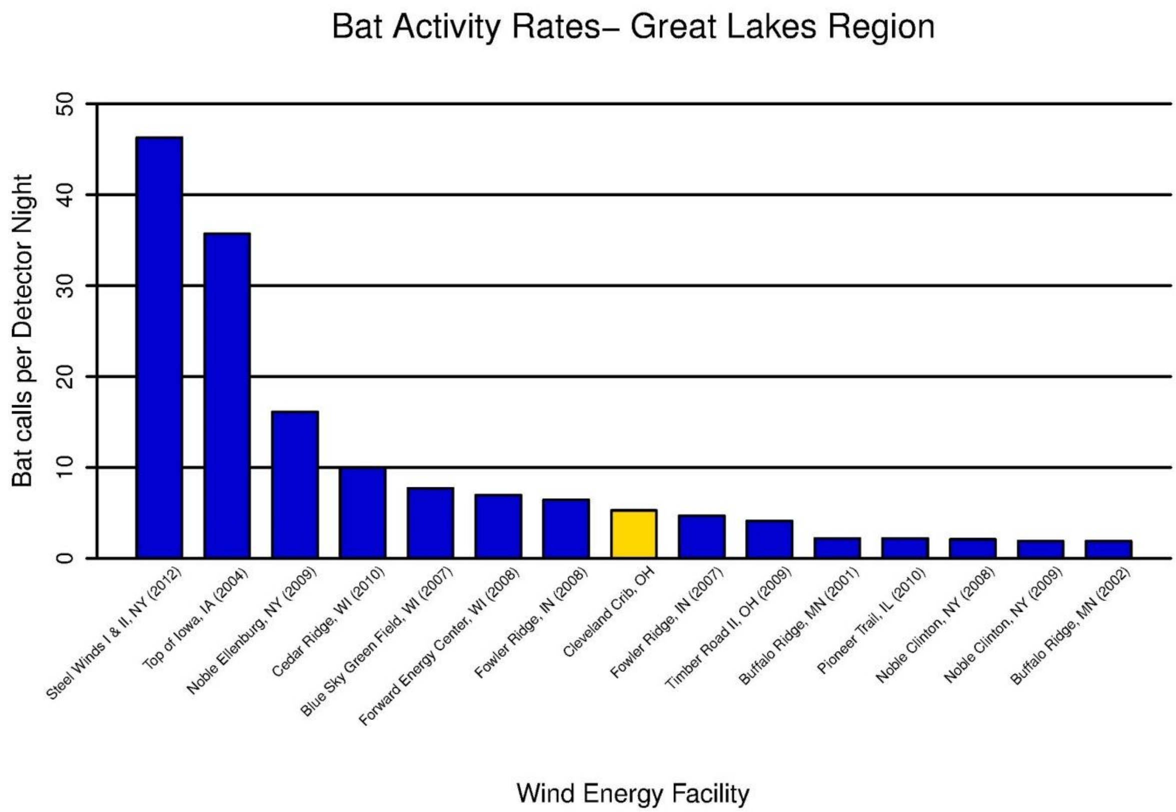

Figure 6. Bat acoustic data during the summer/fall season, expressed in terms of bat calls per detector-night, recorded three miles offshore of Cleveland in Lake Erie at the Cleveland water intake crib (yellow bar labeled "Cleveland Crib", data from Svedlow et al., 2012), in relation to comparable data 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.

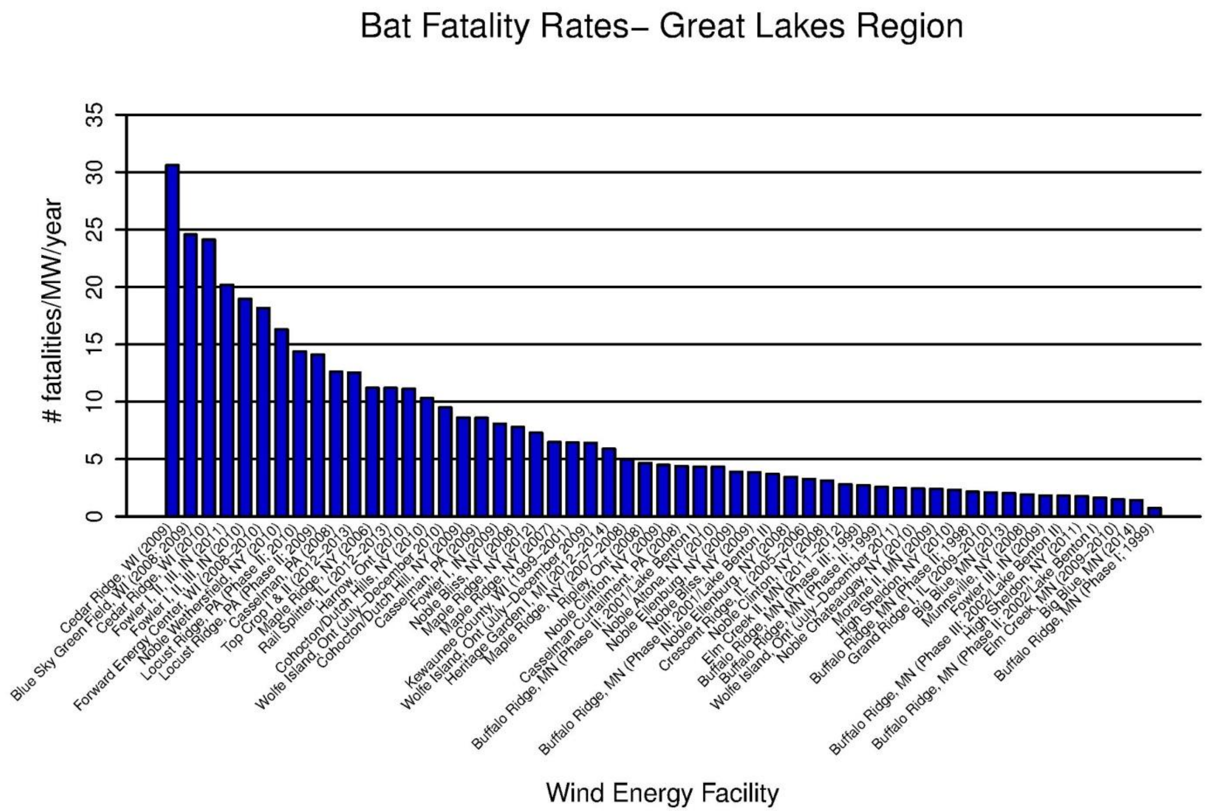

Figure 7. Bias-corrected bat fatality rates, expressed in terms of bat fatalities/megawatt of installed wind energy capacity/year, recorded in 55 studies from land-based wind energy projects in the Great Lakes region, representing all such projects for which comparable data are publicly available.

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).

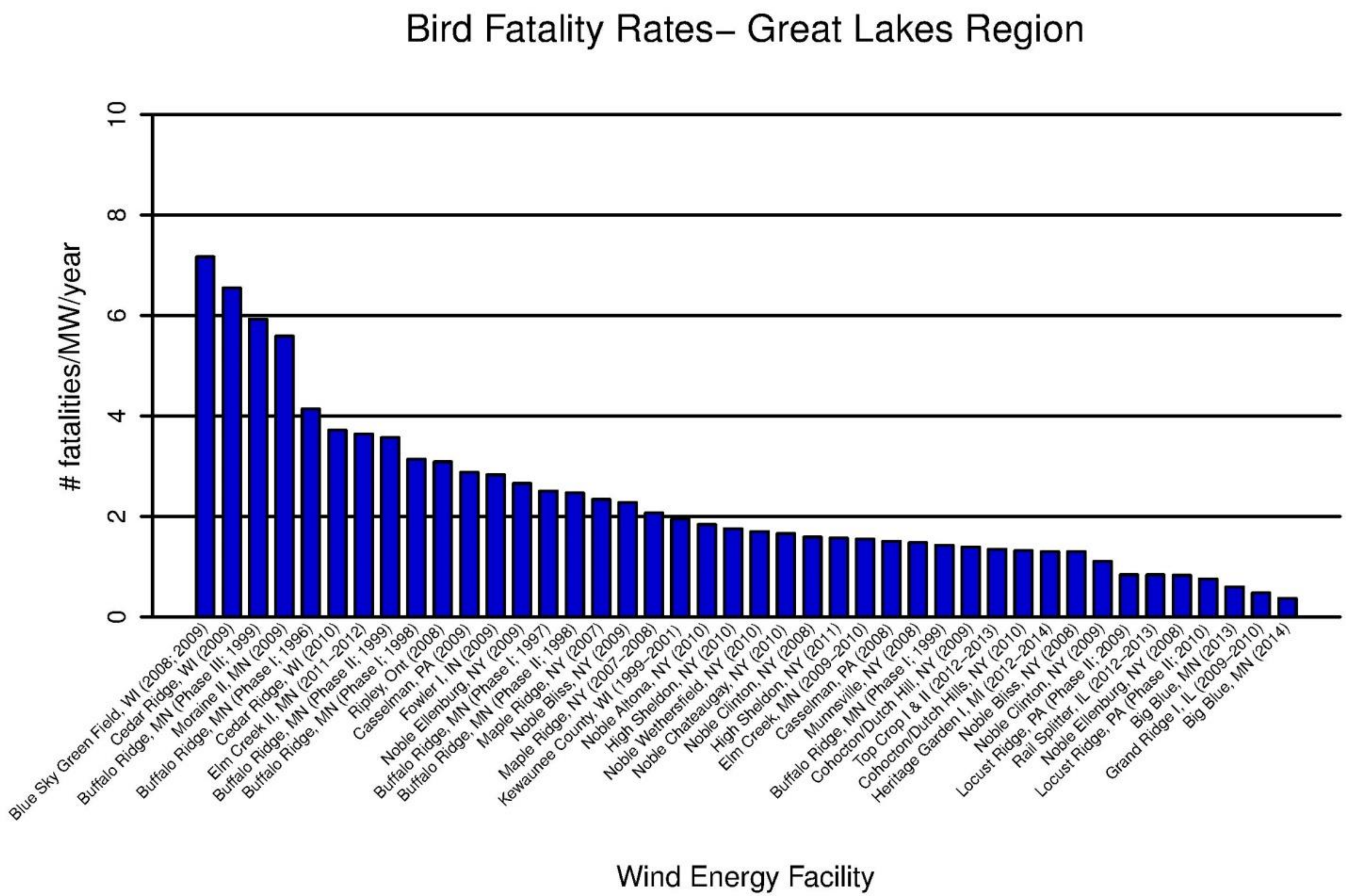

Figure 8. Bias-corrected bird fatality rates, expressed in terms of bird fatalities/megawatt of installed wind energy capacity/year, recorded in 42 studies from land-based wind energy projects in the Great Lakes region, representing all such projects for which comparable data are publicly available.

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

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Big Blue, MN (2014)	Fagen Engineering 2015
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Buffalo Ridge, MN (Phase II; 1997)	Johnson et al. 2000
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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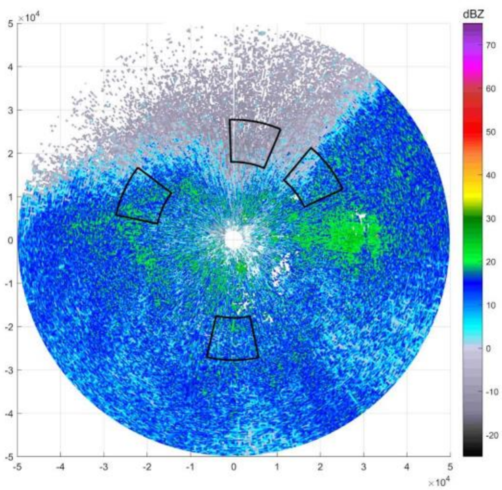

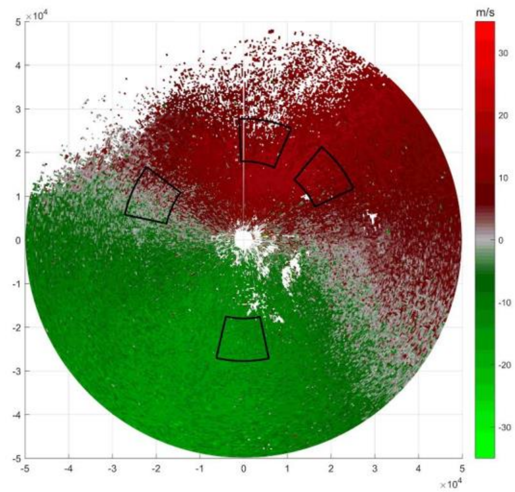

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INTRODUCTION

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

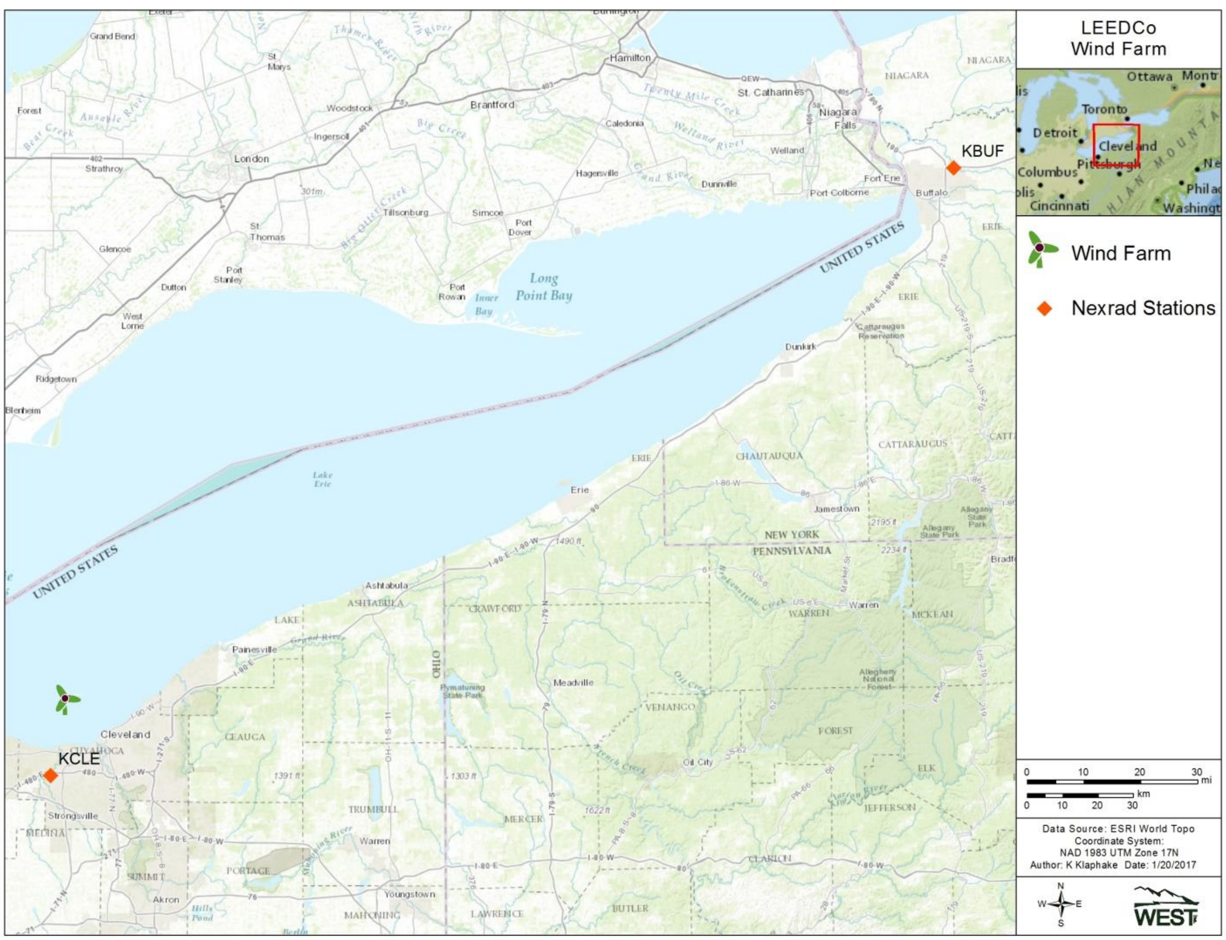

Figure 1. Location of the proposed Icebreaker Wind Energy Facility in Lake Erie, in relation to the KCLE NEXRAD station in Cleveland, OH and the KBUF station in Buffalo, NY.

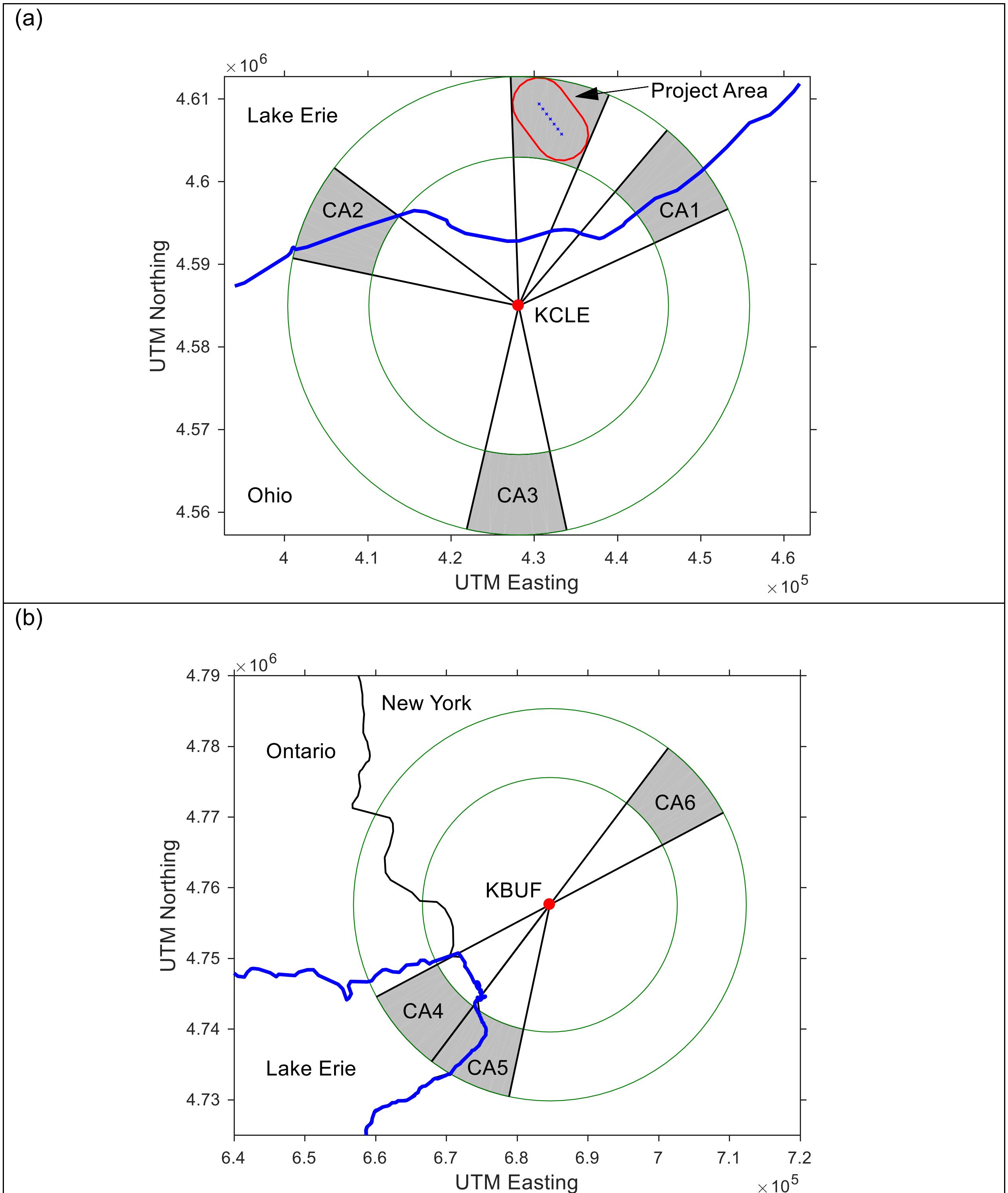

Figure 2. NEXRAD stations (red circles) and sample areas (gray shading), all at the same ranges (green circles) with same arc length (25 degrees) as the Project Area at (a) Cleveland (KCLE) and (b) Buffalo (KBUF). The Project Area in (a) shows the wind turbine locations (small blue circles) for the proposed 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).

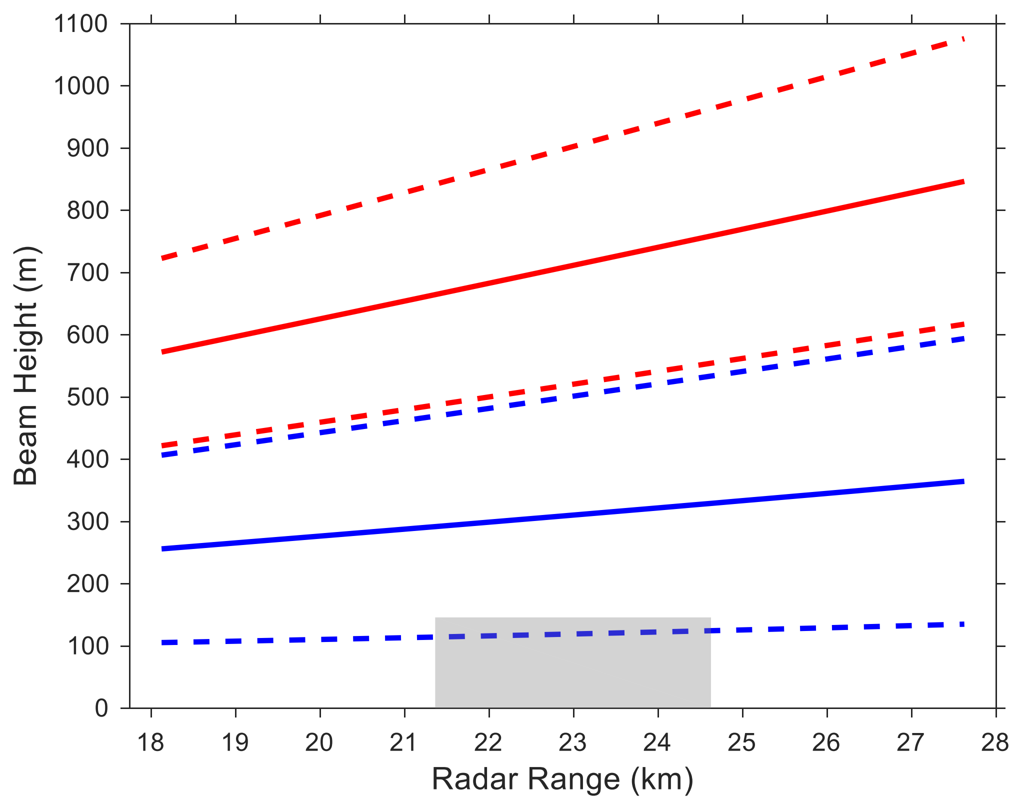

Figure 3. NEXRAD beam height relative to the lake surface, above the Project Area (X-axis limits) and, more specifically, above the wind turbines (gray shading). Solid lines indicate the beam centers, and dotted lines represent approximate beam boundaries of the 0.5^0 (blue) and 1.5^0 azimuth radar beams.

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).

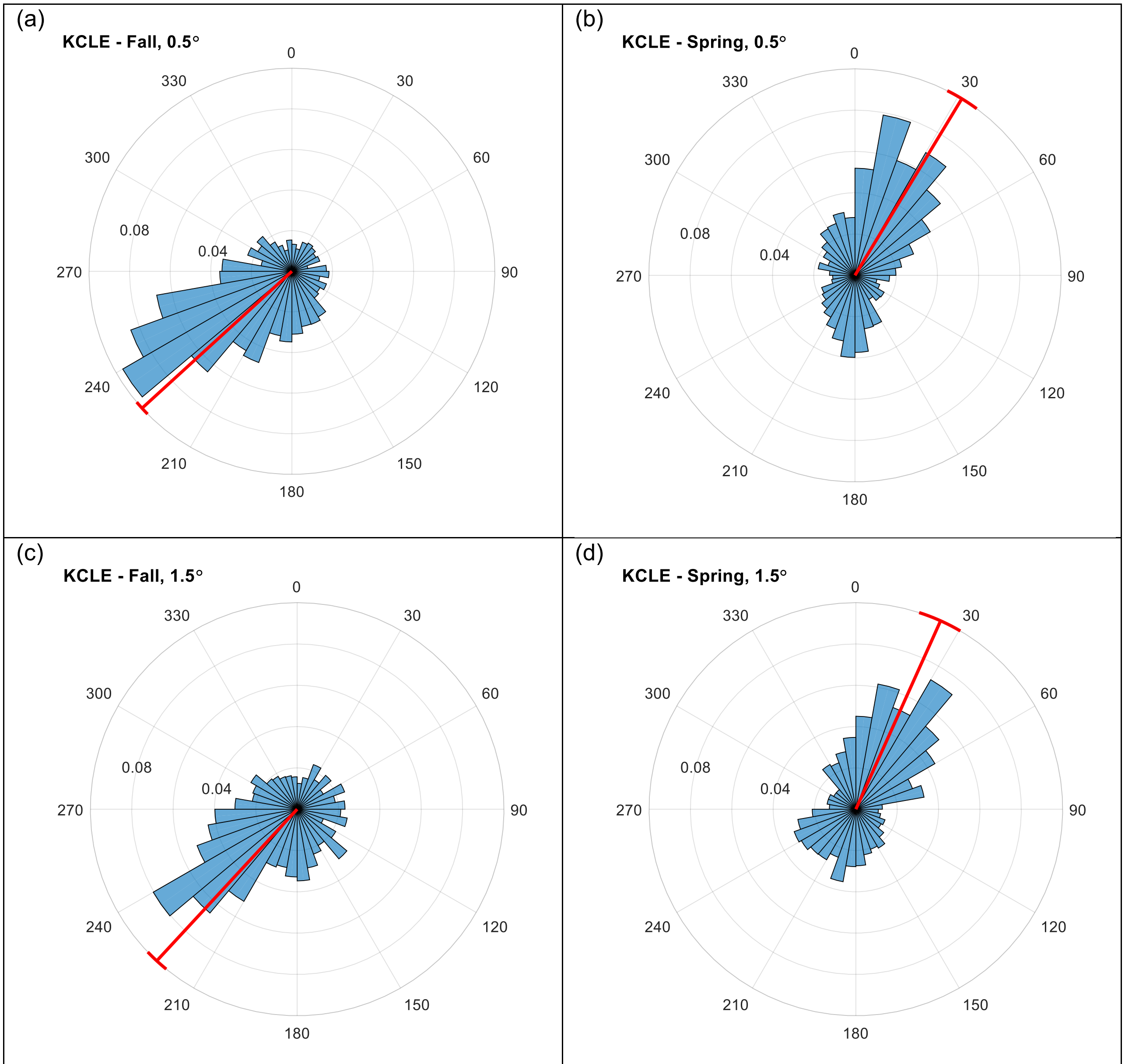

Figure 4. Rose plots showing target movement directions at KCLE at radar beam elevations of 0.5° (a and b) and 1.5° (c and d) in Fall (a and c) and Spring (b and d). Red lines indicate mean direction (radial segment) and 95% confidence interval (perpendicular "T" segment).

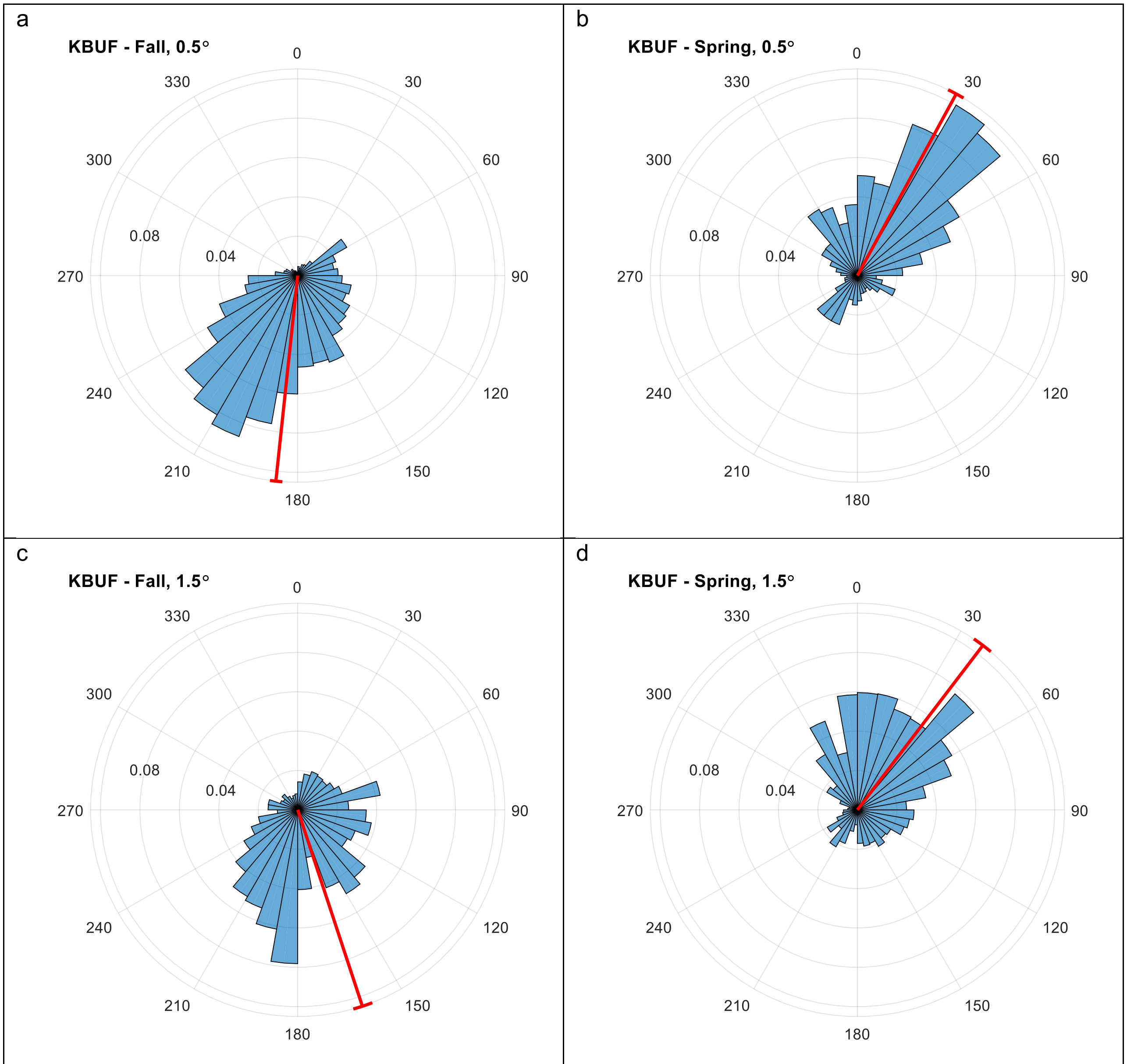

Figure 5. Rose plots showing target movement directions at KBUF at radar beam elevations of 0.5° (a and b) and 1.5° (c and d) in Fall (a and c) and Spring (b and d). Red lines indicate mean direction (radial segment) and 95% confidence interval (perpendicular "T" segment).

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.

Season	Year	Elevation	KCLE Mean (°)	KCLE *r*	KCLE *s* (°)	KBUF Mean (°)	KBUF *r*	KBUF *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

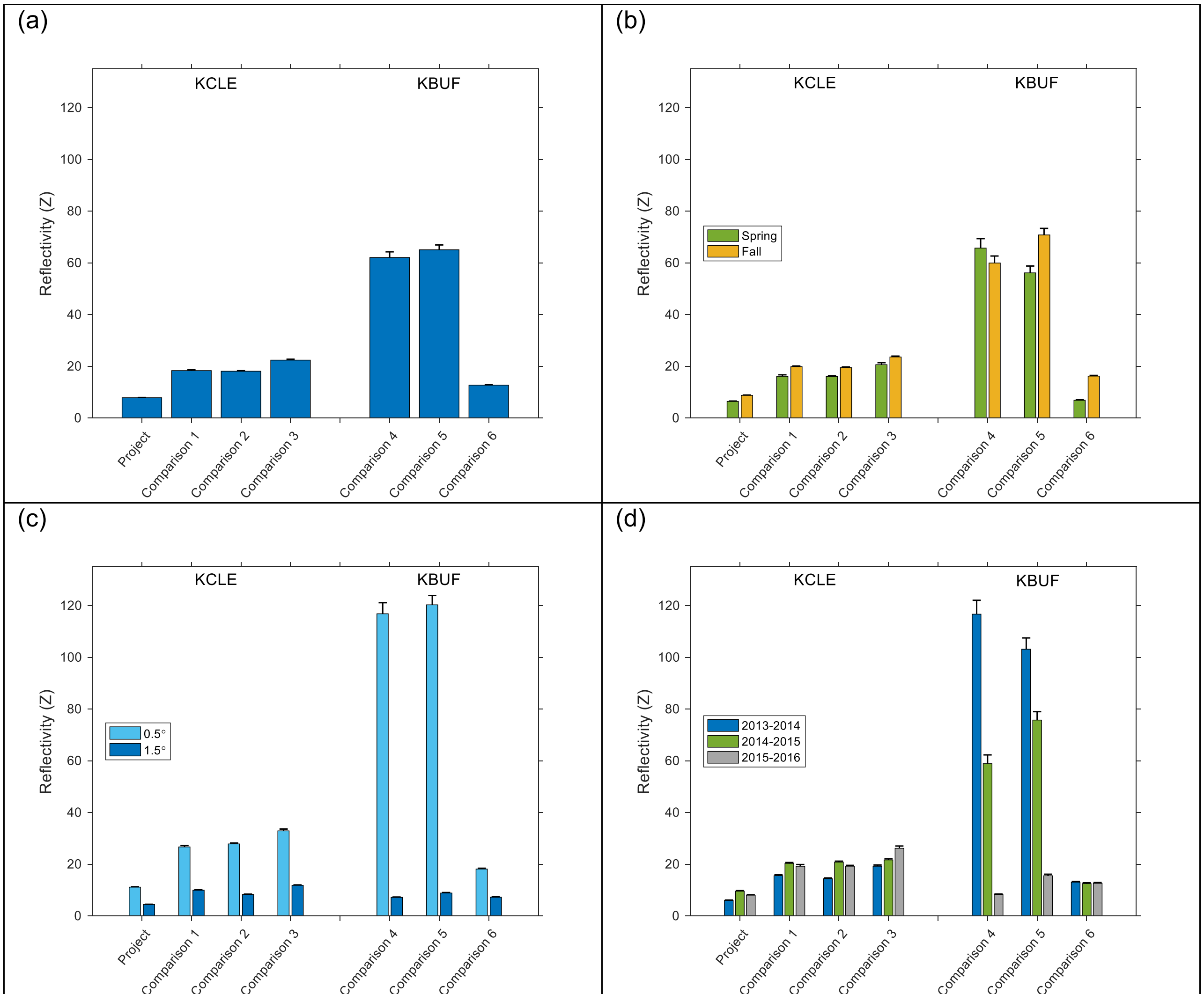

Figure 6. Mean reflectivity (bar heights) plus 1 standard error (error bars) at the seven sample areas:
(a) degrees overall – averaged across season, year, and elevation
(b) by season – averaged across year and elevation
(c) by elevation – averaged across season and year
(d) by year – averaged across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

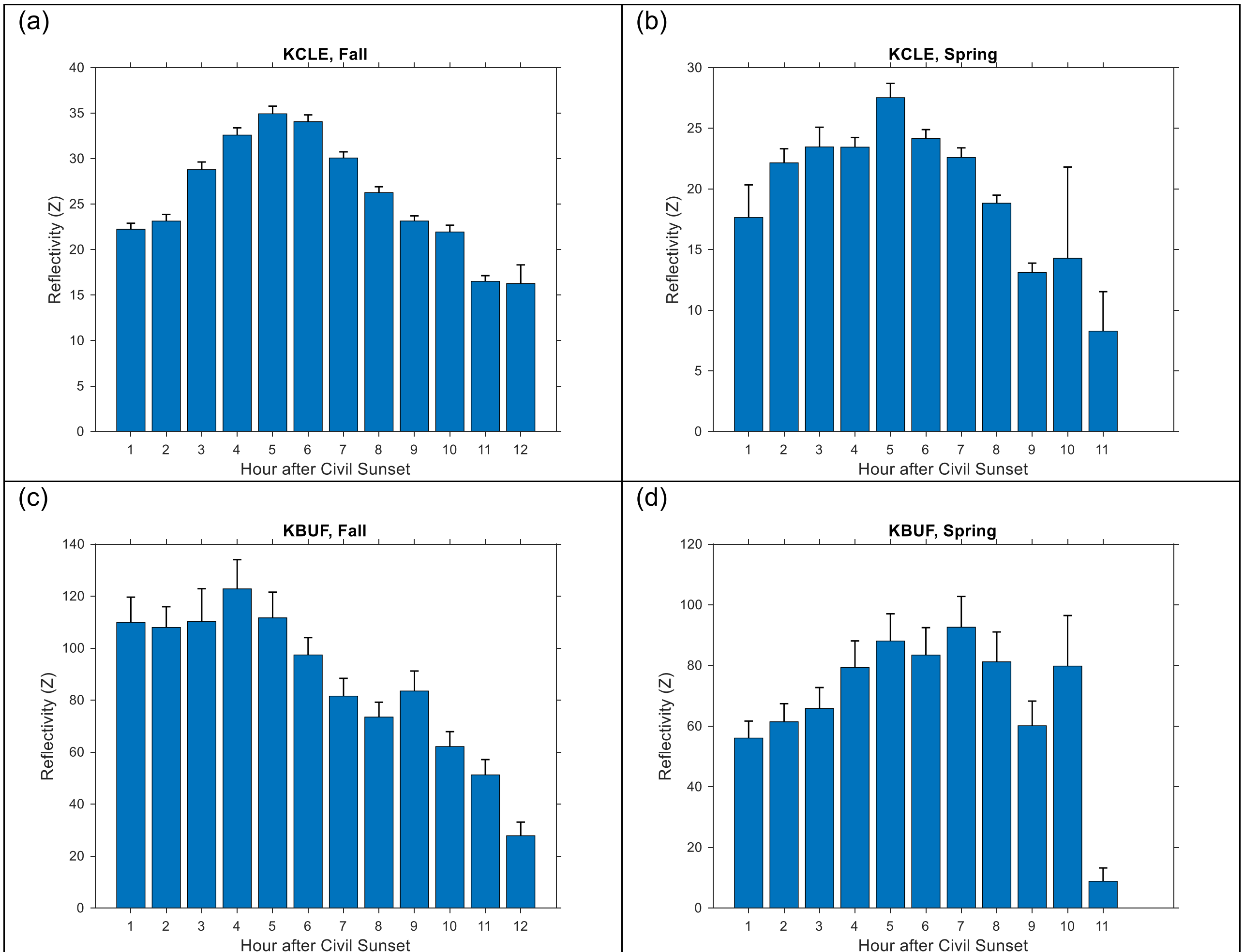

Figure 7. Mean reflectivity (bar heights) plus 1 standard error (error bars) by hour after civil sunset at KCLE and KBUF
(a) KCLE in fall
(b) KCLE in spring
(c) KBUF in fall
(d) KBUF in spring
All plots represent 0.5° elevation averaged across year and sample area. Note different Y-axis scaling in each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

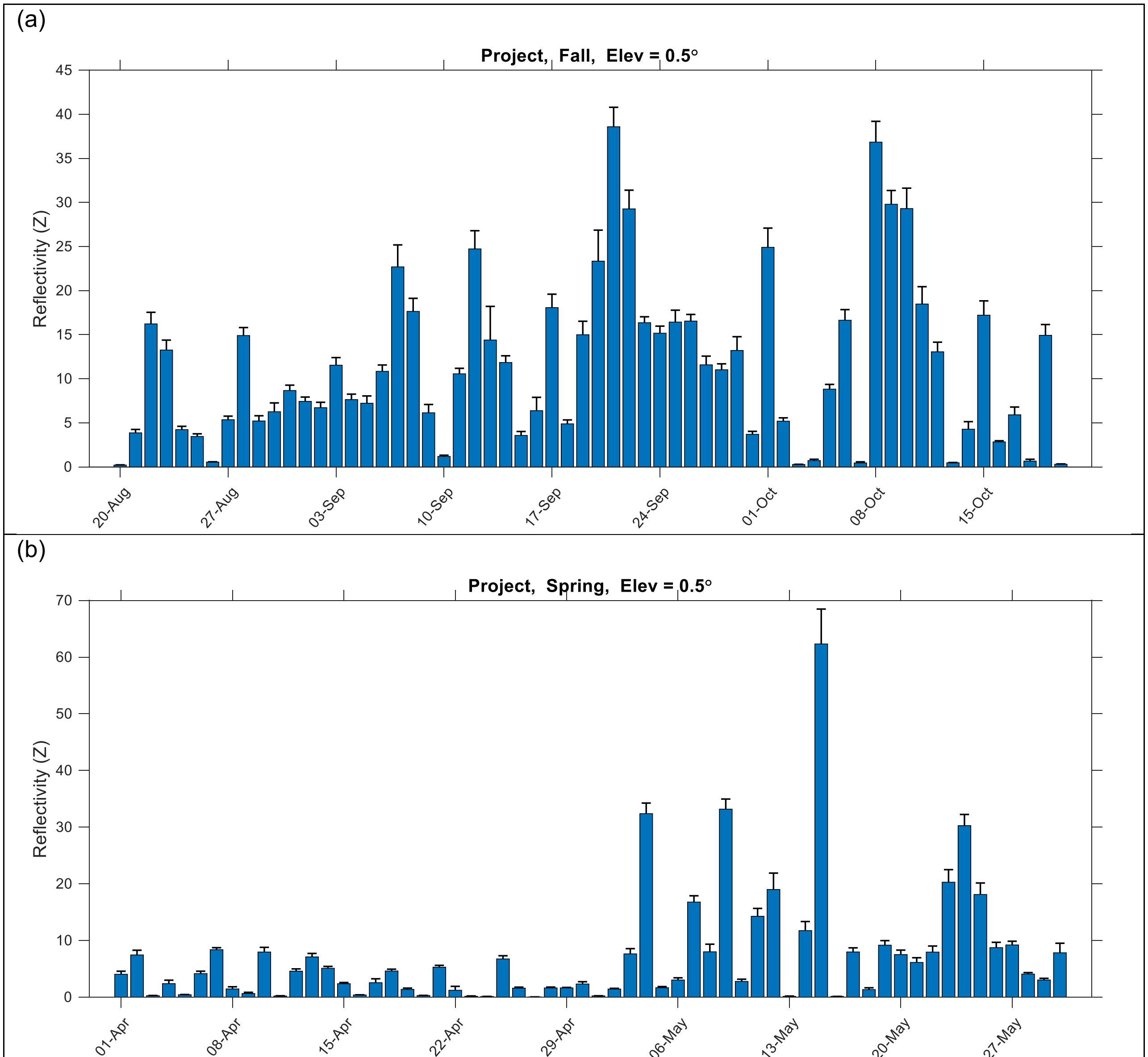

Figure 8. Mean reflectivity by day at the Project Area (KCLE) in (a) fall and (b) spring. Both plots represent 0.5° elevation averaged across year. Note different Y-axis scaling in each plot.

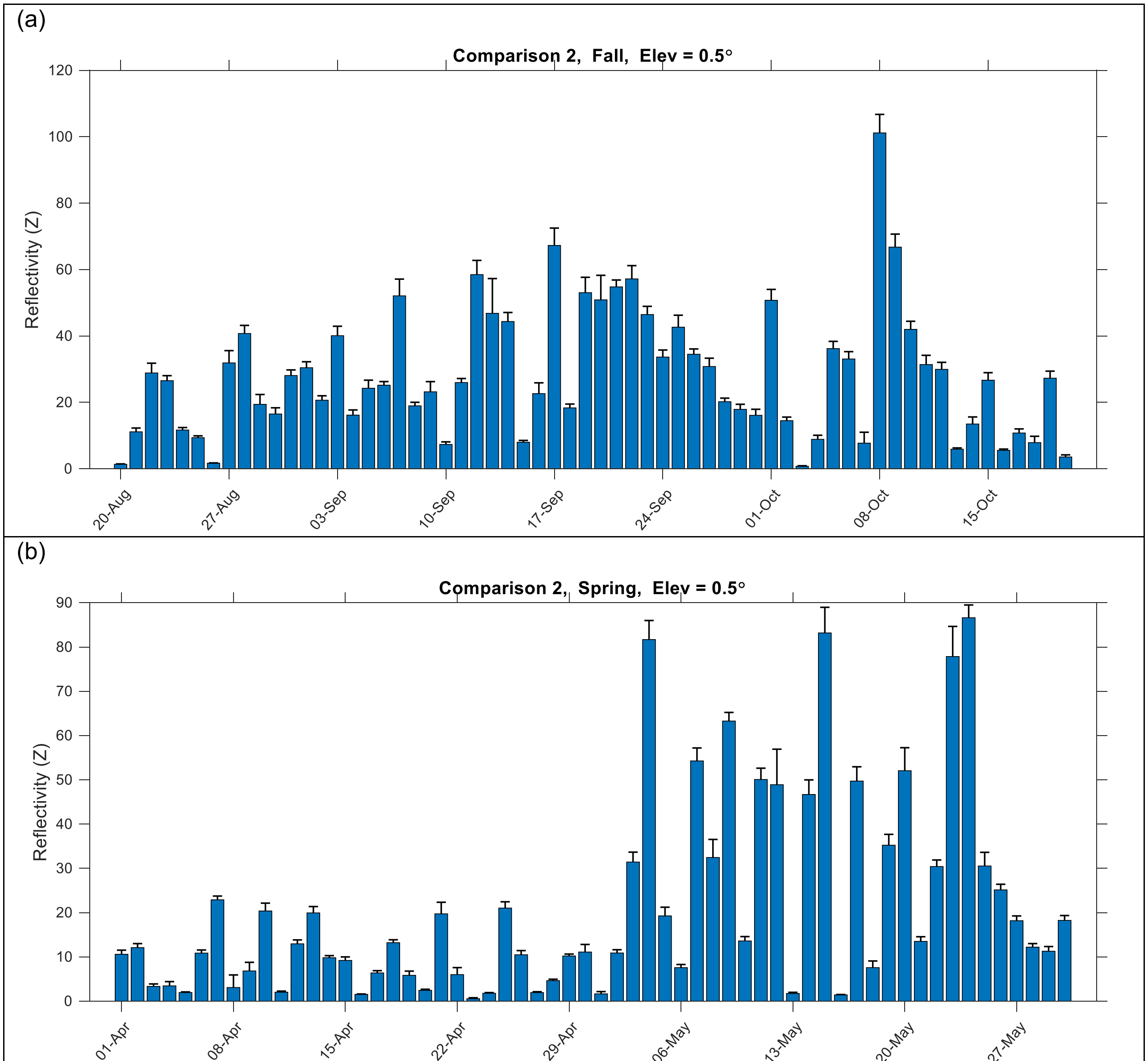

Figure 9. Mean reflectivity by day at Comparison Area 2 (KCLE) in (a) fall and (b) spring. Both plots represent 0.5° elevation averaged across year. Note different Y-axis scaling in each plot.

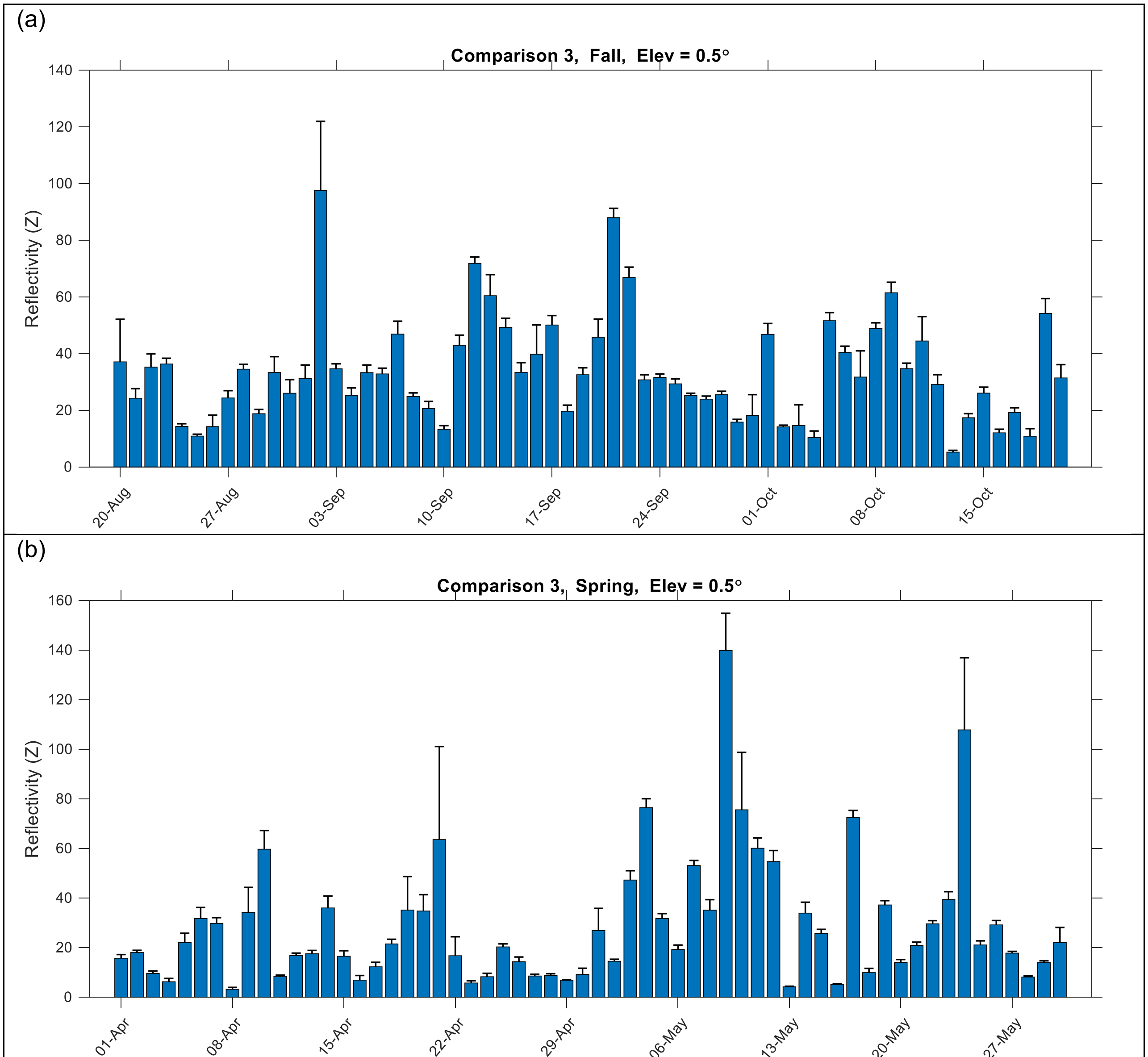

Figure 10. Mean reflectivity by day at Comparison Area 3 (KCLE) in (a) fall and (b) spring. Both plots represent 0.5° elevation averaged across year. Note different Y-axis scaling in each plot.

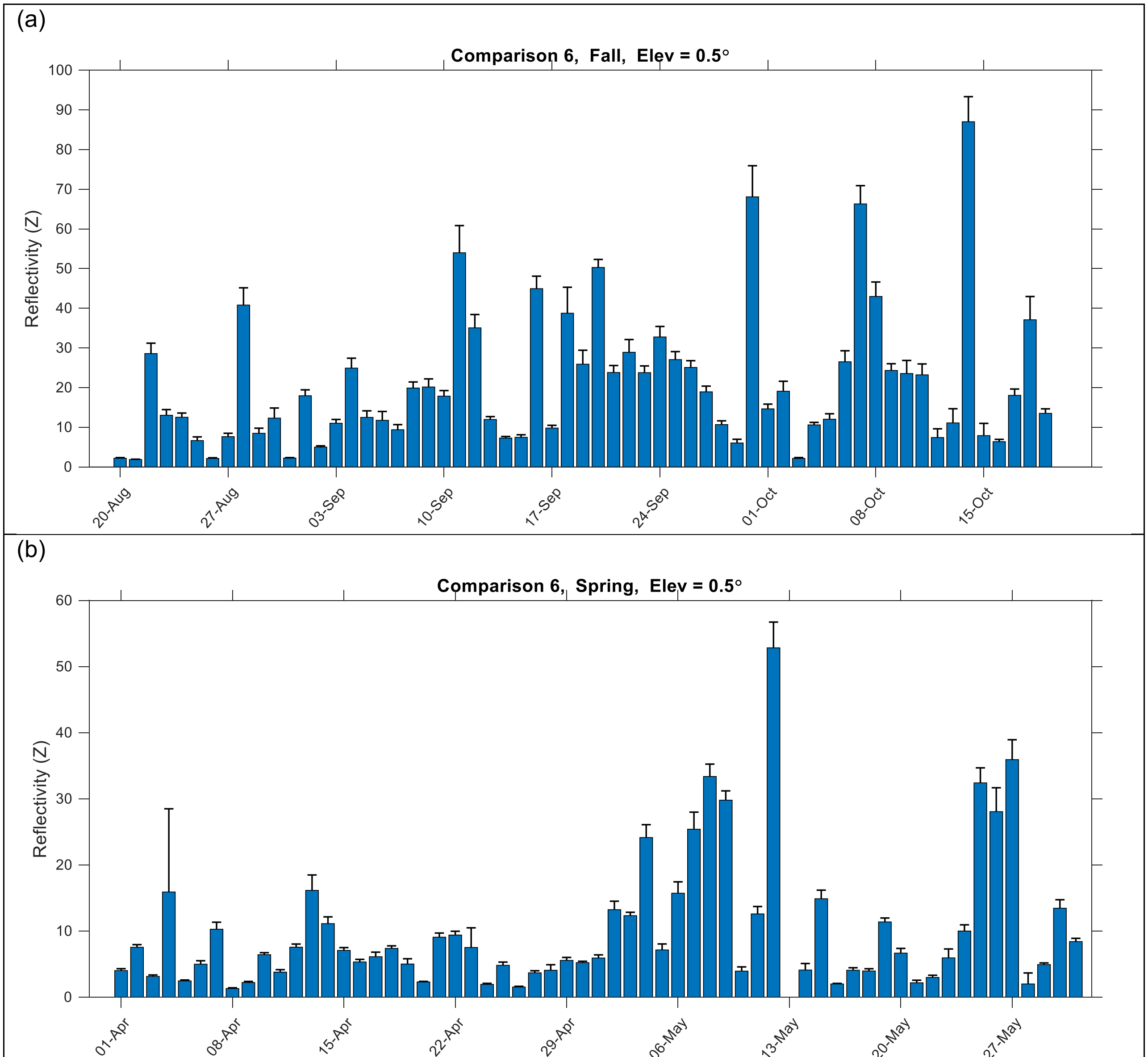

Figure 11. Mean reflectivity by day at Comparison Area 6 (KBUF) in (a) fall and (b) spring. Both plots represent 0.5° elevation averaged across year. Note different Y-axis scaling in each plot.

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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Appendix B. Icebreaker Wind MOU with Ohio DNR, including the Pre- and Post-Construction Monitoring Plan

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July 20, 2017

Ms. Barcy F. McNeal, Secretary
Ohio Power Siting Board
Docketing Division
180 East Broad Street, 11th Floor
Columbus, Ohio 43215

Re: Case No. 16-1871-EL-BGN, In the Matter of the Application of Icebreaker Windpower Inc. for a Certificate to Construct a Wind-Powered Electric Generation Facility in Cuyahoga County, Ohio.

Response to the Chairman's April 3, 2017 Letter and Second Supplement to the Application filed on February 1, 2017.

Dear Ms. McNeal:

On February 1, 2017, as supplemented on March 13, 2017, Icebreaker Windpower, Inc. ("Applicant") filed an application with the Ohio Power Siting Board ("OPSB") for a certificate of public convenience and necessity ("Application") to construct a 6-turbine demonstration wind-powered electric generation facility in Lake Erie, off the shore of Cleveland, in Cuyahoga County, Ohio ("Project"). The Application was prepared in accordance with the requirements set forth in Ohio Administrative Code ("O.A.C.") Chapter 4906-4.

In accordance with O.A.C. Rule 4906-3-06(A), by letter dated April 3, 2017, the Chairman of the OPSB notified the Applicant that additional information was needed in order for the Application to be considered in compliance with O.A.C. Chapters 4906-01, et seq. ("compliance letter"). Specifically, the compliance letter noted that the Application referred to two separate memorandums of understanding ("MOUs") that were being developed in coordination with relevant agencies. Citing pages 33 and 107 of the February 1, 2017 Application, respectively, the letter referred to:

1. A MOU on pre- during-, and post-construction monitoring studies and analyses for Project impact on fisheries and other aquatic resources; and

2. A MOU on pre-, during-, and post-construction monitoring studies and analyses for Project impact on birds and bats.

The compliance letter further provided that:

> [a]t such time as the Applicant files in this proceeding copies of these two MOUs, signed by at least the Applicant and the Ohio Department of Natural Resources [ODNR], Staff will revisit its compliance determination. If the application is found to be in compliance, at that time, a subsequent letter will be sent out outlining instructions on serving the completed application, filing proof of service, and will list the necessary application fee.

At this time, in accordance to the directives in the compliance letter, the Applicant is hereby filing this response to the Chairman's letter and second supplement to the Application. This second supplement includes:

1. Fisheries and Aquatic Resources ("Aquatic") MOU: This MOU is signed by both the Applicant and ODNR and addresses pre- during-, and post-construction monitoring studies and analyses for the Project's impact on fisheries and other aquatic resources. The following exhibits are attached to the Aquatic MOU:

    a. Exhibit A is referred to in the Aquatic MOU as the Lake Erie Monitoring Plan dated January 25, 2017, which was prepared by LimnoTech for the Applicant. Exhibit A is an updated version of Exhibit O that was dated January 23, 2015, and filed with the Application on February 1, 2017. Therefore, Exhibit A attached to the Aquatic MOU supersedes and replaces Exhibit O that was filed with the Application on February 1, 2017.

    b. Exhibit B summarizes the reporting requirements agreed to in the Aquatic MOU.

2. Avian and Bat MOU: This MOU is signed by both the Applicant and ODNR and addresses pre-, during-, and post-construction monitoring studies and analyses for the Project's impact on birds and bats. The following exhibits are attached to the Avian and Bat MOU:

    a. Exhibit A is referred to in the Avian and Bat MOU as the Icebreaker Wind Avian and Bat Monitoring Plan dated July 17, 2017, which was prepared by Western EcoSystems Technology, Inc. ("WEST") for the Applicant.

b. Exhibit B summarizes the reporting requirements agreed to in the Avian and Bat MOU.

With the filing of these two fully-executed MOUs signed by both the Applicant and ODNR in accordance with the directives in the Chairman's April 3, 2017 letter, the Applicant submits that it has fully complied and provided the additional information requested by the OPSB. Therefore, the Applicant respectfully requests that the OPSB do all of the following as expeditiously as possible:

1. Find that the Application is now in compliance with O.A.C. Chapters 4906-01, et seq.

2. Issue a letter of compliance with the additional instructions noted in the April 3, 2017 letter.

3. Establish the procedural schedule for this matter.

The original of this response and second supplement to the Application has been filed electronically. In addition, 5 complete paper copies and 10 USB drives containing the supplemental information to the Application have been provided.

We are available, at your convenience, to answer any questions you may have.

Respectfully submitted,

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Enclosures

Icebreaker Windpower Inc.
Response and Application Second Supplement

Avian and Bat MOU

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Attorneys for Icebreaker Windpower Inc.

Date Filed: July 20, 2017

MEMORANDUM OF UNDERSTANDING

Between the Ohio Department of Natural Resources and Icebreaker Windpower Inc. in the matter of the Application of Fred Olsen Renewables USA LLC/Icebreaker Windpower Inc. for a Certificate to Construct a Wind-Powered Electric Generation Facility

Case No. 16-1871-EL-BGN
Monitoring Protocols for Avian and Bat Resources
July 12, 2017

Since August 2016, Icebreaker Windpower, Inc. ("Applicant") and the Ohio Department of Natural Resources ("ODNR") (jointly referred to as the "Parties") have been working collaboratively to ensure compliance with the requirements in Ohio Revised Code ("R.C.") Chapter 4906 and Ohio Administrative Code ("O.A.C.") Chapter 4906-4 and develop pre-, during-, and post-construction monitoring protocols for avian and bat resources located in the vicinity of the Icebreaker Wind six turbine offshore wind demonstration Project located 8 to 10 miles off the shore of Cleveland, Ohio (the "Project"). On February 1, 2017, as supplemented on March 13, 2017, the Applicant filed its application ("Application") with the Ohio Power Siting Board ("OPSB") for a certificate to construct the Project in Case No. 16-1871-EL-BGN.

The Parties are entering into this Memorandum of Understanding ("MOU") to set forth the agreements that have been reached on the monitoring protocols for avian and bat resources. The purpose of these monitoring protocols will be to help assess, in a scientifically rigorous manner, any impacts that Project construction and operation may have on avian and bat species and resources in the Project vicinity or likely to encounter the Project area. The goal of assessing these impacts is: 1) to document existing conditions and patterns of use by the species of concern at the Project site; 2) to document changing conditions and patterns of use by species of concern and their associated habitats as a result of Project construction and operations at the Project site; 3) to develop and implement effective mitigation and adaptive management strategies to minimize avian and bat resource impacts; 4) to evaluate the feasibility of various monitoring protocols in an offshore setting; and 5) to better understand how future offshore wind projects in Lake Erie or the Great Lakes may affect birds and bats.

The Parties recognize that the location and size of any future offshore wind projects will be significant factors in future risk assessments. There are issues related to the statistical detectability of certain types of impacts due to natural variability, the limited footprint, and size of this demonstration Project. A determination of impact, or lack thereof, whether positive or negative in this small Project, should not be construed to represent an impact condition for larger projects with different turbine configurations and offshore locations. Recognizing these limitations, these monitoring studies and protocols have been designed to provide information that will help to guide future monitoring efforts and provide a sound scientific basis for future decision-making.

By and through this MOU, the Parties hereby agree to the following:

A. The Icebreaker Wind Avian and Bat Monitoring Plan ("MP"), attached as Exhibit A, which was prepared by Western EcoSystems Technology Inc. ("WEST") for the Applicant, and modified pursuant to discussions with the ODNR, will serve as the basis for the avian and bat resources pre-, during-, and post-construction monitoring effort by the Applicant, any of its consultants or sub-consultants acting on its behalf, and any successor(s) to the Applicant, consultants, or sub-consultants. The sampling protocols set forth in the MP are based on the best available scientific methodologies to meet the study objectives defined in the requirements of the ODNR On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio, project specific recommendations provided to the OPSB by the ODNR and United States Fish and Wildlife Service ("USFWS") in comments dated February 28, 2017, and additional consultation between the Applicant and wildlife agencies.

B. The MP is a living document and will serve as a template for all future avian and bat monitoring work related to the Project. The length and type of sampling conducted will be reviewed annually by ODNR as outlined in the MP to determine whether the sampling intensity, frequency, and duration are necessary and appropriate to meet the study objectives. Any such adjustments to the existing protocol will be based on actual sampling results from prior years.

C. Prior to the date of construction as identified by the Applicant pursuant to OAC Section 4906-3-13(B), post-construction protocols in the Plan will be finalized and approved through written communication with the ODNR. In order to effectuate any adjustments, the Parties will review sampling results annually (at the end of the field season) and will meet annually to discuss and reach mutual agreement on any adjustments to the sampling program necessary to meet monitoring and assessment goals. The annual meeting will be held at least one month prior to the next field season. The Parties agree to meet prior to January 31 of each year. This will provide adequate lead time to make adjustments to the sampling program prior to the start of the field season.

D. Annual monitoring reports, including preliminary analyses and summaries of all data collected to date, must be submitted to ODNR at least two weeks prior to the scheduled date of the annual meeting provided for at Paragraph (C) above. Annual pre-construction monitoring reports will provide a summary of pre-construction baseline data collected from the prior sampling season. Annual post-construction monitoring reports will provide a summary of data collected for the prior sampling season and a comparative analysis to identify potential changes and/or impacts due to the construction and/or operation of the offshore wind facility to be developed by the Applicant. Annual monitoring reports will be shared with the USFWS and the OPSB for external review and analysis. These reports will be provided to those officials specified at those agencies to receive notices under Paragraph (L)(10) of this MOU.

E. The applicant shall submit quarterly and interim Project reports to ODNR summarizing monitoring activities performed according to the timeline provided in Exhibit B attached. Quarterly and interim reports will include an outline of all sampling attempted, completed, and a summary of data collected as described in the MP document. Quarterly and interim reports shall be submitted pursuant to the Notice provision set forth at Paragraph (L)(10) of this MOU. Quarterly reports will also be shared with USFWS and the OPSB for review and analysis.

F. Post-construction annual monitoring reports will be required for all post-construction sampling years as identified in Exhibit A attached, with interim, quarterly, and annual reports following the schedule established in Exhibit B, attached. A final Project report shall be submitted to ODNR one year after all sampling and monitoring work has been completed. The final report will include complete analysis of all data, discussion, conclusions, and any recommendations for mitigation if needed, and it will be transmitted pursuant to the Notice provision located at Paragraph (L)(10) of this MOU. A summary of reporting requirements is presented in Exhibit B attached.

G. All raw data collected will be submitted by the Applicant to ODNR within three months of the conclusion of each monitoring component set forth in the MP with each annual report. These data will be distributed to the USFWS for external review and analyses. Such data will become a public record and will be made available upon proper request unless the Applicant specifically identifies any data or information under this section which it believes to be proprietary in nature at the time of submission to the ODNR. If data or information is identified as proprietary in nature, then the ODNR will immediately notify the Applicant, through the contact person specified to receive notices under Paragraph (L)(10) of this MOU, of the fact of a records request under R.C. Section 149.43, et. seq., so that the Applicant will, within fourteen (14) business days, be able to consider and act as it may consider necessary and appropriate to protect its proprietary interest, including without limitation filing an action for injunctive relief to prevent the disclosure of its intellectual property.

H. ODNR, working cooperatively with the USFWS and with designated technical experts, will review all quarterly, annual, interim, and final reports to ensure they meet the assessment goals as outlined in paragraph two of page one of this document. If a finding of significant impact is determined, ODNR shall immediately notify the Applicant and follow-up with appropriate agencies and the Applicant to address and/or remediate the impact.

I. This MOU may be made a condition of Submerged Lands Lease SUB-2356-CU between the State of Ohio and the Applicant.

J. This MOU may be made a condition of any Certificate of Environmental Compatibility and Public Need issued to the Applicant in Case No. 16-1871-EL-BGN by the OPSB.

K. This MOU shall terminate on the date that is five years beyond the date on which commercial operations began for the Project, unless terminated earlier by mutual consent of the Parties. The term of the MOU may be extended beyond five years if the ODNR determines that post-construction assessment results demonstrate a significant adverse impact and that the continued collection of avian and bat sampling data for an additional period of time is scientifically warranted. The specific type of avian and bat sampling required to address the significant adverse impact will be mutually agreed to by the Parties.

L. General Terms and Conditions

1. Liability. The Parties agree that Applicant shall be solely responsible for any and all claims, demands, or causes of action arising from Applicant's obligations under this MOU. Each Party to this MOU must seek its own legal representation and bear its own costs, attorney fees and expenses in any litigation that may arise from the performance of this MOU. It is specifically understood and agreed that ODNR does not indemnify Applicant. Nothing in this MOU shall be construed to be a waiver of

the sovereign immunity of the State of Ohio or the immunity of any of its employees or agents for any purpose. In no event shall ODNR be liable for indirect, consequential, incidental, special, liquidated, or punitive damages, or lost profits.

2. Ethics. By signing this MOU the Applicant certifies that it: (i) has reviewed and understands the Ohio ethics and conflict of interest laws as found in R.C. Chapter 102 and in R.C. Sections 2921.42 and 2921.43, and (ii) will take no action inconsistent with those laws. The Applicant understands that failure to comply with Ohio's ethics and conflict of interest laws is, in itself, grounds for termination of this MOU with the State of Ohio.

3. Ohio Elections Law. Applicant affirms that, as applicable to it, no party listed in Division (I) or (J) of Section 3517.13 of the R.C. has made, as an individual, within the two previous calendar years, one or more contributions to the Governor or to his campaign committees that exceed the limits established by that code.

4. Assignment/Delegation or Amendment. Neither Party to this MOU will assign any of its rights, amend this Agreement, nor delegate any of its duties and responsibilities under this MOU without the prior written consent of the other Party. Any assignment or delegation not consented to may be deemed void by the non-consenting Party.

5. Severability. In case any one or more of the provisions contained in this MOU shall for any reason be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall not affect any other provision thereof and this MOU shall be construed as if such invalid, illegal, or unenforceable provision had never been contained herein.

6. Counterparts. This MOU may be executed in two or more counterparts, each of which shall be deemed to be an original and taken together shall be deemed to be one and the same instrument.

7. Controlling Law. The laws of the state of Ohio shall govern this MOU and any claims arising in any way out of this MOU. Any provision of this MOU prohibited by the law of Ohio shall be deemed void and of no effect. Any litigation arising out of or relating in any way to this MOU or the performance hereunder shall be brought only in Franklin County, Ohio or before the OPSB.

8. Mediation. If a dispute arises between the Parties regarding the performance,

interpretation, or implementation of any provision in this MOU and the Parties reach an impasse, prior to pursuing litigation the Parties will engage a mutually agreed to third-party mediator and will, in good faith, attempt to reach agreement on the issue within a reasonable period of time.

9. Waiver. A waiver by any Party of any breach or default by the other Party under this MOU shall not constitute a continuing waiver by such Party of any subsequent act in breach of or in default hereunder.

10. Notices. Each Party will designate an individual by name, title, and both street and e-mail addresses for the receipt of any notifications required by this MOU and for the purpose of communicating on any issues that relate to the MOU and its objectives. Except to the extent expressly provided otherwise herein, all reports, notices, consents and communications required hereunder (each, a "Notice") shall be in writing and shall be deemed to have been properly given when: 1) hand delivered with delivery acknowledged in writing; 2) sent by U.S. Certified mail, return receipt requested, postage prepaid; 3) sent by overnight delivery service (Fed Ex, UPS, etc.) with receipt; or 4) sent by fax or email to the officers listed below. Notices shall be deemed given upon receipt thereof, and shall be sent to the addresses first set forth below. Notwithstanding the foregoing, notices sent by fax or email shall be effectively given only upon acknowledgement of receipt by the receiving Party. Any Party may change its address for receipt of Notices upon notice to the other Party. If delivery cannot be made at any address designated for Notices, a Notice shall be deemed given on the date on which delivery at such address is attempted.

Contact and delivery information for the Parties:

Wildlife Wind Biologist
Ohio Division of Wildlife
2045 Morse Road, Building G
Columbus, Ohio 43229-6693
(614) 265-6349
Erin.Hazelton@dnr.state.oh.us

President
Icebreaker Windpower, Inc.
1938 Euclid Avenue, Suite 200
Cleveland, Ohio 44115

MOU supersedes any and all previous agreements, whether written or oral, between the Parties.

12. Execution and Electronic Signatures. This MOU is not binding upon the Parties unless executed in full, and is effective as of the last date of signature by the Parties.

Any Party hereto may deliver a copy of its counterpart signature page to this MOU electronically pursuant to R.C. Chapter 1306. Each Party hereto shall be entitled to rely upon an electronic signature of any other Party delivered in such a manner as if such signature were an original.

The Remainder of this Page Intentionally Blank
Signature Page Follows

IN WITNESS THEREOF, ODNR and Icebreaker Windpower, Inc. have caused this Memorandum of Understanding to be duly executed and have caused their seals to be hereto affixed by their duly authorized officers on the date associated with each authorized signature.

This MOU shall be effective as of the date on which the last of the Parties executes it.

STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES

ATTEST:

7/20/17

James Zehringer, Director for — Date

ICEBREAKER WINDPOWER, INC.

ATTEST:

07/12/2017

Lorry Wagner, President — Date

APPROVED:

7/13/17

Michael R. Miller, Chief, Ohio Division of Wildlife — Date

7/13/2017

Scudder D. Mackey, Chief, Office of Coastal Management — Date

ICEBREAKER WIND
AVIAN AND BAT MONITORING PLAN
LAKE ERIE, OHIO

Prepared for:

Icebreaker Windpower, Inc.

Prepared by:

Western EcoSystems Technology, Inc.
415 West 17th Street, Suite 200
Cheyenne, Wyoming, 82001

July 17, 2017

WEST Inc.

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INTRODUCTION

The Icebreaker Wind Avian and Bat Monitoring Plan ("Monitoring Plan" or "Plan") describes the studies and analyses that will be performed to document the avian and bat resources at the Icebreaker Wind Project ("Icebreaker" or "Project") site and assess potential impacts to those resources during the final pre-construction and post-construction phases of the Project. This Project is a six turbine freshwater offshore wind facility proposed 8 to 10 miles off the shore of Cleveland, Ohio by Icebreaker Windpower Inc. ("Applicant" or "IWI"). This Monitoring Plan is based on currently available scientific methodologies (e.g., radar, acoustics, collision monitoring, etc.) to assess avian and bat displacement, avoidance, attraction/deterrence, and potential for mortality. The Plan considers the Project size, offshore location, and other factors specific to the unique design of this Project and is based on the requirements of the Ohio Department of Natural Resources ("ODNR") On-Shore Bird and Bat Pre- and Post- Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio. Project specific recommendations were provided to the Ohio Power Siting Board ("OPSB") by the ODNR and the US Fish and Wildlife Service ("USFWS") in comments dated February 28, 2017, and additional consultation between the IWI project team and the wildlife agencies. Per OPSB's order dated April 3, 2017, a Memorandum of Understanding and monitoring protocols are to be submitted for its consideration.

Due to the unprecedented nature of this demonstration project, protocols for determining potential impacts to birds and bats in an offshore environment have not been previously established for the Great Lakes. Thus, this Plan makes a good-faith effort to document and address the potential impacts of the Project on avian and bat behavior and mortality. The Plan proposes an adaptive management framework to further minimize and mitigate any unforeseen Project impacts. Pre-construction monitoring shall be completed prior to the date on which construction will begin as identified by the Applicant pursuant to Ohio Administrative Code 4906-3-13(B). Post-construction monitoring shall commence coincident with the date the Project begins commercial operation as identified by the Applicant pursuant to Ohio Administrative Code 4906-3-13(B).

The contents of the current Plan have been shaped by studies and risk assessments previously performed by the IWI project team, as well as by the numerous discussions between the IWI project team and wildlife agencies. Some elements described within the current Plan consist of monitoring studies that will supplement data collected by preceding studies. Potential behavioral impacts will be assessed by characterizing pre-construction baseline conditions using methodologies that will be duplicated during the Project's operational (post-construction) phase in order to provide robust pre- vs. post-construction comparisons for impact assessment. Other elements described within the Plan are unique to the operational phase of the Project. As this plan is a living document, certain elements (i.e., radar surveys, post-construction collision monitoring protocols) currently exist in draft form and will be finalized in consultation with the ODNR, OPSB, other agencies and stakeholders. Changes in the Plan, upon timely approval by ODNR in writing, will be incorporated into this document as an amendment.

The specific monitoring elements contained within the current Plan have been shaped by extensive discussions between the IWI project team, the resource agencies, and the Project's lead bird and bat consultant, Western EcoSystems Technology, Inc. ("WEST"). WEST proposed a Post-Construction Monitoring Plan on October 12, 2016. The Plan included a preliminary outline of potential options to assess project impacts. On October 20th, the ODNR and USFWS provided IWI (then the Lake Erie Energy Development Corporation [LEEDCo]) a document setting forth criteria and recommendations related to pre- and post-construction monitoring goals and objectives. In November, the USFWS and ODNR provided a response to WEST's proposed post-construction monitoring plan. Numerous conversations with representatives from the agencies occurred over the next two months. On December 13th and 14th, IWI and WEST met with the ODNR, USFWS, OPSB, and US Department of Energy ("DOE") in Columbus, Ohio to discuss post-construction monitoring, and any additional associated pre-construction baseline monitoring determined necessary. Subsequent to this meeting, WEST prepared a matrix of monitoring options that was presented to the agencies and discussed at a meeting in Columbus, Ohio on January 6, 2017. On February 28th, the ODNR and USFWS submitted recommendations for bird and bat monitoring at the Project to the OPSB in association with IWI's February 1, 2017 application for a Certificate of Environmental Compatibility for Icebreaker, and on March 6th IWI submitted a response.

The current Plan provides comprehensive detail on the monitoring elements of the pre- and post-construction studies for which methodologies can be defined and elaborated at the present time (i.e., bat acoustic monitoring and aerial water bird surveys). With regard to post-construction monitoring for bird and bat collision impacts during the Project's operational phase, no proven technologies or methodologies are currently available for the offshore environment. The Plan articulates the IWI project team's commitment to continue to evaluate emerging collision monitoring technologies in consultation with ODNR, OPSB, and other agencies and stakeholders to design and implement protocols that employ the most promising and viable collision monitoring technology available at the time such monitoring is set to commence. Such monitoring will be specific to the Project size, offshore location, and other factors specific to the unique design of this Project. With regard to radar monitoring, the Plan articulates the IWI project team's commitment to work with ODNR, OPSB, and other agencies and stakeholders to retain an objective third party radar expert to determine the feasibility and precise design of any pre- and post-construction radar monitoring surveys.

As a follow up to the discussions regarding the radar monitoring element, the wildlife agencies and the IWI project team prepared a Request for Information (RFI) to assess the viability of deploying radar on a large vessel with a four point anchor prior to construction at the project site. The RFI was sent to three potential providers and responses were received in late March. Follow-up questions were sent to the providers by the Applicant and the USFWS, and responses were received. The agencies and Project team held a conference call on April 13th to discuss the viability of vessel-based radar. Subsequent discussions have led to a commitment between the ODNR and Applicant to work with the DOE, USFWS, and one or more objective third-party radar experts to design the exact parameters of any pre- and post-construction radar surveys deemed feasible.

This Plan responds to issues and concerns raised by ODNR and the USFWS related to potential impacts on birds and bats resulting from implementation of the proposed Project. These protocols (and the executed Avian and Bat Monitoring MOU) demonstrate IWI's commitment to ODNR that IWI will implement the required pre- and post-construction protocols described herein to monitor and assess environmental impacts on the avian and bat resources in the Project area.

It is critical that sufficient and accurate data are collected pre-and post-construction in order to evaluate risk of the Project to avian and bat species. This Project is the first offshore freshwater wind installation in North America. Established land-based protocols may need to be modified or adapted in order to assess risk in an offshore environment. As a pilot project, it may be necessary to explore the use of experimental technologies or methods to collect the data necessary to assess behavioral impacts and mortality. The protocols described herein in no way establish a state-approved standard for future offshore wind energy development.

The Plan will be continually assessed through interim and quarterly status reports and annual summaries, and reviewed with ODNR and OPSB annually. The exact parameters of the Plan are flexible and will be subject to modification over time based on results of surveys. Any revisions and adjustments to the Plan, which could include changes to the location of sampling, sampling frequency and duration, and sampling protocols and parameters, will be made as appropriate, and only in consultation with the ODNR and OPSB, taking into consideration input from other agencies and stakeholders. ODNR and IWI will review sampling results annually (at the end of the field season) and will meet annually to discuss and reach mutual agreement on any adjustments to the Plan necessary to meet monitoring and assessment goals. Prior to the date of construction as identified by the Applicant pursuant to Ohio Administrative Code 4906-3-13(B), post-construction protocols in this Plan must be finalized and, upon timely approval by ODNR in writing, will be incorporated into this document as an amendment.

STUDY AREA

The proposed Project will consist of six turbines in a single row, located 8 to 10 miles from the Cleveland shore (Figure 1).

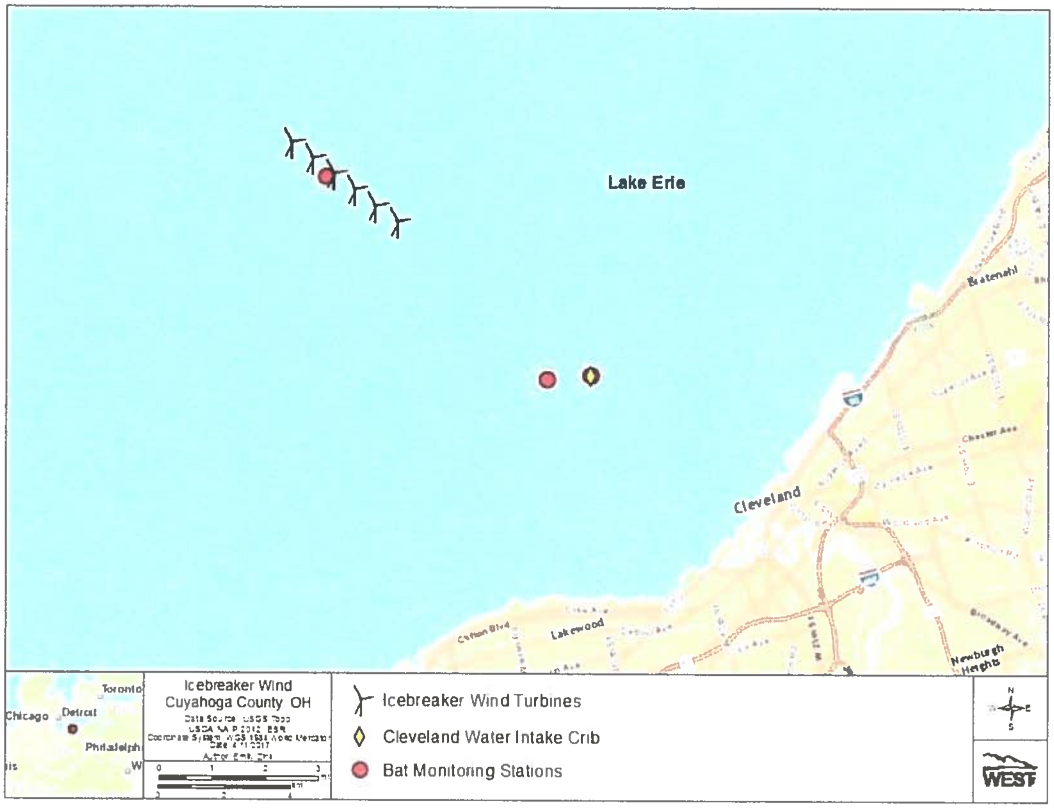

Figure 1. Turbine locations for the Proposed Icebreaker Wind Project, showing locations of pre-construction bat acoustic monitoring (see text). Two buoys have been deployed for bat acoustic monitoring at the location furthest offshore (Mile 7 buoy).

BAT ACOUSTICAL MONITORING

Objectives

The primary objectives of the bat acoustic monitoring element are as follows:

- Characterize the exposure of bats to potential impacts from the Project, pre- and post-construction.
- Characterize the potential behavioral responses of bats to the presence of the Project.
- Characterize bat species composition, activity, and seasonal patterns between the Project site and off site.

Overview of Pre-Construction Bat Monitoring Protocol

Beginning in 2017, the following methods will be deployed to monitor bat activity at and in the vicinity of the Project site:

- At least one full season (15 March – 15 November) of acoustic monitoring. Should inclement weather threaten to delay the monitoring season, IWI will immediately notify ODNR so that survey dates may be amended to maintain 80% functionality.
- Deploy acoustic monitors at the following locations: on the Cleveland Water Intake Crib (one at approximately 50 meter height above water level and one at 3 meter height above water level); on the mile 3 buoy near the water level; on a mile 7 buoy[1] near the water level; and, on a second mile 7 buoy at the 10 meter height to monitor the base of the rotor-swept zone (Figure 1).
- If a vessel is deployed at the project site pre-construction (see radar section, below), deploy an acoustic monitor on the vessel as close to a 50 meter height as mechanically feasible.
- Use Wildlife Acoustics SM4™ detectors, or the equivalent
- Detector sensitivity adjusted to detect a calibration tone at 20 meters
- Run all acoustic detectors 30 minutes before sunset to 30 minutes after sunrise continuously and concurrently during the monitoring season
- Monitor, repair, and replace detectors as needed to maintain 80% functionality at each detection location during monitoring season, with emphasis on the spring and fall migration season data
- Review results of acoustic monitoring with ODNR, Division of Wildlife within three months of deployment of all monitoring equipment to evaluate effectiveness of protocol

[1] The mile 7 buoy is in fact located approximately 9 miles off of the Cleveland shore, or almost in the middle of the Icebreaker Wind project's turbine string.

Overview of Post-Construction Bat Monitoring Protocol

After construction in years 1 and 3 and following the same protocol as pre-construction, bat acoustic monitors will be deployed as follows:

- On three turbines (at least one on an end) with high (nacelle) and low (turbine platform) detectors
- On the mile 7 buoys near the water level and at 10m height
- On the Crib at the same locations as pre-construction monitoring
- Review results of acoustic monitoring with ODNR, Division of Wildlife within three months of deployment to evaluate effectiveness of protocol
- Submit annual report and copy of raw data three months after the completion of the first monitoring season (post-construction) and determine applicability of year three acoustic monitoring

Protocol Discussion

Bat acoustic data gathering will be conducted as described above to complete one full monitoring season prior to Project construction. Bat monitoring will be conducted using full-spectrum acoustic SM4™ detectors (Model: SM4, Wildlife Acoustics™, Maynard, MA; Figure 2) or the equivalent.

Preliminary data was collected using two SM4 units deployed on March 21, 2017 on a buoy located approximately 9 miles offshore of Cleveland, Ohio, within the Project area (Figure 1). This deployment was managed by a WEST bat acoustics specialist working in conjunction with the Project's fisheries consultant, LimnoTech, who deployed and maintains the buoy, and whom WEST trained to monitor and maintain the bat acoustic detectors throughout the recording season. Microphone extension cables were used to raise the microphones to approximately two meters above the water level (Figure 3).

Figure 2. SM4 Bat Acoustic Detector

Figure 3. SM4 Bat Detector Deployed on a buoy for the Icebreaker Wind Project, showing microphones deployed at approximately 2m above the surface of the water

Two additional units were deployed at the Cleveland Water Intake Crib on March 23, 2017. One of these was deployed with its microphone located approximately 3 meters above the water level, and the other was deployed with its microphone located approximately 50 meters above water level on the Crib's meteorological tower (Figure 4). One additional detector was also deployed on March 23, 2017 on the mile 3 LimnoTech buoy located in close proximity to the Cleveland Crib (Figure 1). Similar to the deployment on the mile 7 buoy, the microphone on this detector was also deployed at an altitude approximately 2 meters above water level. Additional detectors have been deployed subsequently at all of these locations for redundancy in June so that there are now two detectors at each of the four recording locations, in order to minimize the potential for data gaps due to equipment malfunctions. An additional buoy with a 10m tall pole was deployed next to the mile 7 buoy on July 11, 2017. When the dual microphones are fitted to the top of this pole and begin recording in order to monitor the base of the rotor-swept zone, the start of the one-year pre-construction monitoring effort will begin. Recordings will be maintained at least 80% functionality for each location, with emphasis on spring and fall migration.

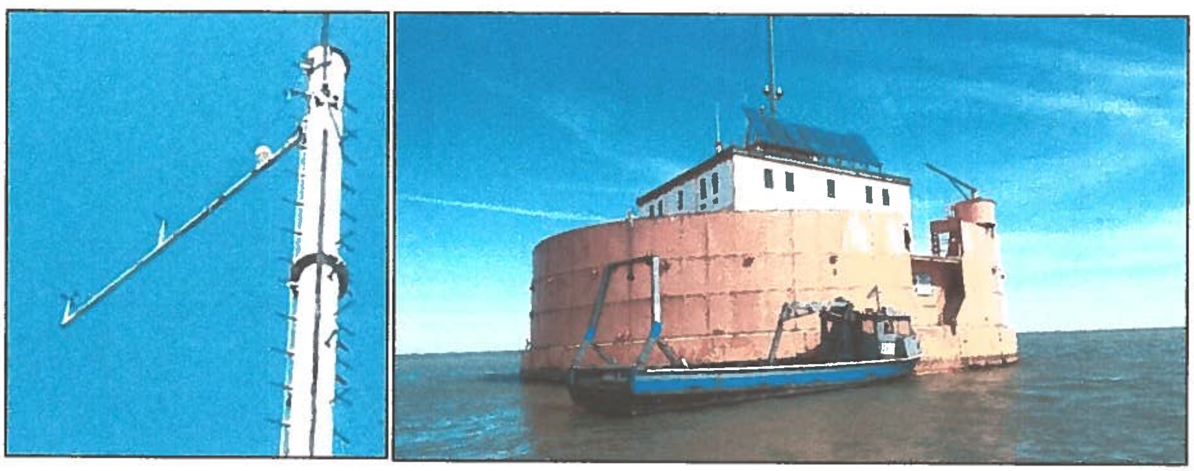

Figure 4. The Cleveland water intake Crib (right), and close-up shot of the Crib's meteorological tower (left) on which a bat acoustical detector was deployed at roughly 50 m above the water level during the March 23, 2017 deployment

If vessel based radar is deployed prior to construction at the project site, a bat acoustic detector will be deployed on the vessel as high as possible, but at a minimum of 20 meters.

All detectors have been, or will be, fitted with LimnoTech-fabricated brackets for attachment to buoys and Cleveland Crib components. LimnoTech will be responsible for bracket fabrication. External batteries (12 volt, 36 ah) and two Sandisk128 GB cards for each unit will be utilized to allow for monthly equipment checks and data card change-outs. Sensitivity has been, or will be adjusted to detect a calibration tone at 20 meters. Detectors have been or will be programmed to begin recording at least 30 minutes before sunset and continue recording until 30 minutes after sunrise. A copy of raw data, acoustic analysis, and methodology will be included in the annual reports to ODNR.

AERIAL WATERFOWL SURVEYS

Objectives

The primary objectives of the aerial waterfowl monitoring element are as follows:

- Characterize whether or not any water bird species are displaced from the Project area due to the presence of the Project
- Characterize the use of the project area by diurnal birds, including species composition, abundance, and distribution patterns

Overview of Pre- and Post-Construction Monitoring Protocol

IWI will adhere to all of the recommendations contained in the February 28, 2017 comments from the USFWS and ODNR regarding aerial waterfowl surveys. IWI will use human observers for these aerial surveys, and will work with the agencies to design the system that offers the most effective means to collect the waterfowl information sought. The Applicant will work with the ODNR, in consultation with the USFWS, to define the survey area and flight patterns to assure study objectives are achieved. The aerial survey project area and flight patterns will be approved by the ODNR in writing at least two months prior to the initiation of the initial survey. The surveys will be designed to include the following[2]:

Pre-construction

- Performed for one complete season (fall through spring) prior to Project construction
- Focus on waterfowl, bald eagles, and ice relative to location of birds
- Survey transects should run parallel to the turbine string
- Survey dates: mid-October through end of May
- Survey frequency: every 2 weeks
- Transect spacing: close enough to the turbines to observe birds between the turbines, but a safe distance from the blades
- Flight heights: 76-100 m in order to detect small water birds
- Flight speeds: 150-200 km/h unless constrained by local flying restrictions
- Suitable weather conditions for surveys defined as follows:

[2] Including recommendations contained within the document entitled "Preliminary recommendations to facilitate data collection during the autumn 2013 migration season Great Lakes aerial surveys" (Gilbert et al. 2013), which was included as an appendix to the ODNR/USFWS Feb 28 comments. Note, where specific recommendations differ between the ODNR/USFWS letter and the Gilbert et al. 2013 (e.g. transect orientation), the former is taken, as it was developed based on site- and application-specific considerations for the Project.

    - Beaufort scale wave conditions of 4 or below
    - winds of 37 km/h or below
    - minimum of 3.2 km visibility (or pilot's discretion)
- Conduct surveys at a variety of different times of day
- Standardize survey parameters
- Standardize environmental parameters
- Standardize observation methods, including the following:
    - Apply distance sampling using distance band method
    - Use a data logger or voice recorder to record data in flight
    - Record all bird species encountered
    - Record time and GPS position of each bird observation
    - Standardize collection of environmental data
    - Minimize the number of different observers used
- Conduct observer training
- Record survey transect times and GPS tracks
- Standardize data collection and QA/QC process, including the following data fields on the data sheets:
    - Survey area
    - Date
    - Time (GMT/UTC or other standardized system)
    - Observer location within the plane
    - Species code and/or common name (use standardized codes/names, as well as various degenerate categories, e.g. "unidentified gull", "unidentified diving duck")
    - Count (# of birds per observation)
    - Distance band
    - Sea state
    - Glare
    - Visibility
    - Geoposition
- Conduct statistical power analysis
- Standardize transect spacing. Transects should be spaced to maximize the number of transects within the project boundary while minimizing likelihood of observing the same flock/individual multiple times.

- Conduct double-observer studies

Post-construction

- Similar transect protocol as pre-construction
- Performed in years 1 and 4 subsequent to Project construction

RADAR

Objectives

The primary objectives of a radar monitoring element would be as follows:

- Characterize the altitudinal distribution and density of flying birds and bats at the Project site, pre- and post-construction
- Characterize behavioral avoidance/attraction effects in flying birds and bats in response to the presence of the Project

Overview of Pre- and Post-Construction Radar Monitoring Protocol

The ODNR, USFWS and IWI have retained an objective third party radar expert (Dr. Robb Diehl, USGS) to determine whether collection of pre-construction radar data at the project site on a vessel is feasible and will achieve the study objectives. A recommendation on the viability and precise design of any pre-construction radar is expected by the Fall of 2017. A decision on the final design of any post-construction radar will be made following the determination regarding pre-construction vessel based radar.

If either or both pre- or post-construction radar studies are determined unlikely to achieve the radar study objectives, the Applicant and agencies will work to re-direct resources to alternative monitoring efforts better designed to produce meaningful information concerning Project impacts.

Figure 5. Example of a barge of the general size and type proposed as the on-site deployment platform for pre-construction radar monitoring to be conducted for the Icebreaker Wind Project.

COLLISION MONITORING

Objectives

The primary objective of the collision monitoring element is as follows:

- Detect collisions of birds and bats with wind turbines and identify to guild (if determined possible), post-construction

IWI recognizes that the potential for birds and/or bats to collide with Project infrastructure during the Project's operational phase is of primary importance for the Project and for the Monitoring Plan. IWI also recognizes that the well-established methods for monitoring such impacts at land-based wind energy facilities cannot be performed at an offshore facility such as the Project. Although several promising technologies are under active development, no proven effective technologies to perform bird/bat collision monitoring at offshore wind energy facilities are currently available; however, several emerging technologies appear promising.

The Applicant will consult with the ODNR, OPSB, and other agencies and stakeholders to design a post-construction mortality monitoring plan using innovative technologies that are economically and logistically feasible for this demonstration project. The commitment made by IWI at the present time is to continue to evaluate developing technologies and available options with the expectation of implementing a robust collision-monitoring program during the Project's operational phase, with the specific technology, protocol, and sampling parameters to be determined through continued consultation with wildlife agencies, experts, and other stakeholders. Depending on the limitations of the technology, additional methods may be warranted to supplement the data collected to provide post-construction collision information, specific to the project size, offshore location, and other factors specific to the unique needs of the project. The specific collision technology, protocol, and sampling parameters will be identified in the post-construction protocol and, upon timely approval by ODNR in writing, will be incorporated into this document as an amendment.

ADAPTIVE MANAGEMENT AND MITIGATION

Icebreaker Wind is a first of its kind U.S. demonstration project, and as such the Applicant recognizes the importance of rigorous post-construction monitoring to continuously evaluate the actual impacts of the Project on fish and wildlife. The Applicant is committed to taking adaptive management steps to further minimize and mitigate any unforeseen adverse impacts on fish and wildlife species. A comprehensive adaptive management plan specifying all of the impacts avoidance, minimization and mitigation measures to be implemented, including quantitative impact thresholds that trigger additional mitigation contingencies, will be developed in consultation with the agencies and included in the Project's Bird and Bat Conservation Strategy ("BBCS"). IWI will submit the results of the pre- and post-construction surveys within three months of the conclusion of the relevant survey and will discuss annually with the wildlife agencies and stakeholders practical and reasonable technologies and methods that can be employed to further avoid, minimize and mitigate any unforeseen adverse impacts that the project is having on bird and bat species.

The Applicant is developing a Bird and Bat Conservation Strategy (BBCS) to conduct thorough post-construction monitoring of Proposed Project impacts, and to undertake adaptive management measures, if necessary. Mitigation and adaptive management measures would be implemented if actual impacts exceed expectations. The BBCS will be submitted during the permitting process and will be finalized, in consultation with the wildlife agencies and stakeholders, well before construction.

The Applicant has agreed that the Proposed Project's turbines would be curtailed until winds reach 6.7 mph at night during the fall bat migratory period.

The Applicant will follow lighting recommendations per the USFWS 2012 land-based wind energy guidance documents. Gehring et al. (2009) found that the use of red or white flashing obstruction lights strongly correlated with a decrease in avian fatalities compared to non-flashing, steady burning lights at tower systems. Gehring et al. (2009) further stated that "Removing non-flashing lights from towers is one of the most effective and economically feasible means of achieving a significant reduction in avian fatalities at existing communication towers." The Proposed Project would use flashing red lights on turbines, as stipulated by FAA for bird safety.

Icebreaker will continue to work with state and federal agencies to: address any bird and bat issues that could arise during planning, construction, operation, or decommissioning of the Proposed Project to ensure that they remain in compliance with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Exhibit B

Timeline of Reporting Requirements, Pre-and Post-Construction

Quarterly status reports are due on the first day of March, June, September, and December for the term of this MOU.

Interim reports for the pre- and post-construction protocols described in Exhibit A (Icebreaker Wind Avian and Bat Monitoring Plan) are due three months after the start of data collection for each monitoring component.

Annual reports are due three months after completion of each monitoring season.

A final report is due one year after all sampling and monitoring work has been completed.

Aerial Waterfowl & Waterbird Study Plan

for

Icebreaker Windpower, Inc.

Cuyahoga County, Ohio

Prepared for:

Icebreaker Windpower, Inc.

Lake Erie Energy Development Corporation

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8 August 2017

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INTRODUCTION

Icebreaker Windpower Inc. (IWI), is proposing to construct Icebreaker Wind, a 6 turbine demonstration offshore wind energy project (Project) in Lake Erie, 8 to 10 miles off the shore of Cleveland, Ohio. Previously, IWI developed the *Icebreaker Wind Avian and Bat Monitoring Plan* (Monitoring Plan), dated July 17, 2017, that describes the studies and analyses that will be performed to document the avian and bat resources at the Project site and assess potential impacts to those resources during the pre-construction and post-construction phases of the Project. The Monitoring Plan was incorporated into the Memorandum of Understanding between IWI and the Ohio Department of Natural Resources (ODNR).

The Monitoring Plan is based on currently available scientific methodologies to assess displacement, avoidance, attraction/deterrence, and potential for mortality. The Monitoring Plan generally follows the requirements of the Ohio Department of Natural Resources (ODNR) *On-Shore Bird and Bat Pre- and Post- Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio*. Project specific recommendations were provided to the Ohio Power Siting Board (OPSB) by the ODNR and the US Fish and Wildlife Service (USFWS) in comments dated February 28, 2017, and additional consultation between the Project team and the wildlife agencies.

This *Aerial Waterfowl and Waterbird Study Plan* (Aerial Waterbird Study Plan) was developed to provide additional details specific to waterfowl and waterbirds previously described in the Monitoring Plan. The Aerial Waterbird Study Plan outlines the specific monitoring methods to meet the two objectives identified previously in the Monitoring Plan. Those objectives are as follows:

1. Characterize waterfowl and waterbird species, numbers, distribution, and use of project area
2. Characterize whether or not any waterfowl or waterbird species are displaced from the Project area due to the presence of wind turbines

The first objective can be assessed prior to construction, providing baseline data for analyses supporting the second objective in the years following construction of turbines. Upon approval by ODNR in writing, this Aerial Waterbird Study Plan will be incorporated into the Monitoring Plan as an amendment.

STUDY AREA

The proposed Icebreaker Wind Project is located in offshore waters of Lake Erie, Cuyahoga County; the city of Cleveland and greater metropolitan area is 12.8 km (8 miles) to the south of the Project. The study area proposed in this Aerial Waterbird Study Plan extends 5 km (3.1 miles) from the proposed turbines, and encompasses 145 km^2 (35,830 US acres) of US waters within Lake Erie (Figure 1). The proposed study area includes water depths of 15-20 m (49-66 ft) (Figure 2). Substrates throughout the area are primarily mud, with some areas of sand, and clay (Figure 3).

STUDY METHODS

Study Design

The Aerial Waterbird Study Plan is designed to incorporate most recommendations by Gilbert et al. (2013) to the Great Lakes commission on survey and data collection design, with the goal of ensuring data quality. These recommendations are identified in the Monitoring Plan*,* and also in design and procedure documents in support of offshore aerial surveys (Bailey et al. 2014, Fox et al. 2006, Buckland et al. 2004, and Camphuysen et al. 2004).

Survey Design and Sampling Methods

The proposed survey area was identified as an area up to 5 km (3.1 mi) beyond all turbines, generalized to a rectangle that is 10 km x 14.5 km (6.2 mi x 9 mi), centered on the proposed 4.5-km (2.8 mi) string of turbines. In comparing co-occurring species between northern Europe and in Lake Erie that may be displaced by wind turbine development, the species potentially most sensitive are loons (i.e. divers, *Gavia spp;* Bailey et al 2014). Displacement of *Gavia spp*. near turbines at Nysted and Horns Rev, Denmark occurred at the scale of 2 km (>1.2 mi) (Petersen et al 2006). Therefore, our survey area will encompass potential displacement effects at Icebreaker 2.5 times greater than that 2-km displacement, to a distance of 5 km (3.1 mi) from the proposed wind turbines (Figure 4) with a maximum distance extending 7 km (4.3 mi) from a turbine to the far corners of the proposed project area. Survey efforts to a distance of 5 km beyond the turbine should be more than adequate to assess use by, and distribution of species, and any potential displacement.

Sampling of the survey area will occur using aerial line transect approaches, following distance sampling, recording perpendicular distances from plane to as close to 0.5 km (0.31 mi) as possible. Recommended spacing to minimize double counting between transects is >2 km (1.24 mi) (Camphuysen et al. 2004). In order to maximize the flight space between turbines, parallel transects will be established 2.2 km (1.37 mi) apart, and perpendicular to the turbine string. This will result in seven 10 km (6.2 mi) transects that will be flown during each survey. In addition to using distance sampling to aid in density estimation and correct, or account for, decreasing probability of detection from from the transect line (plane), a double-observer data collection strategy permits estimation of inter-observer variability. These methods, in combination, can increase the robustness in the estimates of population abundance within the project area, thereby increasing the likelihood of detecting change attributable to displacement rather than sampling skill of the observers.

Orientation of sampling transects perpendicular to the proposed turbine string follows a gradient design, which is the preferred method for assessing point-source disturbance impacts (Ellis and Schneider 1997).[1]

[1] Although Before-After-Control-Impact (BACI) designs were used previously in offshore wind studies they are no longer recommended due to the recognition of wind turbines as a point effect disturbance, which varies by species and over distance rather than a uniform fixed effect. Furthermore, identifying truly comparable control sites, and then statistically accounting for differences between impact and control sites can mask assessing the impact of the wind turbines; *see* Bailey, Brooks, and Thompson (2014) for a review.

Data Collection Requirements

In addition to use of distance sampling from line transects to collect data, and a double observer design to assess observer detection, specific data collection conditions must be considered and accounted for during each survey. The following list identifies requirements and constraints integral to the survey effort. These closely reflect the survey protocol set forth in comments received from the agencies previously.

Survey Timing

- Surveys will be performed for one complete survey season 15 October – 31 May prior to Project construction.
- Survey frequency will be once every 2 weeks per survey season
- During any periods of extensive ice cover, when the next scheduled survey may not capture extensive ice conditions, an additional survey(s) may be flown to document bird use of the survey area and the ice status.
- Surveys will be conducted throughout daylight hours as much as possible, aiming for relatively equal representation, by thirds, and in relation to sunrise/sunset, with early-day (0500-1000H), mid-day (1000-1400H) and later-day (1400-1900H).
- Surveys will be performed during one year preceding construction and in years one and four subsequent to Project construction.

Transects

- Survey transects will be established parallel to each other with spacing maintained at 2.2 km (1.37 mi).
- Survey transects will be perpendicular to the turbine string.
- Transect order and direction within the survey will be established with a random start location and direction.
- Each of the seven transects will be flown during each survey on a single day unless precluded by weather/wind/visibility conditions.
- Transects will be 10 km (6.2 mi) each, and will be sampled with a single pass per survey.
- Flight heights will be maintained at 76-100 m AGL in order to detect small water birds and minimize flushing.
- Flight speeds will be maintained as close to 150-200 km/h (93-124 mph) as possible to minimize flushing.
- Deviation from prescribed flight heights or speeds will be considered if required for safety, but any proposed deviation would be discussed with cooperators unless required on an emergency basis.

Weather and Visibility Conditions

- Beaufort scale wave conditions categorized as 4 or below (Beaufort=4 winds 20-28 kmh (13-17 mph), and surface conditions of long breaking crests and whitecaps (wave height <1 m (3 ft) in Great Lakes). This metric will reassessed in the lake environment where the wave periodic is shorter than in marine environments, and a consistent approach will be used among observers.

- winds of 37 km/h (23 mph) or below
- minimum of 3.2 km (2 mi) visibility (or pilot's discretion)

Data collection

- WEST will establish a database to store, retrieve, and organize field observations. Data from electronic and/or field forms will be keyed into electronic data files using a pre-defined format that should make subsequent data analysis straightforward. All field data forms, field notebooks, and electronic data files will be retained for ready reference.
- Distance sampling to 300 m on each side of airplane using distance band method (or better) to estimate distance by groups
- Double observer design, with three observers per flight, with two on the right side of the plane; the pilot will not serve as an observer.
- Each observer will use a data logger and/or voice recorder to record data in flight
- Standard environmental and survey conditions will be recorded by each observer for each transect, including:
    - Date
    - Start Time / End Time
    - Sea state
    - Glare
    - Visibility
    - Transect name and geoposition
    - Azmith, direction of flight
    - Observer location within the plane
    - Survey type (regularly scheduled or ice cover)

- GPS tracks (3) will be recorded by each observer for each survey to ensure redundancy.
- Record all bird species encountered, focusing on waterfowl and waterbirds, and presence of raptors and bald eagles. For each bird observation the following will be recorded:
    - Time and GPS position
    - Species, or finest resolution ID possible. e.g. "unidentified gull", "unidentified diving duck"
    - Distance or distance band
    - Group size
    - Behavior (including all flying, swimming and diving birds)
    - Location
    - Ice Conditions

QAQC and training

- WEST will ensure appropriate quality assurance/quality control (QA/QC) measures will be implemented at all stages of the study, including field data collection, data entry, data analysis, and report preparation. At the end of each survey day, each observer will be responsible for inspecting his or her data forms for completeness, accuracy, and legibility. Periodically, the study team leader will review data forms to insure completeness; any problems detected will be corrected. Any changes made to the data forms will be initialed and dated by the person making the change.

- All data forms will be checked thoroughly for data entry errors. Any errors will be corrected by referencing the raw data and/or consulting with the observer(s) who collected the data. Any irregular codes detected, or any data suspected as questionable, will be discussed with the observer and study team leader. Any changes made to the raw data will be documented for future reference.
- All reasonable efforts will be made to minimize the number of different observers used
- All observers will be qualified biologists that will complete at least 10 hours of observer training specific to this project, at least one week prior to the first flight, including a trial flight to ensure all observers are competent and able to conduct surveys. Training will focus on increasing accuracy and consistency in the following areas:
    - species ID
    - distance estimation
    - environmental variables
    - equipment operation
    - safety and emergency preparedness
    - data handling and QAQC
- Require use of polarized sunglasses.
- Standardize data collection, data entry, and QA/QC process.
- Maintain local and remote copies of electronic data

Analysis Methods

Analysis is anticipated to include fitting distance sampling detection models to estimate the probability of detection of groups (>1) of birds as a function of distance to survey transect and other potential variables such as: group size, species size, behavioral state (flying versus swimming, diving), distance to shore, light conditions (glare), time of day, season, distance to ice, surficial ice coverage, water depth, and lake substrate. Distance sampling methods assume a probability of detection of 1.0 (perfect) on or near the flown transect line. Given the nature of the surveys, perfect detection is unlikely and a mark-recapture design using the double observer observations can estimate the probability of detection of at least one of the observers. The probability of detection of at least one of the observers can be fit using an applicable model such as a logistic regression. Using this approach, density of waterbird species will be estimated using the distance sampling function and the probability of detection by at least one of the observers, if appropriate. Complex modeling approaches require adequate observations of individuals and groups for appropriate inference from statistical models. If survey densities and surveys yield numerous zero (0) observations, or low counts, alternative methods will be considered, including modeling to groups, such as genera (or higher taxa), other biologically relevant groups, or switching to another modeling approach designed for handling minimal observations.

A key objective of this survey effort is to detect any potential displacement or attraction effects in any bird species that may result from the construction and operation of the Project. This analysis will be performed in two ways: 1) before - after analysis; 2) gradient analysis (post-construction only). Although the proposed design has been developed in consideration of optimal design for these analyses, we note that displacement analyses will only be possible after post-construction data is collected during years 1 and 4 of Project operations.

Survey Reports

Once the field data has been collected, WEST will prepare reports describing the surveys and their results. Reports will summarize species, numbers, distribution, and use of project area, in texts and illustration. Annual reports will be submitted 60 days following completion of surveys.

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Figure 1. Location of the proposed aerial survey area and survey transects for the Icebreaker Wind Farm.

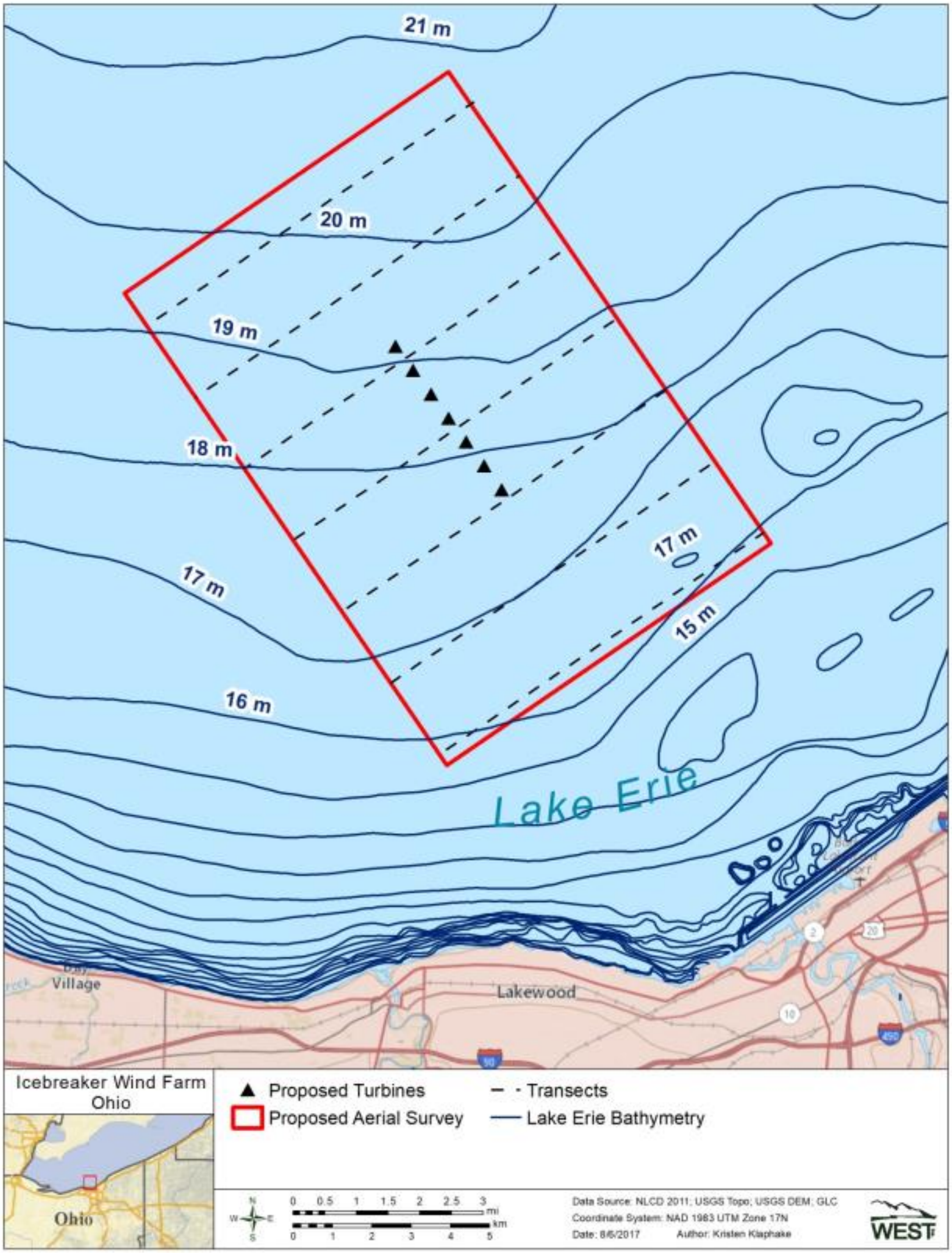

Figure 2. Bathymetry within the proposed aerial survey area for the Icebreaker Wind Farm.

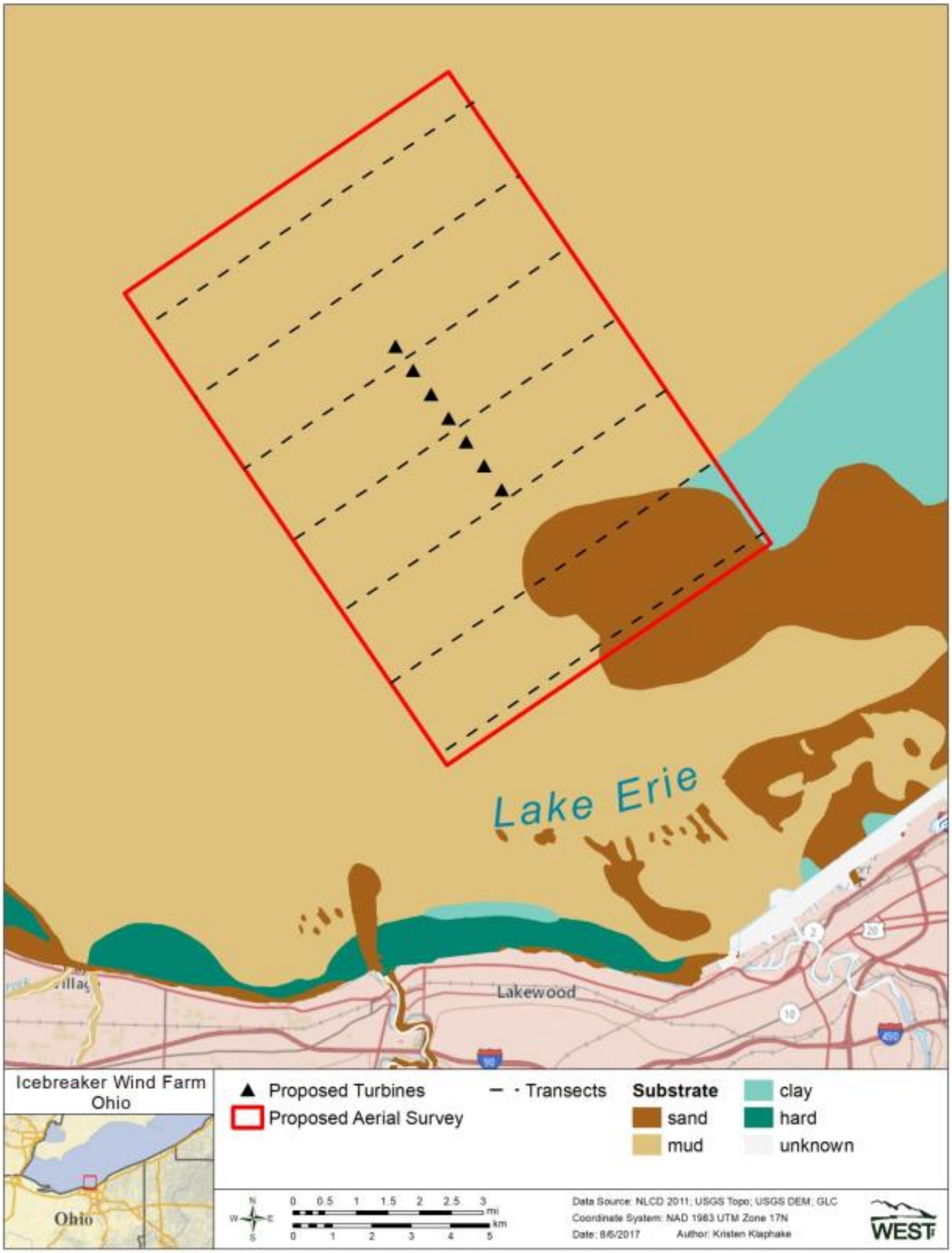

Figure 3. Substrate materials within the proposed aerial survey area for the Icebreaker Wind Farm.

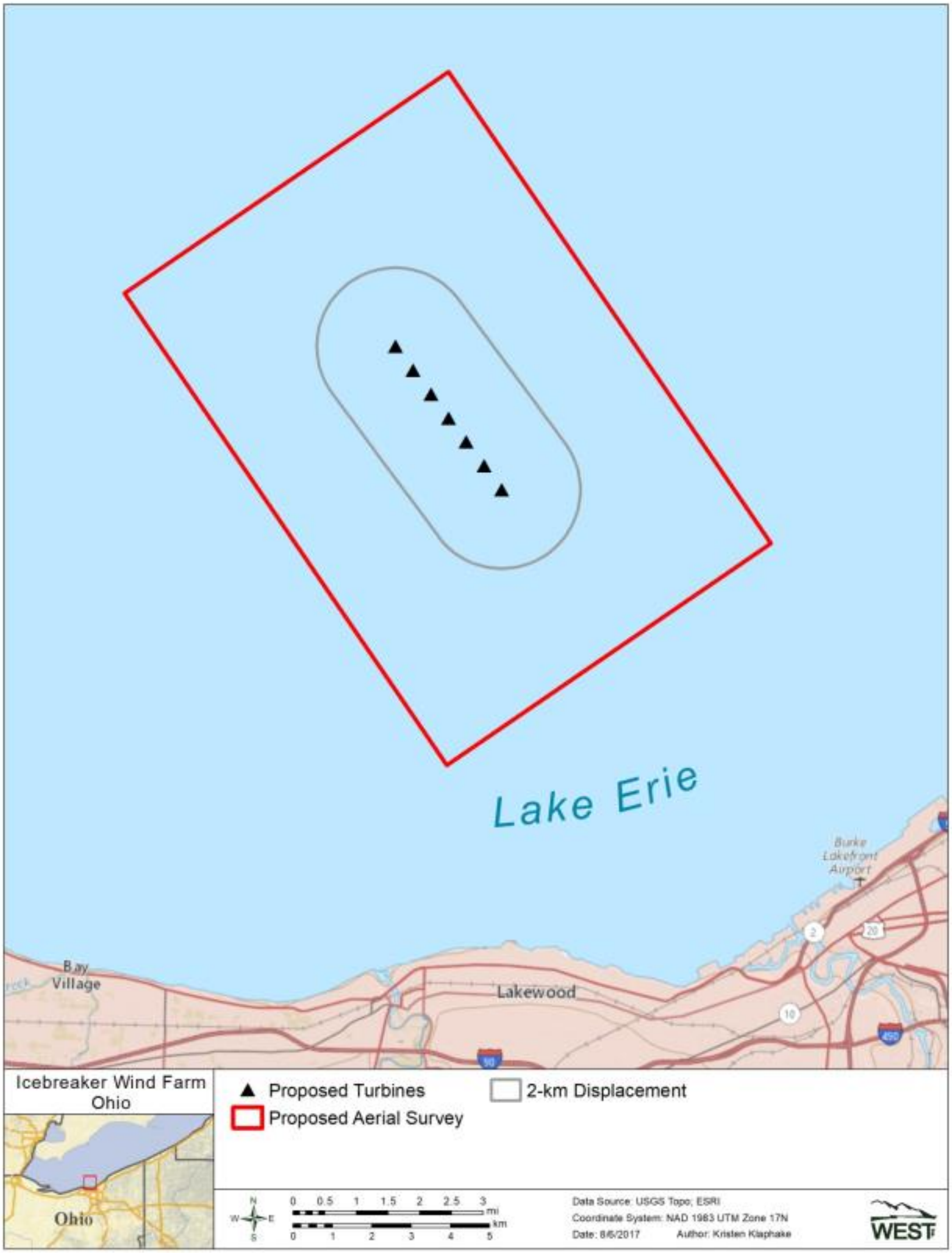

Figure 4. The proposed aerial survey area for the Icebreaker Wind Farm, with an illustration of a hypothetical 2 km displacement area.

Appendix C. Wildlife Survey Results 2017 – 2018

As research reports are finalized this Appendix will be populated

Icebreaker Wind Bat Activity Monitoring

(March 21 to November 14, 2017)

Lake Erie, Ohio

Final Report

February 15, 2018

Prepared for:

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February 15, 2018

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INTRODUCTION

The Icebreaker Bat Activity Monitoring Final Report is being provided by Western EcoSystems Technology Inc. (WEST) to the Ohio Department of Natural Resources (ODNR) pursuant to the Memorandum of Understanding (MOU) between ODNR and Icebreaker Windpower Inc. (IWP) filed July 20, 2017, which MOU adopts the Avian and Bat Monitoring Plan ("MP") dated July 17, 2017, as well as reporting requirements and other commitments of the parties in regard to construction and operation of the Icebreaker Wind Project (Project), a 20.7 megawatt offshore wind demonstration project proposed 12.9 – 16 kilometers (km) (8-10 miles) off the shore of Cleveland, Ohio. IWP currently has an application for a Certificate of Environmental Compatibility and Public Need pending at the Ohio Power Siting Board, which has been assigned case no. 16-1871-EL-BGN.

This report covers all bat monitoring activities undertaken by the WEST team related to items described in the MOU for the entirety of the 2017 bat activity season as defined by ODNR, covering monitoring efforts from March 21 through November 15, 2017. WEST was assisted in the bat monitoring efforts by LimnoTech and Conserve First LLC, who took primary responsibility for deploying, maintaining, and retrieving data from the buoys and acoustic monitors used for this survey.

METHODS

As defined in the MP, the primary objectives of the bat acoustic monitoring were:

- Characterize the exposure of bats to potential impacts from the Project, pre- and post-construction.
- Characterize the potential behavioral responses of bats to the presence of the Project.
- Characterize bat species composition, activity, and seasonal patterns between the Project site and off site.

The exposure, behavioral responses, bat species composition, activity, and seasonal patterns of use were characterized through the use of acoustic bat detectors.

Overview of Bat Diversity

The Project is within the species distribution range of seven bat species. The state of Ohio lists the following species as state species of concern: little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), tri-colored bat (*Perimyotis subflavus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*; ODNR 2012). The evening bat (*Nycticeius humeralis*) is within the range but is not a species of concern.

Table 1. Bat species with potential to occur within the Icebreaker Wind Project Bat Survey Area categorized by minimum echolocation call frequency.

Common Name	Scientific Name
High-Frequency (greater than 30 kHz)	
eastern red bat[1,3]	*Lasiurus borealis*
little brown bat[1]	*Myotis lucifugus*
evening bat[1]	*Nycticeius humeralis*
tri-colored bat[1,2]	*Perimyotis subflavus*
Low-Frequency (less than 30 kHz)	
big brown bat[1]	*Eptesicus fuscus*
hoary bat[1,3]	*Lasiurus cinereus*
silver-haired bat[1,3]	*Lasionycteris noctivagans*

[1] species known to have been killed at wind energy facilities
[2] currently being considered for listing by the U.S. Fish and Wildlife Service under the endangered species act
[3] long-distance migrant
Data source: Bat Conservation International (BCI) 2017
kHz = kilohertz

Study Area and Deployment Schedule

Bat acoustic surveys were conducted at one location within the proposed Project, and two locations outside the Project (Figure 1). Results in this report are a summary of our findings at all of the surveyed locations, referred to in the report at the Icebreaker Wind Project Bat Survey Area.

Five stations were monitored with Song Meter full-spectrum ultrasonic detectors (SM3 and SM4; Wildlife Acoustics, Inc.; Concord, Massachusetts) from either March 21 or March 23 through November 14, 2017, with the exception of the “seven mile” elevated, which was monitored from July 11 to August 30, 2017. The original plan described monitoring as starting on March 15 and ending November 15; detectors were not deployed at the stations until March 21 and 23, 2017, due to unsafe lake conditions, and were removed from the stations on November 14, 2017, due to weather conditions. Microphones were deployed at the following stations located within and outside the Project (Table 2, Figure 1):

- <u>“Seven-mile” lower</u>: Located within the Project at roughly one meter (m) above water level on a seven-mile buoy[1]
- <u>“Seven-mile” elevated</u>: Located within the Project at 10 m elevation on a second seven-mile buoy.
- <u>Three-mile lower</u>: Located outside the Project at roughly one m above water level at a three-mile buoy
- <u>Crib elevated</u>: Located outside the Project at an approximate 50 m elevation on the Cleveland water intake crib, and

[1]Both of the seven-mile buoys are nine miles offshore, at the Project site

- Crib lower: Located outside the Project site at an approximate three m elevation on the Cleveland water intake crib.

Acoustic monitoring began at the seven-mile lower station on March 21, 2017 (two SM4 detectors were deployed), and at the three-mile lower, crib elevated and crib lower stations on March 23, 2017 (one SM4 detector was deployed at each station). An additional SM4 detector was deployed at the crib elevated station on June 1, 2017, to add redundancy and further reduce the risk of data loss. Due to a detector failure, an SM3 detector was used on a temporary basis at the crib elevated station from June 8 to June 20, 2017. Additional SM4 detectors were deployed at the three-mile lower and crib lower stations on June 21, 2017, to add redundancy and further reduce the risk of data loss. As discussed below, SM4/SM3 microphones are more sensitive and record more bat calls than Anabat (Adams et al. 2012). Therefore, it is difficult to compare the results of this survey with results of other bat surveys that utilized Anabat detectors.

LimnoTech and Aaron Godwin of Conserve First LLC worked with WEST to install microphones and data loggers throughout 2017 on the Cleveland Crib and buoys. LimnoTech and Aaron Godwin received approval from the City of Cleveland prior to installation of bat detectors on the crib. LimnoTech visited each logger every two to three weeks to download data and ensure the logger and microphone were working correctly. Acoustic bat data were sent to WEST for processing after each visit.

The ODNR asked Icebreaker to test deployment of an additional elevated detector within the Project area, hereafter referred to as the seven-mile elevated station. LimnoTech designed an experimental system that included a detector elevated 10-m above water level on a pole attached to an offshore buoy. On July 11, 2017, a SM4 detector was deployed at the seven-mile elevated station (on a second buoy of the same design as the original seven-mile buoy, and moored near it), and on July 19, 2017, a second SM4 detector was deployed at the seven-mile elevated location for redundancy. On September 6, 2017, it was discovered that the 10 m pole on the seven-mile elevated station had snapped off of the buoy in high winds and/or high waves. On September 20, 2017, a dive team recovered one detector from the seven-mile elevated station from the bottom of the lake. Based on the recovered data, WEST inferred that the seven-mile elevated station went into the lake on August 31, 2017; the unit recorded data through the morning of August 31, but the detector did not turn on or record any data the night of August 31, 2017.

On November 14, 2017, detectors deployed at the seven-mile lower, three-mile lower, crib elevated, and crib lower stations were removed for the season (Table 2).

Table 2. Station deployment schedule at the Icebreaker Wind Project Bat Survey Area from March 21 to November 14, 2017.

Station	Station ID	Microphone Placement	Detector Type	Deployed Date	Takedown Date
Seven-mile elevated 1	X7.elevated.1	Elevated 10 m	SM4	July 11	August 30
Seven-mile elevated 2	X7.elevated.2	Elevated 10 m	SM4	July 19	August 30
Seven-mile lower 1	X7.lower.1	Water-level+one m	SM4	March 21	November 14
Seven-mile lower 2	X7.lower.2	Water-level+one m	SM4	March 21	November 14
Three-mile lower 1	X3.lower.1	Water-level+one m	SM4	March 23	November 14
Three-mile lower 2	X3.lower.2	Water-level+one m	SM4	June 21	November 14
Crib elevated 1	crib.elevated.1	Elevated 50 m	SM4	March 23	November 14
Crib elevated 2	crib.elevated.2	Elevated 50 m	SM4	June 1	November 14
Crib lower 1	crib.lower.1	Water-level+three m	SM4	March 23	November 14
			SM3	June 8	June 20
Crib lower 2	crib.lower.2	Water-level+three m	SM4	June 21	November 14

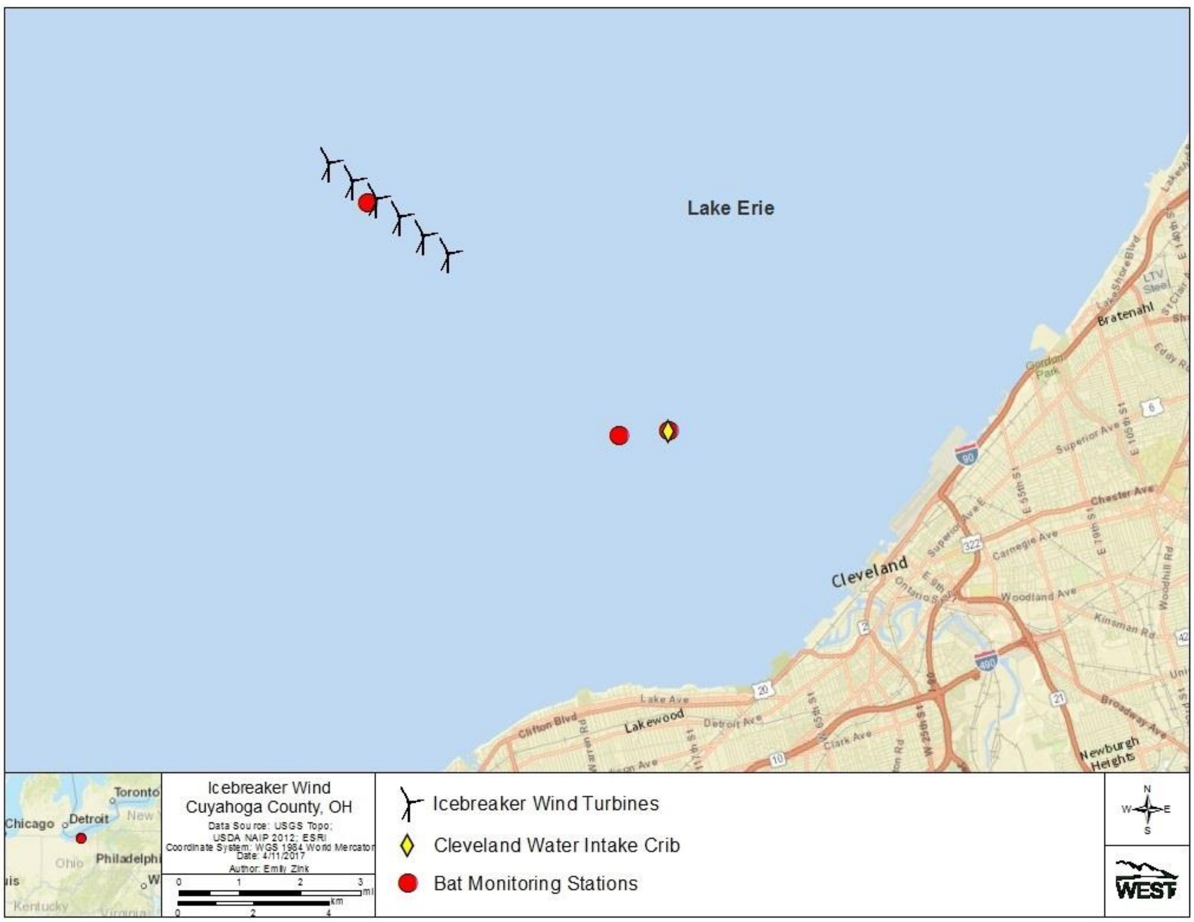

Figure 1. Acoustic sampling locations at the Icebreaker Wind Energy Project in 2017. The red dot among the turbines is the "seven-mile" location, where two buoys containing ultrasound microphones are located in close proximity to one another, and the red dot to the west of the Cleveland Water intake crib is the "three-mile buoy" location (see text). The "seven-mile" location is nine miles offshore at the Project site.

Data Collection and Call Analysis

Acoustic detectors were programmed to turn on 30 minutes before sunset and continue running until 30 minutes after sunrise the following morning throughout the monitoring period. A night of recording (hereafter referred to as detector-night) was defined as 30 minutes before sunset to 30 minutes after sunrise; for example, the night of September 4th began 30 minutes before sunset on September 4th and ended 30 minutes after sunrise on September 5th. If a detector failed at any time during the recording night, that night was not counted as a successful detector-night.

Bat passes were sorted into two groups based on their minimum frequency. High frequency (HF) bats such as eastern red bats, tri-colored bats, and *Myotis* species typically have minimum frequencies greater than 30 kilohertz (kHz). Low frequency (LF) bats such as big brown bats, silver-haired bats, and hoary bats typically emit echolocation calls with minimum frequencies below 30 kHz. HF and LF species that may occur in the study area are listed in Table 1.

Bat passes were identified to species where possible, depending on call quality. Bat call files recorded at all stations were initially identified to species using Wildlife Acoustics Kaleidoscope Pro (v4.2.0) automated acoustic identification program[2]. WEST bat biologists qualitatively (manually) reviewed each file to determine if they were bat calls or noise, and to verify species if possible. Unidentifiable calls lacked the necessary diagnostic characteristics needed to make a correct identification, contained primarily approach phase calls[3], or were of too poor quality to identify. Unidentified bat calls were classified either as high frequency unknown (calls greater than 30 kHz) or low frequency unknown (calls less than 30 kHz). In some cases, bat calls shared characteristics between two species, and were classified accordingly. For example, big brown bat and silver-haired bat calls, eastern red bat and evening bat calls, and eastern red bat and tri-colored bat calls, can be difficult to distinguish from one another in certain cases. Bat calls that fit that definition were labeled as EF_LN for big brown/silver-haired bats, LB_NH for eastern red/evening bats or LB_PS for eastern red/tri-colored bats.

Statistical Analysis

The number of bat passes per detector-night was used as the standard metric for measuring bat activity. A bat pass was defined as a sequence of at least two echolocation calls (pulses) produced by an individual bat with no pause between calls of more than one second (Fenton 1980). The same bat could be recorded echolocating during multiple passes at a given station; therefore, <u>bat pass rates represent an index of bat activity, and do not represent numbers of individuals at each recording location</u>. For example, 10 bats could echolocate near a detector once on a given night, or one bat could echolocate near a detector 10 times on a given night; both situations would result in 10 bat passes per detector-night. .The number of bat passes was

[2] Kaleidoscope software, Wildlife Acoustics, 2017, Concord, Massachusetts

[3] Approach phase calls refer to certain calls that bats make as they approach prey items. These calls are highly variable, and may have different characteristics than the regular echolocation calls on which most identification processes, both automated and manual, are based, confounding identification of such calls.

determined by a WEST bat biologist with significant experience in acoustic analysis and identification of bat calls.

The sampling period was broken down into different seasons (spring, summer, and fall) based on migratory patterns seen in bats, to provide information on how the bats are using the areas in the vicinity of the recording stations during different times of the year. Spring migration season (spring) was defined as March 21 to May 14, 2017. Summer maternity season (summer) was defined as May 15 to July 31, 2017. Fall season (fall) was defined as August 1 to November 15, 2017, and the fall migration period (FMP; July 30 to October 14) was included as a subset of the fall season. The FMP was defined by WEST as a standard for comparison with activity estimates from other wind energy facilities. During the FMP, bats begin moving toward wintering areas, and many species of bats initiate reproductive behaviors (Cryan 2008). This period of increased landscape-scale movement and reproductive behavior is often associated with increased levels of bat fatalities at operational onshore wind energy facilities (Arnett et al. 2008; Arnett and Baerwald 2013).

The period of peak sustained bat activity was defined as the seven-day period with the highest average bat activity. If multiple seven-day periods equaled the peak sustained bat activity rate, all dates in these seven-day periods were reported. This and all multi-detector averages in this report were calculated as an unweighted average of total activity (bat passes per detector-night) at each detector.

RESULTS

Acoustic detectors were deployed at the seven-mile elevated, seven-mile lower, three-mile lower, crib elevated, and crib lower stations for a total of 999 nights (station nights). Detectors were operational on 939 nights, (successful station nights; Table 3) resulting in a 93.7% success rate (including seven-mile elevated station during deployment of the station July 11 to August 30, 2017).

The MOU specified that detectors should be managed to ensure they operated correctly during at least 80% of the survey period. The seven-mile elevated station was not included in the following overall percent success calculations due to the experimental nature of the sampling. The overall project success during the warm season, defined as the nights of March 15 through November 15, 2017 by the MOU, was 90.2%, meeting the 80% minimum requirement of monitoring nights (Figure 2). The only nights where Figure 2 shows zero percent operational were nights that detectors were not deployed at the Project.

Duplicate detectors were deployed at each station for all or part of 2017 monitoring to add redundancy and further reduce the risk of data loss. Deployed nights include all nights that a detector was deployed at a station. Successful station nights include the number of nights at least one detector was functional at a station. Therefore, two detectors (both functioning) deployed at a station for one night equals one deployed night and one successful station night, or two detectors deployed for three nights, both functioned night one, one functioned night two, and neither functioned night three equals three deployed nights and two successful station nights. Non-successful detector nights were due to detector or microphone failure likely due to harsh weather conditions and/or lightning strikes.

Table 3. Operational success at the Icebreaker Wind Project Bat Survey Area, defined by detector-nights of acoustic data, by station and season.

	Station					
	Seven-Mile Elevated*	**Seven-Mile Lower**	**Three-Mile Lower**	**Crib Elevated**	**Crib Lower**	**Overall**
Spring	NA	55	40	53	52	200
Summer	21	78	58	75	78	310
Fall	30	105	105	89	100	429
Successful Detector- Nights	51	238	203	217	230	939
Number of Nights Detectors Were Deployed at a Given Station	51	238	238	238	238	999
Total Nights Available (full warm season)	246	246	246	246	246	1230
Success During Deployment	**100%**	**100%**	**86.0%**	**91.6%**	**97.1%**	**93.7%****
Success of Total Warm Season	**N/A**	**96.8%**	**82.5%**	**88.2%**	**93.5%**	**90.4%****

* Seven-mile elevated station was not included in overall percent success calculations
** includes only seven-mile lower, three-mile buoy, crib elevated, and crib lower stations

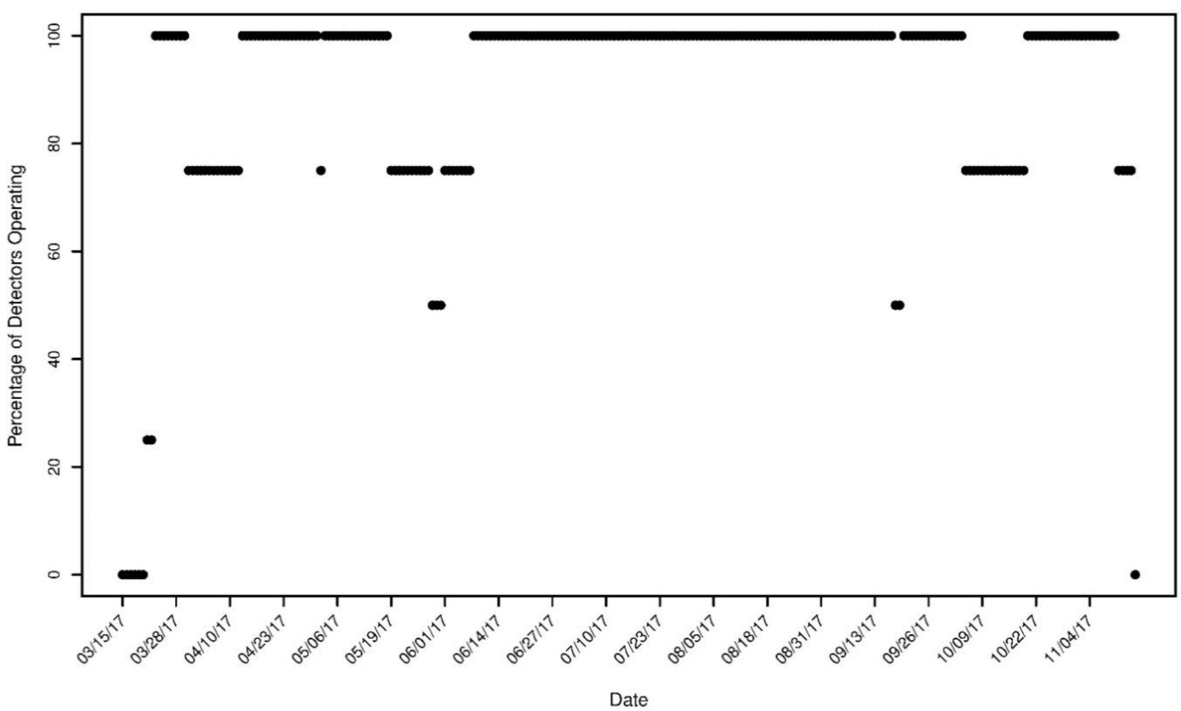

Figure 2. Operational success defined by successful station nights at the seven-mile lower, three-mile lower, crib elevated, and crib lower stations at the Icebreaker Wind Project Bat Survey Area during each night of deployment from March 15 to November 15, 2017. This does not incorporate the seven-mile elevated station due to the experimental nature of its deployment.

Overall Bat Activity

All 10 detectors at all five stations recorded a total of 10,114 bat passes on 1,531 successful detector nights[4]. The eight detectors deployed at seven-mile lower, three-mile lower, crib elevated, and crib lower stations from March 21 through November 14, 2017 recorded a total of 9,389 bat passes on 1,453 successful detector nights[4] for a mean ± standard error of 6.8±0.7 bat passes per detector-night. Lower detectors recorded a total of 9,128 bat passes over 1,118 successful detector-nights, with an average of 8.8±1.0 bat passes per detector-night. Elevated detectors recorded a total of 261 bat passes on 335 detector-nights, with an average of 0.8±0.1 bat passes per detector-night (Table 4; Figure 3). Low-frequency bat passes (5,499 bat passes recorded) were recorded more commonly than high-frequency bat passes (3,890 bat passes recorded; Table 4). Due to the duplicate detectors deployed at the same station it is likely that the same bat could be recorded echolocating on both detectors at the same time. It is also possible that the same bat could be recorded echolocating during multiple passes at a given station (or detector); therefore, bat pass rates (bat passes / detector night), also referred to as bat activity in this report, are a more appropriate metric for comparing use between detectors. Bat pass rates represent an index of bat activity, and do not represent numbers of individuals at each recording location.

Table 4. Results of acoustic bat surveys conducted at the Icebreaker Wind Project Bat Survey Area from March 21 to November 14, 2017. Bat passes are separated by call frequency: high frequency (HF) and low frequency (LF) groups.

Station	Microphone Placement	Number of HF Bat Passes	Number of LF Bat Passes	Total Bat Passes	Detector-Nights	Bat Passes/ Night*
Seven-mile lower 1	Water-level+one m	467	518	985	238	4.1±0.5
Seven-mile lower 2	Water-level+one m	436	509	945	212	4.5±0.6
Three-mile lower 1	Water-level+one m	468	601	1,069	203	5.3±0.7
Three-mile lower 2	Water-level+one m	486	435	921	140	6.6±1.1
Crib elevated 1	Elevated 50 m	9	133	142	185	0.8±0.1
Crib elevated 2	Elevated 50 m	18	101	119	150	0.8±0.1
Crib lower 1	Water-level+three m	1,154	2,131	3,285	206	16.0±1.5
Crib lower 2	Water-level+three m	852	1,071	1,923	119	16.2±2.1
Total Lower		**3,863**	**5,265**	**9,128**	**1,118**	**8.8±1.0**
Total Elevated		**27**	**234**	**261**	**335**	**0.8±0.1**
Total		**3,890**	**5,499**	**9,389**	**1,453**	**6.8±0.7**

* ± bootstrapped standard error; m = meters

[4] Nightly success of every detector including duplicate detectors deployed at all stations except the 7-mi elevated station.

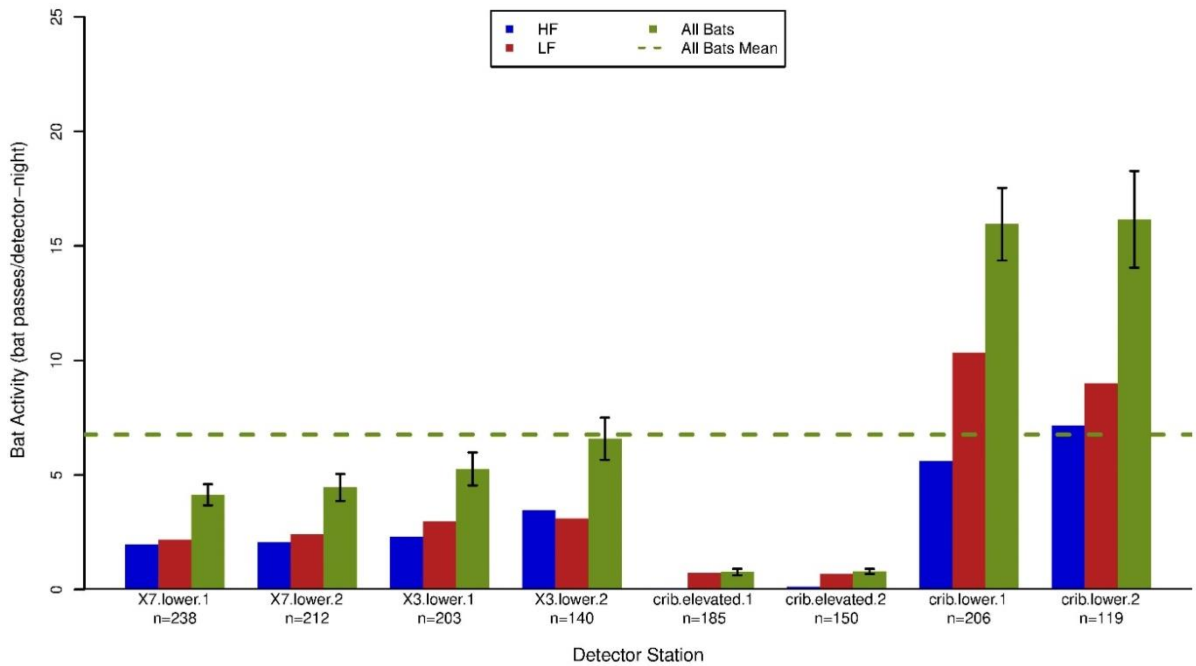

Figure 3. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at all detectors and stations at the Icebreaker Wind Project Bat Survey Area from March 21 to November 14, 2017.

X7.lower = seven-mile buoy lower stations, X3.lower = three mile buoy lower stations

Bat activity varied between stations, with the highest activity seen at the crib lower detectors (16.0±1.6 and 16.2±2.1 bat passes per detector-night), and the lowest activity seen at the crib elevated detectors (0.8±0.1 and 0.8±0.1 bat passes per detector-night; Table 3). Bat activity decreased as distance from land increased. The three-mile lower detectors recorded an average of 5.3±0.7 and 6.6±1.1 bat passes per detector-night, and the seven-mile lower detectors recorded an average of 4.1±0.5 and 4.5±0.6 bat passes per detector-night (Table 3).

"Seven-Mile" Elevated Station

The seven-mile elevated station was deployed only during the middle of the warm season, July 11 to August 30, 2017. This time period included the end of the summer season, beginning of the fall season and the fall migration period. In order to focus on direct comparison of bat activity at the different stations during this time period a subset of all data recorded at all stations were analyzed. Bat activity was highest at the crib lower detectors (28.7±4.5 and 20.9±3.5 bat passes per detector-night), and lowest at the crib elevated detectors (2.4±0.5 and 1.0±0.2 bat passes per detector-night). Bat activity at the seven-mile elevated, seven-mile lower, and three-mile lower stations was similar, falling within the bootstrapped standard error of mean bat passes per detector-night (Table 5; Figure 4).

Table 5. Results of acoustic bat surveys conducted at the Icebreaker Wind Project Bat Survey Area from July 11 through August 30, 2017*. Bat passes are separated by call frequency: high frequency (HF) and low frequency (LF) groups.

Station	Microphone Placement	Number of HF Bat Passes	Number of LF Bat Passes	Total Bat Passes	Detector-Nights	Bat Passes/ Night**
Seven-mile elevated 1	Elevated 10 m	112	189	301	35	8.6±1.7
Seven-mile elevated 2	Elevated 10 m	171	253	424	43	9.9±1.8
Seven-mile lower 1	Water-level+one m	212	225	437	51	8.6±1.7
Seven-mile lower 2	Water-level+one m	203	266	469	51	9.2±1.6
Three-mile lower 1	Water-level+one m	176	263	439	51	8.6±1.7
Three-mile lower 2	Water-level+one m	200	233	433	51	8.5±1.5
Crib elevated 1	Elevated 50 m	8	87	95	40	2.4±0.5
Crib elevated 2	Elevated 50 m	10	42	52	51	1.0±0.2
Crib lower 1	Water-level+three m	556	737	1,293	45	28.7±4.5
Crib lower 2	Water-level+three m	486	578	1,064	51	20.9±3.5
Total Lower		**1,833**	**2,302**	**4,135**	**300**	**14.1±2.0**
Total Elevated		**301**	**571**	**872**	**169**	**5.5±0.8**
Total		**2,134**	**2,873**	**5,007**	**469**	**10.6±1.5**

* July 11 through August 30, 2017 is the time period that the seven-mile elevated stations were deployed
** ± bootstrapped standard error.
m = meters

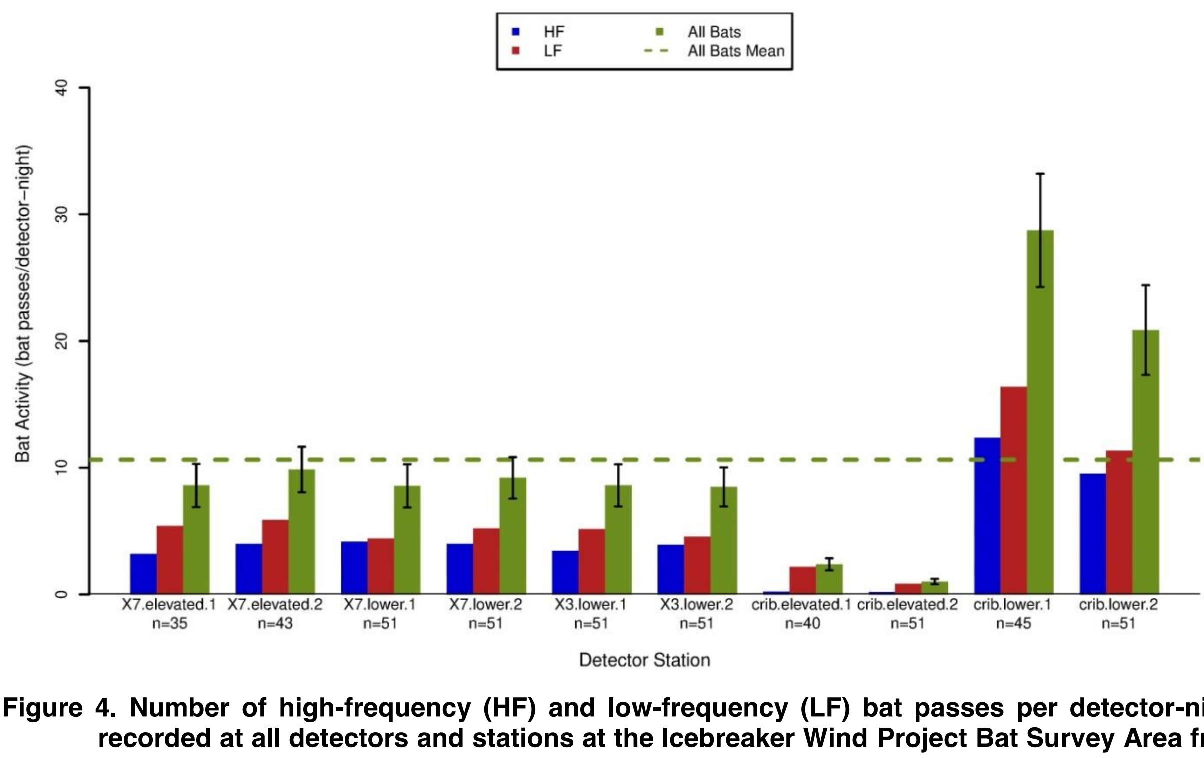

Figure 4. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at all detectors and stations at the Icebreaker Wind Project Bat Survey Area from July 11 through August 30, 2017*.

X7. Elevated = seven-mile buoy elevated stations, X7.lower = seven-mile buoy lower stations, X3.lower = three mile buoy lower stations

* July 11 through August 30, 2017 is the time period that the seven-mile elevated stations were deployed

Seasonal Patterns of Bat Activity

Fall Migration Period

Data from the Seven-mile elevated station was excluded from seasonal comparisons of activity, because this station only operated during a portion of the fall migration period. Overall bat activity at the seven-mile lower, three-mile lower, crib elevated, and crib lower stations combined, was highest during the FMP with 10.0±1.4 bat passes per detector-night. Bat activity at lower stations was highest during the FMP with 13.2±1.9 bat passes per detector-night. Bat activity at elevated stations was highest during the summer season with 1.6±0.3 bat passes per detector-night.

Spring

Overall bat activity was lowest during the spring season with 1.7±0.6 bat passes per detector-night. The majority of bat activity during the spring season was attributed to low-frequency bats (1.6±0.6 bat passes per detector-night). There were very few high-frequency bats recorded during the spring (0.2±0.0 bat passes per detector-night). High-frequency bats were only recorded at lower stations in the spring.

Summer and Fall

Overall bat activity was higher during the summer season with 8.5±1.0 bat passes per detector-night than during the fall season with 7.0±1.0 bat passes per detector-night. Lower stations had slightly higher bat activity during the summer season (10.8±1.4 bat passes per detector-night) than during the fall season (9.2±1.5 bat passes per detector night). Crib elevated stations had higher bat activity in the summer season (1.6±0.3 bat passes per detector-night) than in the fall (0.3±0.1 bat passes per detector-night; Table 6; Figure 5).

Project Site – "Seven-mile" buoy

Bat activity at the seven-mile lower station was highest during the FMP with 9.2±1.4 bat passes per detector night, followed by fall with 6.3±1.0 bat passes per detector-night, summer with 4.1±0.8 bat passes per detector-night, and spring with 0.7±0.2 bat passes per detector-night. During the FMP and fall high-frequency bat activity was higher (FMP: 5.1±0.8 bat passes per detector-night; fall: 3.7±0.6 bat passes per detector-night) than low-frequency bat activity (FMP: 4.1±0.8 bat passes per detector-night; fall: 2.6±0.5 bat passes per detector-night). During the spring and summer low-frequency bat activity was higher (spring: 0.7±0.2 bat passes per detector-night; summer: 3.1±0.7 bat passes per detector-night) than high-frequency bat activity (spring: 0.1±0.0 bat passes per detector-night; summer: 1.0±0.2 bat passes per detector-night).

Table 6. The number of bat passes per detector-night recorded at the Icebreaker Wind Project Bat Survey Area during each season, separated by call frequency: high-frequency (HF), low-frequency (LF), and all bats (AB).

Station	Call Frequency	Spring March 21 – May 14*	Summer May 15 – July 31	Fall Aug 1 – Nov 15	Fall Migration Period Jul 30 – Oct 14
	LF	0.7	2.9	2.5	3.8
Seven-mile lower 1	HF	0.0	0.9	3.8	5.3
	AB	0.7	3.7	6.3	9.1
	LF	0.7	3.4	2.8	4.3
Seven-mile lower 2	HF	0.1	1.1	3.6	5.0
	AB	0.7	4.4	6.3	9.3
	LF	1.7	4.7	2.5	4.0
Three-mile lower 1	HF	0.1	2.3	3.1	4.5
	AB	1.8	7.0	5.6	8.5
	LF	NA	4.4	2.6	3.8
Three-mile lower 2	HF	NA	3.0	3.7	5.0
	AB	NA	7.4	6.2	8.7
	LF	0.1	1.7	0.2	0.5
Crib elevated 1	HF	0.0	0.1	0.0	0.1
	AB	0.1	1.8	0.2	0.6
	LF	NA	1.2	0.3	0.3
Crib elevated 2	HF	NA	0.1	0.1	0.1
	AB	NA	1.3	0.4	0.5
	LF	4.8	16.0	8.4	14.3
Crib lower 1	HF	0.6	6.7	7.9	12.5
	AB	5.4	22.7	16.3	26.8
	LF	NA	12.4	7.2	8.6
Crib lower 2	HF	NA	7.0	7.3	8.1
	AB	NA	19.4	14.5	16.7
	LF	**2.0±0.7**	**7.3±1.1**	**4.3±0.7**	**6.5±1.0**
Lower Totals	**HF**	**0.2±0.1**	**3.5±0.5**	**4.9±0.9**	**6.7±1.1**
	AB	**2.1±0.7**	**10.8±1.4**	**9.2±1.5**	**13.2±1.9**
	LF	**0.1±0.1**	**1.5±0.2**	**0.2±0.1**	**0.4±0.2**
Elevated Totals	**HF**	**0.0±0.0**	**0.1±0.0**	**0.1±0.0**	**0.1±0.1**
	AB	**0.1±0.1**	**1.6±0.3**	**0.3±0.1**	**0.5±0.2**
	LF	**1.6±0.6**	**5.8±0.7**	**3.3±0.5**	**5.0±0.7**
Overall	**HF**	**0.2±0.0**	**2.6±0.3**	**3.7±0.6**	**5.1±0.7**
	AB	**1.7±0.6**	**8.5±1.0**	**7.0±1.0**	**10.0±1.4**

* not all stations had duplicate detectors deployed during the spring season

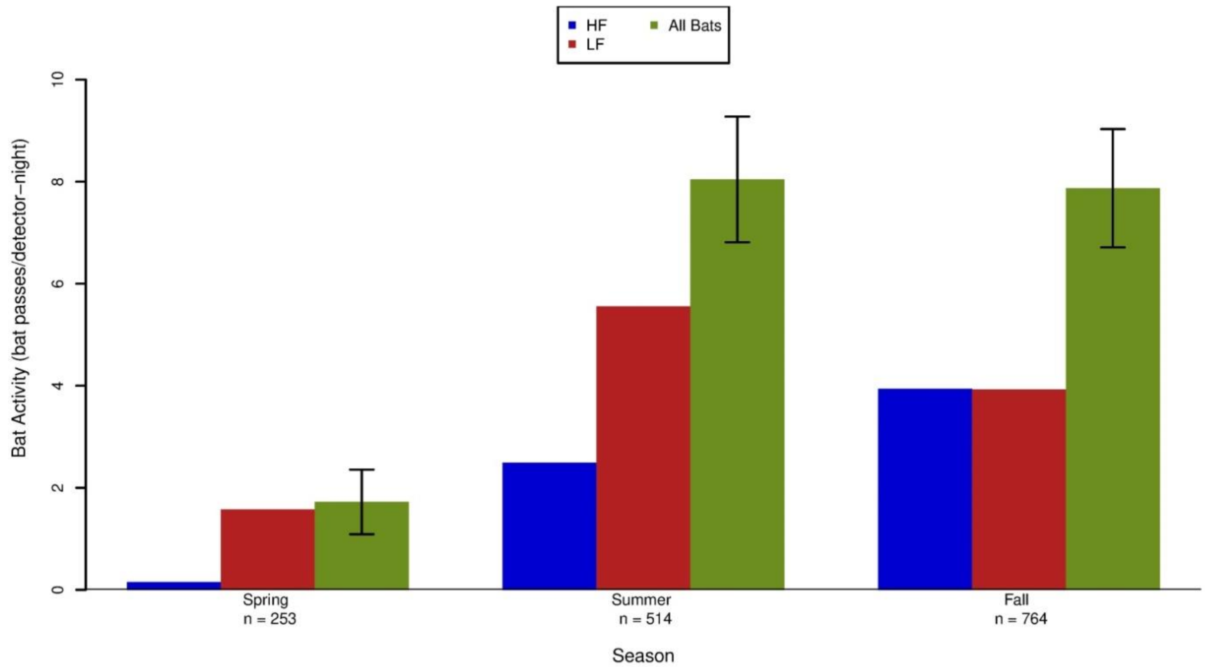

Figure 5. Seasonal bat activity by high-frequency (HF), low-frequency (LF), and all bats at the Icebreaker Wind Project Bat Survey Area from March 21 through November 14, 2017. The bootstrapped standard errors are represented on the 'All Bats' columns.

Overall weekly acoustic activity at the crib elevated and lower, three-mile buoy, and seven-mile lower buoy stations for all bats peaked from September 20 to September 26, 2017 with 31.7 bat passes per detector-night. Low-frequency bat activity peaked during the same time week as all bat activity with 14.1 bat passes per detector-night. High-frequency bat activity peaked slightly earlier, from September 18 to September 24, 2017 with 17.9 bat passes per detector-night. In all seasons high-frequency bat activity peaked earlier than low-frequency and all bat activity (Table 7; Figure 6). Overall bat activity gradually decreased for the remainder of the study period from September 26 through November 14, 2017 (Figure 6).

Table 7. Periods of peak activity for high-frequency, low-frequency, and all bats at the Icebreaker Wind Project Bat Survey Area from March 21 to November 14, 2017.

	High-Frequency			Low-Frequency			All Bats		
Season	**Start**	**End**	**Bat passes per detector-night**	**Start**	**End**	**Bat passes per detector-night**	**Start**	**End**	**Bat passes per detector-night**
Spring	4/9	4/15	0.5	4/24	4/30	5.5	4/24	4/30	5.8
Summer	7/17	7/23	5.9	7/25	7/31	11.1	7/25	7/31	16.7
Fall	9/18	9/24	17.9	9/20	9/26	14.1	9/20	9/26	31.7
FMP	9/18	9/24	17.9	9/20	9/26	14.1	9/20	9/26	31.7
Overall	9/18	9/24	17.9	9/20	9/26	14.1	9/20	9/26	31.7

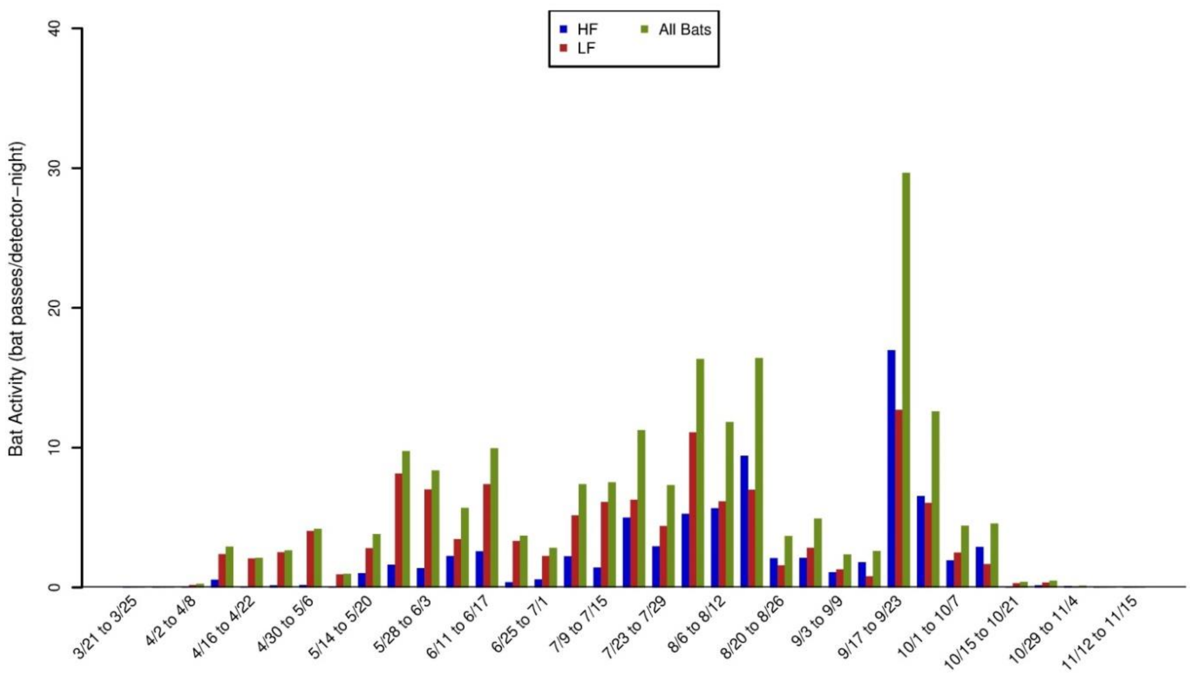

Figure 6. Weekly patterns of bat activity by high-frequency (HF), low-frequency (LF), and all bats at the Icebreaker Wind Project Bat Survey Area from March 21 to November 14, 2017.

Overall weekly acoustic activity at the seven-mile lower station for all bats peaked from September 20 to September 26, 2017 with 20.8 bat passes per detector-night. Low-frequency bat activity peaked from August 28 to September 3, 2017 with 10 bat passes per detector-night. High-frequency bat activity peaked from September 17 to September 23, 2017 with 14.4 bat passes per detector-night (Table 8).

Table 8. Periods of peak activity for high-frequency, low-frequency, and all bats at the Icebreaker Wind Project Seven-mile lower station from March 21 to November 14, 2017.

	High-Frequency			Low-Frequency			All Bats		
Season	**Start**	**End**	**Bat passes per detector-night**	**Start**	**End**	**Bat passes per detector-night**	**Start**	**End**	**Bat passes per detector-night**
Spring	4/8	4/16	0.3	4/12	4/21	2.1	4/12	4/21	2.2
Summer	7/16	7/25	2.4	7/25	7/31	7	7/25	7/31	8.6
Fall	9/17	9/23	14.4	8/28	9/3	10	9/20	9/26	20.8
FMP	9/17	9/23	14.4	8/28	9/3	10	9/20	9/26	20.8
Overall	9/17	9/23	14.4	8/28	9/3	10	9/20	9/26	20.8

Species Composition

Overall Bat Species Activity

Kaleidoscope isolated a total of 10,426 bat passes files from all seasons, detectors, and stations; this number also includes files containing bat calls that could not be identified to species by Kaleidoscope. WEST biologists identified 10,114 bat passes of these passes to species or species group (high- or low-frequency unknown, EF_LN, LB_NH or LB_PS; Table 9). There were 312 bat passes that were identified as bats by Kaleidoscope that were determined to be noise files during manual review.

Long-distance migratory species were the three most commonly identified bat species across all stations, accounting for approximately 80% of all bat activity. Eastern red bats were the most commonly identified species with a total of 4,097 bat passes (40.5%) recorded across all stations. Hoary bats were the second most commonly identified species with a total of 2,454 bat passes (24.3%) recorded across all stations. Silver-haired bats were the third most commonly identified species with a total of 1,545 bat passes (15.3%) recorded across all stations. Big brown bats were the fourth most commonly identified species with a total of 1,210 bat passes (12.0%) recorded across all stations. Less commonly identified species included low-frequency unknown bats (440 bat passes [4.4%]), big brown/silver-haired bat group (292 bat passes [2.9%]), high-frequency unknown bats (45 bat passes [0.4%]), tri-colored bats (13 bat passes [0.1%], eastern red/evening bat group (10 bat passes [0.1%]), eastern red/tri-colored bat group (7 bat passes [0.1%]), and little brown bats (1 bat pass [0.01%]; Table 9 and Table 10) All species across all seasons had higher activity at the lower stations than the elevated stations.

At the Project site, seven-mile lower buoy (nine miles offshore), long-distance migratory species were the three most commonly identified bat species at the seven-mile lower and elevated stations, accounting for approximately 80% of all bat activity. Eastern red bats were the most commonly identified species with a total of 1,159 bat passes (53.8%) recorded at the seven-mile elevated and lower stations for the entire duration of sampling. Hoary bats were the second most commonly identified with a total of 630 bat passes (29.2%) recorded. Silver-haired bats were the third most commonly identified species with a total of 365 bat passes (16.9%) recorded. Other less commonly recorded species included big brown bats (273 bat passes [7.9%]), tri-colored bats (three bat passes [less than 0.1%]), and little brown bats (one bat pass [less than 0.1%]). The little brown bat and tri-colored bats were both recorded at the seven-mile lower stations.

Bat species diversity was highest at the seven-mile lower station with the following six bat species identified: big brown, eastern red, hoary, silver-haired, little brown, and tri-colored bats. Five bat species and five bat species groups were identified at the crib lower station: big brown, eastern red, hoary, silver-haired, and tri-colored bats. The crib elevated station had the lowest bat diversity, with the following four bat species identified: big brown, eastern red, hoary, silver-haired bats (Figure 7).

Table 9. Number of bat calls qualitatively verified at the Icebreaker Wind Energy Project Bat Survey Area from March 21 to November 14, 2017.

Station	EF_LN	EPFU	LABO	LACI	LANO	LB_NH	LB_PS	MYLU	PESU	UNHF	UNLF	All Bats
Seven-mile elevated 1	10	28	112	124	13	0	0	0	0	0	14	**301**
Seven-mile elevated 2	8	51	170	137	31	0	0	0	0	1	26	**424**
Seven-mile lower 1	24	97	454	176	179	1	0	0	2	10	42	**985**
Seven-mile lower 2	26	97	423	193	142	1	0	1	1	10	51	**945**
Three-mile lower 1	44	85	461	269	184	0	0	0	0	7	19	**1,069**
Three-mile lower 2	26	76	475	211	90	2	0	0	0	9	32	**921**
Crib elevated 1	0	5	9	107	16	0	0	0	0	0	5	**142**
Crib elevated 2	1	1	17	75	19	0	0	0	0	1	5	**119**
Crib lower 1	107	488	1,141	719	690	1	2	0	6	4	127	**3,285**
Crib lower 2	46	282	835	443	181	5	5	0	4	3	119	**1,923**
Total Lower	**273**	**1,125**	**3,789**	**2,011**	**1,466**	**10**	**7**	**1**	**13**	**43**	**390**	**9,128**
Total Elevated	**19**	**85**	**308**	**443**	**79**	**0**	**0**	**0**	**0**	**2**	**50**	**986**
Total	**292**	**1,210**	**4,097**	**2,454**	**1,545**	**10**	**7**	**1**	**13**	**45**	**440**	**10,114**

EF_LN = big brown /silver –haired bat group, EPFU = big brown bat, LABO = eastern red bat, LACI = hoary bat, LANO = silver haired bat, LB_NH = eastern red/evening bat group, LB_PS = eastern red/tri-colored bat group, MYLU = little brown bat, PESU = tri-colored bat, UNHF = high frequency unidentified, UNLF = low frequency unidentified.

Table 10. Percentage[1] of bat calls qualitatively verified at the Icebreaker Wind Energy Project Bat Survey Area from March 21 to November 14, 2017.

Station	EF_LN	EPFU	LABO	LACI	LANO	LB_NH	LB_PS	MYLU	PESU	UNHF	UNLF	All Bats
Seven-mile elevated 1	3.4%	2.3%	2.7%	5.1%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	3.2%	**3.0%**
Seven-mile elevated 2	2.7%	4.2%	4.1%	5.6%	2.0%	0.0%	0.0%	0.0%	0.0%	2.2%	5.9%	**4.2%**
Seven-mile lower 1	8.2%	8.0%	11.1%	7.2%	11.6%	10.0%	0.0%	0.0%	15.4%	22.2%	9.5%	**9.7%**
Seven-mile lower 2	8.9%	8.0%	10.3%	7.9%	9.2%	10.0%	0.0%	100%	7.7%	22.2%	11.6%	**9.3%**
Three-mile lower 1	15.1%	7.0%	11.3%	11.0%	11.9%	0.0%	0.0%	0.0%	0.0%	15.6%	4.3%	**10.6%**
Three-mile lower 2	8.9%	6.3%	11.6%	8.6%	5.8%	20.0%	0.0%	0.0%	0.0%	20.0%	7.3%	**9.1%**
Crib elevated 1	0.0%	0.4%	0.2%	4.4%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%	**1.4%**
Crib elevated 2	0.3%	0.1%	0.4%	3.1%	1.2%	0.0%	0.0%	0.0%	0.0%	2.2%	1.1%	**1.2%**
Crib lower 1	36.6%	40.3%	27.8%	29.3%	44.7%	10.0%	28.6%	0.0%	46.2%	8.9%	28.9%	**32.5%**
Crib lower 2	15.8%	23.3%	20.4%	18.1%	11.7%	50.0%	71.4%	0.0%	30.8%	6.7%	27.0%	**19.0%**
Total Lower	**93.5%**	**93.0%**	**92.5%**	**81.9%**	**94.9%**	**100%**	**100%**	**100%**	**100%**	**95.6%**	**88.6%**	**90.3%**
Total Elevated	**6.5%**	**7.0%**	**7.5%**	**18.1%**	**5.1%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**4.4%**	**11.4%**	**9.7%**
Total[2]	**2.9%**	**12.0%**	**40.5%**	**24.3%**	**15.3%**	**0.1%**	**0.1%**	**<0.1%**	**0.1%**	**0.4%**	**4.4%**	**100.0%**

EF_LN = big brown /silver –haired bat group, EPFU = big brown bat, LABO = eastern red bat, LACI = hoary bat, LANO = silver haired bat, LB_NH = eastern red/evening bat group, LB_PS = eastern red/tri-colored bat group, MYLU = little brown bat, PESU = tri-colored bat, UNHF = high frequency unidentified, UNLF = low frequency unidentified.

[1] Calculated by taking the number of species bat passes recorded at a detector or station type divided by the total number of species bat passes recorded.

[2] Calculated by taking the number of species bat passes recorded divided by the all bats total number of bat passes recorded at the Icebreaker Wind Energy Project.

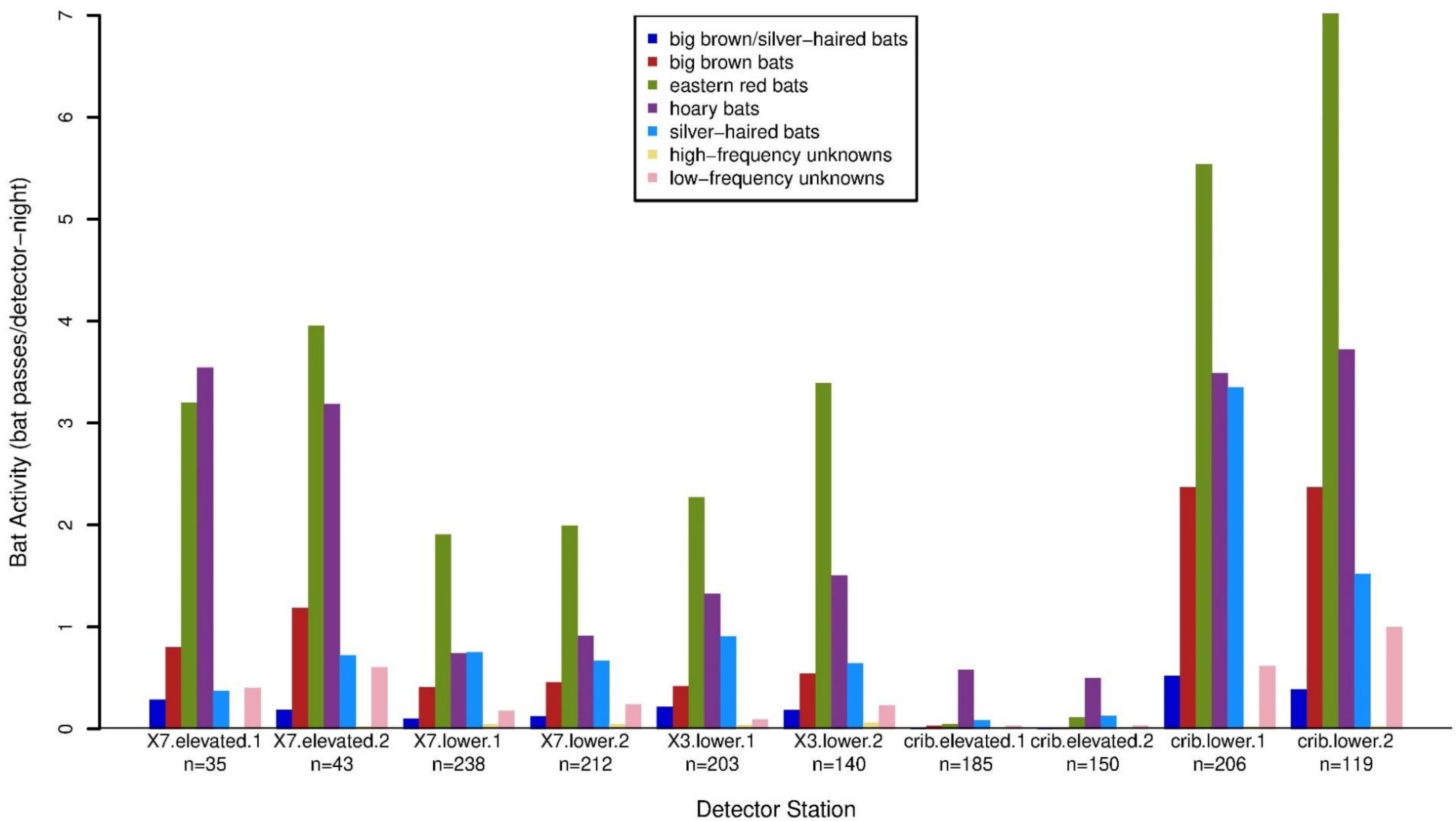

Figure 7. Bat species present at each detector location and station at the Icebreaker Wind Project Bat Survey Area from March 21 to November 14, 2017.

X7.elevated = seven-mile buoy elevated stations, X7.lower = seven-mile buoy lower stations, X3.lower = three mile buoy lower stations

Seasonal Patterns of Bat Species Activity

Spring season was defined as beginning March 21 through May 14, 2017. There were 430 bat passes identified to species or species group during the spring season. Silver-haired bats were the most commonly identified species during the spring, with 312 bat passes (72.6%) recorded across all stations. Big brown bats, eastern red bats, and hoary bats were identified in low numbers during the spring season; eastern red bats with 37 bat passes (8.6%), big brown/silver-haired bat group with 33 bat passes (7.7%), hoary bats with 22 bat passes (5.1%), and big brown bats with 17 bat passes (4.0%). There were eight bat passes (1.9%) categorized into the low-frequency unknown group, and one bat pass (0.2%) categorized into the high-frequency unknown group (Table 11 and Table 12).

Summer season was defined as May 15 through July 31, 2017. There were 4,230 bat passes identified to species or species group during the summer season. Hoary bats were the most commonly identified species during the summer, with 1,359 bat passes (32.1%) recorded across all stations. Eastern red bats were the second most commonly identified species during the summer, with 1,258 bat passes (29.7%) recorded across all stations. Silver-haired bats and big brown bats were recorded in moderate numbers during the summer season; silver-haired bats (622 bat passes [14.7%]), and big brown bats (606 bat passes [14.3%]). Additional species detected in lower numbers included: low-frequency unknown group (215 bat passes [5.1%]), big brown/silver-haired bat group (157 bat passes [3.7%]), high-frequency unknown group (eight bat passes [0.2%]), tri-colored bats (three bat passes [0.1%]), eastern red/evening bat group (one bat pass [less than 0.1%]), and eastern red/tri-colored bat group (one bat pass [less than 0.1%]; Table 13 and Table 14).

Table 11. Number of bat calls qualitatively verified at the Icebreaker Wind Energy Project Bat Survey Area during the spring season (March 21 – May 14, 2017).

Station	EF_LN	EPFU	LABO	LACI	LANO	LB_NH	LB_PS	MYLU	PESU	UNHF	UNLF	All Bats
Seven-mile lower 1	1	0	2	5	30	0	0	0	0	0	0	**38**
Seven-mile lower 2	0	0	3	2	33	0	0	0	0	0	1	**39**
Three-mile lower 1	1	3	2	3	58	0	0	0	0	1	2	**70**
Crib elevated 1	0	0	0	0	4	0	0	0	0	0	0	**4**
Crib lower 1	31	14	30	12	187	0	0	0	0	0	5	**279**
Total Lower	**33**	**17**	**37**	**22**	**308**	**0**	**0**	**0**	**0**	**1**	**8**	**426**
Total Elevated	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**4**
Total	**33**	**17**	**37**	**22**	**312**	**0**	**0**	**0**	**0**	**1**	**8**	**430**

EF_LN = big brown /silver –haired bat group, EPFU = big brown bat, LABO = eastern red bat, LACI = hoary bat, LANO = silver haired bat, LB_NH = eastern red/evening bat group, LB_PS = eastern red/tri-colored bat group, MYLU = little brown bat, PESU = tri-colored bat, UNHF = high frequency unidentified, UNLF = low frequency unidentified.

Table 12. Percentage[1] of bat calls qualitatively verified at the Icebreaker Wind Energy Project Bat Survey Area during the spring season (March 21 – May 14, 2017).

Station	EF_LN	EPFU	LABO	LACI	LANO	LB_NH	LB_PS	MYLU	PESU	UNHF	UNLF	All Bats
Seven-mile lower 1	3.0%	0%	5.4%	22.7%	9.6%	0%	0%	0%	0%	0%	0%	**8.8%**
Seven-mile lower 2	0%	0%	8.1%	9.1%	10.6%	0%	0%	0%	0%	0%	12.5%	**9.1%**
Three-mile lower 1	3.0%	17.6%	5.4%	13.6%	18.6%	0%	0%	0%	0%	100%	25.0%	**16.3%**
Crib elevated 1	0%	0%	0%	0%	1.3%	0%	0%	0%	0%	0%	0%	**0.9%**
Crib lower 1	93.9%	82.4%	81.1%	54.5%	59.9%	0%	0%	0%	0%	0%	62.5%	**64.9%**
Total Lower	**100%**	**100%**	**100%**	**100%**	**98.7%**	**0%**	**0%**	**0%**	**0%**	**100%**	**99.1%**	**99.1%**
Total Elevated	**0%**	**0%**	**0%**	**0%**	**1.3%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0.9%**	**0.9%**
Total[2]	**7.7%**	**4.0%**	**8.6%**	**5.1%**	**72.6%**	**0%**	**0%**	**0%**	**0%**	**0.2%**	**1.9%**	**100%**

[1] Calculated by taking the number of species bat passes recorded at a detector or station type divided by the total number of species bat passes recorded.
[2] Calculated by taking the number of species bat passes recorded divided by the all bats total number of bat passes recorded at the IWP.

Table 13. Number of bat calls qualitatively verified at the Icebreaker Wind Energy Project Bat Survey Area during the summer season (May 15 – July 31, 2017).

Station	EF_LN	EPFU	LABO	LACI	LANO	LB_NH	LB_PS	MYLU	PESU	UNHF	UNLF	All Bats
Seven-mile elevated 1	5	10	42	76	3	0	0	0	0	0	7	**143**
Seven-mile elevated 2	1	7	23	40	3	0	0	0	0	0	2	**76**
Seven-mile lower 1	14	40	66	82	64	0	0	0	0	0	23	**289**
Seven-mile lower 2	5	35	53	92	36	0	0	0	0	4	15	**240**
Three-mile lower 1	24	45	136	141	55	0	0	0	0	0	7	**408**
Three-mile lower 2	9	37	117	105	22	0	0	0	0	4	9	**303**
Crib elevated 1	0	4	8	98	11	0	0	0	0	0	5	**126**
Crib elevated 2	1	0	6	58	11	0	0	0	0	0	4	**80**
Crib lower 1	71	277	523	457	365	1	0	0	2	0	75	**1,771**
Crib lower 2	27	151	284	210	52	0	1	0	1	0	68	**794**
Total Lower	**150**	**585**	**1,179**	**1,087**	**594**	**1**	**1**	**0**	**3**	**8**	**197**	**3,805**
Total Elevated	**7**	**21**	**79**	**272**	**28**	**0**	**0**	**0**	**0**	**0**	**18**	**425**
Total	**157**	**606**	**1,258**	**1,359**	**622**	**1**	**1**	**0**	**3**	**8**	**215**	**4,230**

EF_LN = big brown /silver –haired bat group, EPFU = big brown bat, LABO = eastern red bat, LACI = hoary bat, LANO = silver haired bat, LB_NH = eastern red/evening bat group, LB_PS = eastern red/tri-colored bat group, MYLU = little brown bat, PESU = tri-colored bat, UNHF = high frequency unidentified, UNLF = low frequency unidentified.

Table 14. Percentage[1] of bat calls qualitatively verified at the Icebreaker Wind Energy Project Bat Survey Area during the summer season (May 15 – July 31, 2017).

Station	EF_LN	EPFU	LABO	LACI	LANO	LB_NH	LB_PS	MYLU	PESU	UNHF	UNLF	All Bats
Seven-mile elevated 1	3.2%	1.7%	3.3%	5.6%	0.5%	0%	0%	0%	0%	0%	3.3%	**3.4%**
Seven-mile elevated 2	0.6%	1.2%	1.8%	2.9%	0.5%	0%	0%	0%	0%	0%	0.9%	**1.8%**
Seven-mile lower 1	8.9%	6.6%	5.2%	6.0%	10.3%	0%	0%	0%	0%	0%	10.7%	**6.8%**
Seven-mile lower 2	3.2%	5.8%	4.2%	6.8%	5.8%	0%	0%	0%	0%	50%	7.0%	**5.7%**
Three-mile lower 1	15.3%	7.4%	10.8%	10.4%	8.8%	0%	0%	0%	0%	0%	3.3%	**9.6%**
Three-mile lower 2	5.7%	6.1%	9.3%	7.7%	3.5%	0%	0%	0%	0%	50%	4.2%	**7.2%**
Crib elevated 1	0%	0.7%	0.6%	7.2%	1.8%	0%	0%	0%	0%	0%	2.3%	**3.0%**
Crib elevated 2	0.6%	0%	0.5%	4.3%	1.8%	0%	0%	0%	0%	0%	1.9%	**1.9%**
Crib lower 1	45.2%	45.7%	41.6%	33.6%	58.7%	100%	0%	0%	66.7%	0%	34.9%	**41.9%**
Crib lower 2	17.2%	24.9%	22.6%	15.5%	8.4%	0%	100%	0%	33.3%	0%	31.6%	**18.8%**
Total Lower	**95.5%**	**96.5%**	**93.7%**	**80%**	**95.5%**	**100%**	**100%**	**0%**	**100%**	**100%**	**91.6%**	**90%**
Total Elevated	**4.5%**	**3.5%**	**6.3%**	**20%**	**4.5%**	**0%**	**0%**	**0%**	**0%**	**0%**	**8.4%**	**10%**
Total[2]	**3.7%**	**14.3%**	**29.7%**	**32.1%**	**14.7%**	**<0.1%**	**<0.1%**	**0%**	**0.1%**	**0.2%**	**5.1%**	**100%**

[1] Calculated by taking the number of species bat passes recorded at a detector or station type divided by the total number of species bat passes recorded.
[2] Calculated by taking the number of species bat passes recorded divided by the all bats total number of bat passes recorded at the IWP.

Fall season was defined as August 1 through November 14, 2017. There were 5,454 bat passes identified to species or species group during the fall season. Eastern red bats were the most commonly identified species during the fall, with 2,802 bat passes (51.4%) recorded across all stations. Hoary, silver-haired, and big brown bats were other commonly identified species during the fall season, with 1,073 hoary bat passes (19.7%), 611 silver-haired bat passes (11.2%), and 587 big brown bat passes (10.8%) recorded across all stations. Additional species detected in lower numbers included: low-frequency unknown group (217 bat passes [4.0%]), big brown/silver-haired bat group (102 bat passes [1.9%]), high-frequency unknown group (36 bat passes [0.7%]), tri-colored bats (10 bat passes [0.2%]), eastern red/evening bat group (nine bat passes [0.2%]), and eastern red/tri-colored bat group (six bat passes [0.1%]). The only little brown bat pass identified was recorded during the fall season (one bat pass [less than 0.1%]; Table 15 and Table 16).

The FMP overlaps with the end of the summer season and beginning of the fall season, beginning July 30 and ending October 14, 2017. There were 6,018 bat passes identified to species or species group during the FMP. Species activity during the FMP was similar to the fall season. The most commonly identified species during the FMP were eastern red bats (2,962 bat passes [49.2%]), followed by hoary bats (1,219 bat passes [21.5%]), big brown bats (713 bat passes [11.8%]), and silver-haired bats (618 bat passes [10.3%]). The little brown bat pass was recorded at the seven-mile lower station during the FMP (Table 17 and Table 18).

Table 15. Number of bat calls qualitatively verified at the Icebreaker Wind Energy Project Bat Survey Area during the fall season (August 1 – November 14, 2017).

Station	EF_LN	EPFU	LABO	LACI	LANO	LB_NH	LB_PS	MYLU	PESU	UNHF	UNLF	All Bats
Seven-mile elevated 1	5	18	70	48	10	0	0	0	0	0	7	**158**
Seven-mile elevated 2	7	44	147	97	28	0	0	0	0	1	24	**348**
Seven-mile lower 1	9	57	386	89	85	1	0	0	2	10	19	**658**
Seven-mile lower 2	21	62	367	99	73	1	0	1	1	6	35	**666**
Three-mile lower 1	19	37	323	125	71	0	0	0	0	6	10	**591**
Three-mile lower 2	17	39	358	106	68	2	0	0	0	5	23	**618**
Crib elevated 1	0	1	1	9	1	0	0	0	0	0	0	**12**
Crib elevated 2	0	1	11	17	8	0	0	0	0	1	1	**39**
Crib lower 1	5	197	588	250	138	0	2	0	4	4	47	**1,235**
Crib lower 2	19	131	551	233	129	5	4	0	3	3	51	**1,129**
Total Lower	**90**	**523**	**2,573**	**902**	**564**	**9**	**6**	**1**	**10**	**34**	**185**	**4,897**
Total Elevated	**12**	**64**	**229**	**171**	**47**	**0**	**0**	**0**	**0**	**2**	**32**	**557**
Total	**102**	**587**	**2,802**	**1,073**	**611**	**9**	**6**	**1**	**10**	**36**	**217**	**5,454**

EF_LN = big brown /silver –haired bat group, EPFU = big brown bat, LABO = eastern red bat, LACI = hoary bat, LANO = silver haired bat, LB_NH = eastern red/evening bat group, LB_PS = eastern red/tri-colored bat group, MYLU = little brown bat, PESU = tri-colored bat, UNHF = high frequency unidentified, UNLF = low frequency unidentified.

Table 16. Percentage[1] of bat calls qualitatively verified at the Icebreaker Wind Energy Project Bat Survey Area during the fall season (August 1 – November 14, 2017).

Station	EF_LN	EPFU	LABO	LACI	LANO	LB_NH	LB_PS	MYLU	PESU	UNHF	UNLF	All Bats
Seven-mile elevated 1	4.9%	3.1%	2.5%	4.5%	1.6%	0%	0%	0%	0%	0%	3.2%	**2.9%**
Seven-mile elevated 2	6.9%	7.5%	5.2%	9.0%	4.6%	0%	0%	0%	0%	2.8%	11.1%	**6.4%**
Seven-mile lower 1	8.8%	9.7%	13.8%	8.3%	13.9%	11.1%	0%	0%	20%	27.8%	8.8%	**12.1%**
Seven-mile lower 2	20.6%	10.6%	13.1%	9.2%	11.9%	11.1%	0%	100%	10%	16.7%	16.1%	**12.2%**
Three-mile lower 1	18.6%	6.3%	11.5%	11.6%	11.6%	0%	0%	0%	0%	16.7%	4.6%	**10.8%**
Three-mile lower 2	16.7%	6.6%	12.8%	9.9%	11.1%	22.2%	0%	0%	0%	13.9%	10.6%	**11.3%**
Crib elevated 1	0%	0.2%	0%	0.8%	0.2%	0%	0%	0%	0%	0%	0%	**0.2%**
Crib elevated 2	0%	0.2%	0.4%	1.6%	1.3%	0%	0%	0%	0%	2.8%	0.5%	**0.7%**
Crib lower 1	4.9%	33.6%	21.0%	23.3%	22.6%	0%	33.3%	0%	40%	11.1%	21.7%	**22.6%**
Crib lower 2	18.6%	22.3%	19.7%	21.7%	21.1%	55.6%	66.7%	0%	30%	8.3%	23.5%	**20.7%**
Total Lower	**88.2%**	**89.1%**	**91.8%**	**84.1%**	**92.3%**	**100%**	**100%**	**100%**	**100%**	**94.4%**	**85.3%**	**89.8%**
Total Elevated	**11.8%**	**10.9%**	**8.2%**	**15.9%**	**7.7%**	**0%**	**0%**	**0%**	**0%**	**5.6%**	**14.7%**	**10.2%**
Total[2]	**1.9%**	**10.8%**	**51.4%**	**19.7%**	**11.2%**	**0.2%**	**0.1%**	**<0.1%**	**0.2%**	**0.7%**	**4.0%**	**100%**

[1] Calculated by taking the number of species bat passes recorded at a detector or station type divided by the total number of species bat passes recorded.
[2] Calculated by taking the number of species bat passes recorded divided by the all bats total number of bat passes recorded at the IWP.

Table 17. Number of bat calls qualitatively verified at the Icebreaker Wind Energy Project Bat Survey Area during the fall migration period (July 30 – October 14, 2017).

Station	EF_LN	EPFU	LABO	LACI	LANO	LB_NH	LB_PS	MYLU	PESU	UNHF	UNLF	All Bats
Seven-mile elevated 1	8	25	86	72	12	0	0	0	0	0	12	**215**
Seven-mile elevated 2	7	50	155	114	30	0	0	0	0	1	26	**383**
Seven-mile lower 1	8	64	394	112	87	1	0	0	2	10	24	**702**
Seven-mile lower 2	20	71	376	125	74	1	0	1	1	6	42	**717**
Three-mile lower 1	23	47	343	146	77	0	0	0	0	6	12	**654**
Three-mile lower 2	19	50	375	120	74	2	0	0	0	5	27	**672**
Crib elevated 1	0	1	5	17	1	0	0	0	0	0	0	**24**
Crib elevated 2	0	1	8	19	2	0	0	0	0	0	0	**30**
Crib lower 1	5	240	630	298	133	0	2	0	4	3	54	**1,369**
Crib lower 2	21	164	590	268	128	5	4	0	3	3	66	**1,252**
Total Lower	**96**	**636**	**2,708**	**1,069**	**573**	**9**	**6**	**1**	**10**	**33**	**225**	**5,366**
Total Elevated	**15**	**77**	**254**	**222**	**45**	**0**	**0**	**0**	**0**	**1**	**38**	**652**
Total	**111**	**713**	**2,962**	**1,291**	**618**	**9**	**6**	**1**	**10**	**34**	**263**	**6,018**

EF_LN = big brown /silver –haired bat group, EPFU = big brown bat, LABO = eastern red bat, LACI = hoary bat, LANO = silver haired bat, LB_NH = eastern red/evening bat group, LB_PS = eastern red/tri-colored bat group, MYLU = little brown bat, PESU = tri-colored bat, UNHF = high frequency unidentified, UNLF = low frequency unidentified.

Table 18. Percentage[1] of bat calls qualitatively verified at the Icebreaker Wind Energy Project Bat Survey Area during the fall migration period (July 30 – October 14, 2017).

Station	EF_LN	EPFU	LABO	LACI	LANO	LB_NH	LB_PS	MYLU	PESU	UNHF	UNLF	All Bats
Seven-mile elevated 1	7.2%	3.5%	2.9%	5.6%	1.9%	0%	0%	0%	0%	0%	4.6%	**3.6%**
Seven-mile elevated 2	6.3%	7.0%	5.2%	8.8%	4.9%	0%	0%	0%	0%	2.9%	9.9%	**6.4%**
Seven-mile lower 1	7.2%	9.0%	13.3%	8.7%	14.1%	11.1%	0%	0%	20%	29.4%	9.1%	**11.7%**
Seven-mile lower 2	18.0%	10%	12.7%	9.7%	12.0%	11.1%	0%	100%	10%	17.6%	16.0%	**11.9%**
Three-mile lower 1	20.7%	6.6%	11.6%	11.3%	12.5%	0%	0%	0%	0%	17.6%	4.6%	**10.9%**
Three-mile lower 2	17.1%	7.0%	12.7%	9.3%	12.0%	22.2%	0%	0%	0%	14.7%	10.3%	**11.2%**
Crib elevated 1	0%	0.1%	0.2%	1.3%	0.2%	0%	0%	0%	0%	0%	0%	**0.4%**
Crib elevated 2	0%	0.1%	0.3%	1.5%	0.3%	0%	0%	0%	0%	0%	0%	**0.5%**
Crib lower 1	4.5%	33.7%	21.3%	23.1%	21.5%	0%	33.3%	0%	40%	8.8%	20.5%	**22.7%**
Crib lower 2	18.9%	23.0%	19.9%	20.8%	20.7%	55.6%	66.7%	0%	30%	8.8%	25.1%	**20.8%**
Total Lower	**86.5%**	**89.2%**	**91.4%**	**82.8%**	**92.7%**	**100%**	**100%**	**100%**	**100%**	**97.1%**	**85.6%**	**89.2%**
Total Elevated	**13.5%**	**10.8%**	**8.6%**	**17.2%**	**7.3%**	**0%**	**0%**	**0%**	**0%**	**2.9%**	**14.4%**	**10.8%**
Total[2]	**1.8%**	**11.8%**	**49.2%**	**21.5%**	**10.3%**	**0.1%**	**0.1%**	**<0.1%**	**0.2%**	**0.6%**	**4.4%**	**100%**

[1] Calculated by taking the number of species bat passes recorded at a detector or station type divided by the total number of species bat passes recorded.
[2] Calculated by taking the number of species bat passes recorded divided by the all bats total number of bat passes recorded at the IWP.

In addition to the analysis of bat acoustic recordings described above, WEST also performed a statistical analysis of the correlation between the seven-mile lower and seven-mile elevated detector bat activity levels. This analysis was specifically requested by the IWP team based on discussions with ODNR, who requested that this additional analysis be performed to address the question of whether the data being gathered at these two recording stations was truly additive, as would be the case if the two data streams were found to be uncorrelated, or largely redundant, or if the two data streams were highly correlated. The results of this analysis showed bat activity at lower and elevated stations were highly correlated. The analysis was presented in a separate report provided by WEST to the IWP team, dated October 31, 2017. This report was submitted to ODNR on November 1, 2017, revised in response to ODNR comments on the initial draft, and the revised draft is attached as Appendix A.

DISCUSSION

The MOU signed by IWP and ODNR describes the goals of bat monitoring as 1) to document existing conditions and patterns of use by species of concern at the Project site; 2) to document changing conditions and patterns of use by species of concern and their associated habitats as a result of Project construction and operations at the Project site; 3) to develop and implement effective mitigation and adaptive management strategies to minimize avian and bat resource impacts; 4) to evaluate the feasibility of various monitoring protocols in an offshore setting; and 5) to better understand how offshore wind projects in Lake Erie or the Great Lakes may affect birds and bats. The bat monitoring completed in 2010 by Tetra Tech and 2017 by WEST measured patterns of use within and outside the Project site, and provides a baseline to which use can be compared after construction.

Offshore monitoring of bats provides unique challenges that on-shore facilities do not face. Humid conditions and harsh weather can cause bat detectors to malfunction more often than desired; despite the harsh conditions, detector success rates exceeded the 80% goal desired by ODNR, and met the intentions of the MOU. Use of redundant detectors at stations and regular checks of equipment by LimnoTech increased the success rate. The ability of SM4/3 detectors to handle moist conditions also increased the success rate relative to other detectors typically used collect bat activity at wind-energy projects, such as Anabat.

ODNR requested a detector be raised as high as possible within the Project site to better assess bat use closer to the rotor swept zone of turbines; in response, LimnoTech deployed an experimental offshore buoy with a 10-m carbon fiber pole attached to the buoy. The detector was placed near the buoy and the microphone was elevated to the top of the 10-m pole. The detector operated successfully until the bolts connecting the pole to the buoy failed and the pole broke off from the buoy. The failure of the bolts was likely due to high winds and large waves, illustrating the logistical challenges associated with monitoring bat activity in offshore environments. As described in Appendix A, attached, data collected from the 10-m detector was highly correlated with data collected at a nearby detector located near water level, suggesting that both detectors recorded bat calls within similar airspaces. Wave action and harsh weather associated with offshore environments make it impractical to collect acoustic bat data at heights greater than approximately 10-m for the majority of the active bat season. Collecting this additional data from elevated buoys is unlikely to provide additional insight into the existing conditions and patterns of use by bats at the Project site.

Previous Study Results

Acoustic studies using ultrasonic bat detectors provide a way to sample bats in locations, such as open water, that would not be able to be sampled using traditional bat capture methods. A wide variety of bat detectors exist on the market; however, different detector models use different technology and microphones to record bat echolocation calls (Downes 1982 and Fenton 2000). A study by Adams et al. (2012) compared five different bat detector models, and found that there is significant variation in detection ability of different bat detectors. Different detector models use different microphone types, such as directional and omnidirectional microphones. Omnidirectional microphones have a greater chance of recording bat echolocation calls than a directional microphone (Limpens and McCraken 2004). Direct comparison between studies that used different recording methods and technology should be made with caution, understanding that there are innate differences in the ability of different bat detectors to detect and record bat echolocation calls. Adams et al. (2012) showed Anabat detectors to consistently record fewer calls than four other detector types, including Wildlife Acoustics SM2 detectors. For example, Anabat units recorded approximately 5 synthetic bat calls played at 10-m from detectors at 25Khz compared to approximately 15 calls recorded by the SM2 detector.

Tetra Tech conducted a bat activity study (Svedlow et al. 2012) using some stations that were also monitored WEST in 2017. Svedlow et al. (2012) found different, generally lower, bat activity rates than the study by WEST. Different bat detectors were deployed in the two studies. In 2010, Anabat SD1 bat detectors were deployed and, in 2017, SM4/SM3 bat detectors were deployed. SD1 bat detectors use a directional microphone that is not waterproof (requires additional housing to protect the microphone); whereas the SM4 bat detectors use an omnidirectional waterproof microphone that is better suited for off-shore bat activity monitoring. SM4/SM3 microphones are more sensitive and record more bat calls than Anabat detectors. The differences in detector type preclude direct comparison of the number of bat passes recorded in 2017 to Svedlow et al. (2012) or most land-based wind-energy projects that used Anabat detectors. Generally, both the WEST study and Svedlow et al. (2012) found a similar species composition, along with seasonal activity trends (higher activity in the summer and fall) at the recording locations. Both WEST and Svedlow et al. (2012) documented significantly more bat activity at the lower detector on the crib compared to other detectors. Svedlow et al. (2012) suggested the reason for the increase activity was that bats were attracted to the crib, the reasons for which were unclear but could be related to insects congregating around lights on the crib.

CONCLUSIONS

The results of this study provide a valuable baseline to which use and mortality can be compared post-construction. For example, the bat species recorded, and the timing of bat activity was similar to patterns of mortality at on-shore wind-energy facilities (Arnett et al. 2008); post-construction monitoring can be used to determine if bat mortality off-shore at the Project also follows patterns observed at on-shore facilities. While it is tempting to use activity rates recorded during this study to precisely predict post-construction mortality rates by comparing our results to Svedlow et al. (2012) or projects located on-shore, the ability of SM detectors to record significantly more bat calls than Anabats makes these comparisons inappropriate. Most existing studies of on-shore wind-energy facilities Ohio and elsewhere have utilized Anabat detectors to characterize bat activity, which record significantly fewer bat passes.

The lack of empirical relationships between pre-construction bat activity and post-construction bat mortality rates also precludes precise predictions of bat mortality rates. Research completed to date has not shown a strong correlation between pre-construction bat activity rates and post-construction bat mortality rates. Baerwald and Barclay (2009) found a significant positive association between pass rates measured at 30 m and fatality rates for hoary and silver-haired bats across five on-shore wind projects in southern Alberta; however, only 31% of the variation in activity and mortality was explained during their study. Hein et al. (2013) were unable to find a significant relationship between bat activity and mortality in a review of 12 wind projects in the US with adequate pre-construction activity data and post-construction mortality data, and similar to Baerwald and Barclay (2009), a small portion of variation in fatalities (21.8%) was explained by bat activity. Differences in survey methodologies could partially explain the lack of correlation; however the propensity for bats to be attracted to turbines is the more likely explanation for the lack of strong correlation between pre-construction bat activity estimates and post-construction bat mortality rates (Jameson and Willis 2014, Cryan et al. 2014).

Gordon and Erickson (2016) assessed risk to bats from the Project based on available data, and predicted that bat fatality rates would be within the broad range of mortality recorded at on-shore wind-energy facilities, and there was a low potential for collision risk of species protected under the endangered species act. The results of this study are consistent with the conclusions of Gordon and Erickson (2016).

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Appendix A: Memorandum RE Analysis of the Correlation Between Low and High Microphones in the Daily Patterns of Bat Acoustic Activity Recorded at the Buoys at the Icebreaker Wind Project Site During Summer, 2017 (Revised December 30, 2017)

ENVIRONMENTAL & STATISTICAL CONSULTANTS

2990 Richmond Avenue, Suite 510
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December 30, 2017

Beth Nagusky
Icebreaker Wind, Inc.
1938 Euclid Avenue, Suite 200
Cleveland, OH 44114

RE: Analysis of the correlation between low and high microphones in the daily patterns of bat acoustic activity recorded at buoys located at the Icebreaker Wind Project site during summer, 2017

Dear Ms. Nagusky,

Icebreaker Wind, Inc. (IWI) requested that Western EcoSystems Technology, Inc. (WEST) prepare a data summary including a quantitative analysis of the strength of the correlation between high (10 meters above water surface) and low (2 meters above water surface) microphones located on buoys within the Icebreaker Project site, in the daily patterns of bat acoustical activity detected at these microphones during the period of time during which data was gathered at both high and low microphones (July 11 – August 30, 2017). This memorandum presents our findings with regard to this request.

Please let me know if you have any questions regarding the data or analysis presented herein.

Sincerely,

Caleb Gordon, Ph. D.
WEST, Inc.
512-229-8399
cgordon@west-inc.com

Field Sampling

The data analyzed in this memorandum are bat acoustic data gathered with four SM4 bat acoustic detectors deployed on two buoys deployed roughly 300m from one another within the Icebreaker Wind Project site, roughly 9 miles from the shore of Cleveland, Ohio. Two detectors were deployed on each buoy. On one buoy, both detectors were deployed at an elevation roughly 2 meters above the water's surface. These are referred to herein as the "low" detectors. On the other buoy, the microphones for the detectors were deployed atop a carbon fiber pole, such that they were located at an elevation roughly 10 meters above the water's surface. These are referred to herein as the "high" detectors. Further details regarding these deployments, the buoys, the detectors, and the acoustic data processing and analysis methods is provided in the MOU signed between IWI and the Ohio Department of Natural Resources[1] and the first quarterly report on bat acoustic monitoring prepared by WEST[2].

Analysis Methods

The objective of the present analysis was to examine the strength of the correlation between the high and the low detectors in the patterns of nightly variation in bat acoustic activity, or "calls," recorded at each of these locations during the period where simultaneous recordings were gathered at both high and low detectors, extending from 11 July through 30 August, 2017.

To this end, we performed a two-tiered analysis. The first comprised a simple investigation of correlation involving dates for which all four detectors successfully obtained data. The second comprised a more involved analysis incorporating data from detectors on days for which at least one detector type's data of bat calls was available. Table 1 describes the temporal ranges during which different detectors successfully collected data.

Prior to analysis, nightly call-count data were first normalized by adding one, and then transformed via the log function. The variable used for this analysis was nightly total bat call counts. Thus, there is no analysis of patterns over hourly time within nights. Only the pattern of night to night variation in total nightly calls was analyzed.

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[1] Icebreaker Windpower Inc., 2017. Response and Application Second Supplement. Avian and Bat MOU. Memorandum of Understanding between the Ohio Department of Natural Resources and Icebreaker Windpower, Inc. in the matter of the Application of Fred Olsen Renewables USA LLC/Icebreaker Windpower Inc. for a Certificate to construct a wind-powered electric generation facility. Case # 16-1871-EL-BGN. Filed July 20, 2017.

[2] Matteson, A., B. Hale, C. Gordon, and R. E. Good, 2017. Icebreaker Wind Bat Monitoring, Lake Erie, Ohio. Interim report March 21-August 14, 2017. Prepared for Icebreaker Wind, Inc. by Western EcoSystems Technology, Inc.

Table 1: Date ranges of data included in both analysis strategies, with respect to each of the four detectors. For a date to be included in the Correlation analysis, data must have been recorded at all four detectors. For inclusion in the Analysis of Covariance, data need only have been recorded at one of the two Detectors of a particular Altitude. Column N describes the number of nights of data from that Detector contributing to that analysis strategy

Altitude	Detector	Correlation Date Range	N	Analysis of Covariance Date Range	N
High	1	Jul 19 – Aug 14	27	Jul 11 – Aug 14	35
	2	Jul 19 – Aug 14	27	Jul 19 – Aug 30	43
Low	1	Jul 19 – Aug 14	27	Jul 11 – Aug 30	51
	2	Jul 19 – Aug 14	27	Jul 11 – Aug 30	51

Correlation

In order to obtain an initial simple snapshot of the underlying data, correlation patterns between the log-call counts recorded via the high detectors were compared with the same from the low. Generally speaking, correlation analyses investigate the relative strength of the correlation between two variables by pairing each value of the first variable with a corresponding value in the second.

To ensure an appropriate comparison between the high- and low-altitudes, the nightly data recorded at both detectors, for each altitude, were averaged. Thus, for any one day, the two available data points of that altitude type were reduced to one data point. Dates for which one of the detector data points were missing for an altitude were removed from consideration. In this way, 27 paired observations covering the temporal range from Jul 19 – Aug 14, inclusive, were obtained for initial correlation investigations, with one variable describing average low logged call-counts, and the other high.

To estimate the correlation between the log-count data recorded from both altitudes, standardized high-altitude calls were regressed against the same of low-altitude calls via simple linear regression. When performed in this way, the slope estimate from the resulting model equals the correlation r between the regressor and outcome. Squaring of the slope estimate, in this case the correlation, provides the coefficient of determination r^2. The coefficient of determination identifies the proportion of variance of log-scale high-altitude calls explained by the variability in log-scale low-altitude calls.

The same log-scale simple linear regression was then repeated, but with non-standardized original values. From this regression of high-altitude log-counts against low-altitude log-counts, the values of the intercept and slope were obtained and assessed. Data exhibiting high correlation between high-altitude log-counts and low-altitude log-counts should have estimated regression intercepts close to zero, and estimated slopes close to one. In this case, this means that high-altitude log-counts can be accurately predicted via low-altitude log-counts alone, or vice versa.

Analysis of Covariance

The correlation analysis described above only incorporates data on dates for which all four detectors were functioning. However, different detectors were functioning on different days (Table 1). Use of all the available data, including those dates on which at least one detector of an altitude was non-functioning, requires a different analysis.

Analysis of covariance is a statistical technique that combines regression with analysis of variance. Statistical regression, as applied here, allows for the trending of bat calls against time. Analysis of variance identifies statistical differences between categorical groups, or in this case, the mean number of bat calls recorded at discrete detector altitudes. Here then, an analysis-of-covariance model allows for the evaluation of trends in bat calls over time over categorical detector altitude ("high" or "low"), along with nuisance parameters (replicated detector), in one modeling framework.

Via its regression-like structure, analysis of covariance allows for the control of possible confounding variables which could influence the accuracy of simple correlation, as described above. It also allows for the use of all data, even on days for which only one of the four detectors was functioning. Finally, it also permits more complicated covariance structures.

To identify important predictors of log call-counts recorded over time, an initial analysis-of-covariance model was fit. The initial model considered categorical detector altitude, time, their interaction, and replicated detector. Consideration of an interaction allows for independent trending of detector-altitude bat-call time series, within one modeling framework. As applied here, the presence of an interaction of log call-counts against time, with respect to high and low detectors, would graphically result in the two temporal high- and low-trends not being parallel.

However, prior to the investigation and possible removal of individual variables, possible call-count lag-1 autocorrelation was assessed via examination of four autocovariance plots for each of the two detectors at each of the high and low altitudes. Lag-1 autocorrelation is the tendency for the call-count at a detector on any one night to correlate with values from the previous night. Lag-1 autocorrelation, a type of covariance structure, was assessed by fitting the initial-model analyses of covariance models described above, in restricted maximum-likelihood models with and without an overall lag-1 autocorrelation variance structure. Statistical significance of the overall autocorrelation was then assessed via a likelihood-ratio test.

After the initial assessment of lag-1 autocorrelation, and assuming its removal, analysis of covariance was then run in a sequential manner to assess for the significance of individual model covariates. Modeling followed a backwards regression fitting procedure, in which more complicated models were considered first. Variables were removed, one-by-one, if the use of a one-degree-of-freedom likelihood ratio test exhibited a *p*-value greater than 0.05. In this case, we concluded that this variable did not contribute significantly to the explanatory value of the model, and it was removed. The procedure was then repeated with the newly simplified model. The procedure was stopped when all included variables exhibited sufficiently low *p*-values. In these subsequent tests involving only fixed effects, maximum likelihood was used.

The models were first assessed for significance of replicated detector. Next, the interaction was evaluated, followed by detector height. The time trend was the final covariate evaluated. In all cases, evaluation of the next covariate only proceeded if the likelihood-ratio test of the previous covariate was not significant (thereby ensuring its previous removal).

Results

Correlation

The first-look of correlation between low- and high-altitude log call-counts, following the averaging of non-missing nightly detector data, was r = 0.8744, 90% CI: (0.8442, 0.8991), with a coefficient of determination r^2 = 76.46%.

The regression of nightly averaged log-counts of high versus low led to an intercept estimate of 0.3606, 90% CI: (0.0827, 0.6385) and slope estimate of 0.8440, 90% CI: (0.6910, 0.9970).

Figure 1 depicts the 27 nightly counts of bat-calls, averaged over detector, for each of the high and low altitudes utilized in the correlation analysis.

Analysis of Covariance

Examination of autocovariance plots suggested no significant autocorrelation. Further, results from the first likelihood-ratio test examining lag-1 autocorrelation were non-significant (p=0.3629). Analysis-of-covariance model fitting suggested removal of the following covariates due to low explanatory value: replicated detector (p=0.7735), time-altitude interaction (p=0.8207), and altitude (p=0.3666). Nonetheless, because of the interest in altitude as a potential explanatory factor, we present data from a model that included altitude as an explanatory factor (the second-to-last model), as well as a final model, which retained only date and an intercept as factors governing the night-to-night variation in total bat calls.

Figure 2 illustrates all four time series (two high detectors and two low detectors). All four time series exhibit similar patterns. Figure 2 also includes a model fit for each of the detectors from the second-to-last model (the one that retained altitude as an explanatory factor, even though the model selection process showed that altitude did not explain a significant amount of variation in nightly bat calls).

Conclusion/Discussion

Our initial simple correlation analysis, using dates for which data were available from all four detectors, led to the conclusion that the patterns of daily variation in bat call activity are highly correlated between the high-altitude and low-altitude detectors. This suggests that either one of the altitudes alone could be used to assess the temporal trend of bat calls at the Icebreaker Wind Project site, within altitudes sampled by detectors placed between 2m and 10m altitude.

The plot of high-altitude vs low-altitude counts of calls shows a preponderance of nights with very low numbers of calls, and a greater number of points above the light-gray line of perfect fit on such nights (Figure 1). To explore the effect of this pattern on the correlation, we repeated the regression of nightly averaged high-altitude log-counts versus low-altitude log-counts with regression forced through the origin. Regressing in this way led to a slope estimate of 1.0487, 90% CI: (0.9506, 1.1468). This strong value very near one aligns with the strong correlation result discussed earlier, and indicates that the result of high correlation between high and low altitude detectors is stable when the intercept is stabilized at the origin.

The correlation reported here of r = 0.8744, after averaging nightly detector data, is incredibly strong. Similarly, the strong slope estimate of 1.0487 following a forced fitting through the origin, suggests that for the period covered by the correlation analysis (July 19 through August 14), the nightly call totals for high and low detectors were statistically the same.

An expanded statistical effort, designed to use all the data, even on nights when at least one detector was not operational, found similar evidence of sameness in the high and low log call-count patterns. This expanded analysis-of-covariance effort, which incorporated more data, considered possible autocorrelation, and tested for possible confounders, led to a similar "sameness" result. That result indicated no statistically significant difference between detector altitudes at the alpha = 0.05 level. Thus, the analysis-of-covariance analysis echoes the conclusion of sameness suggested from the correlation analysis.

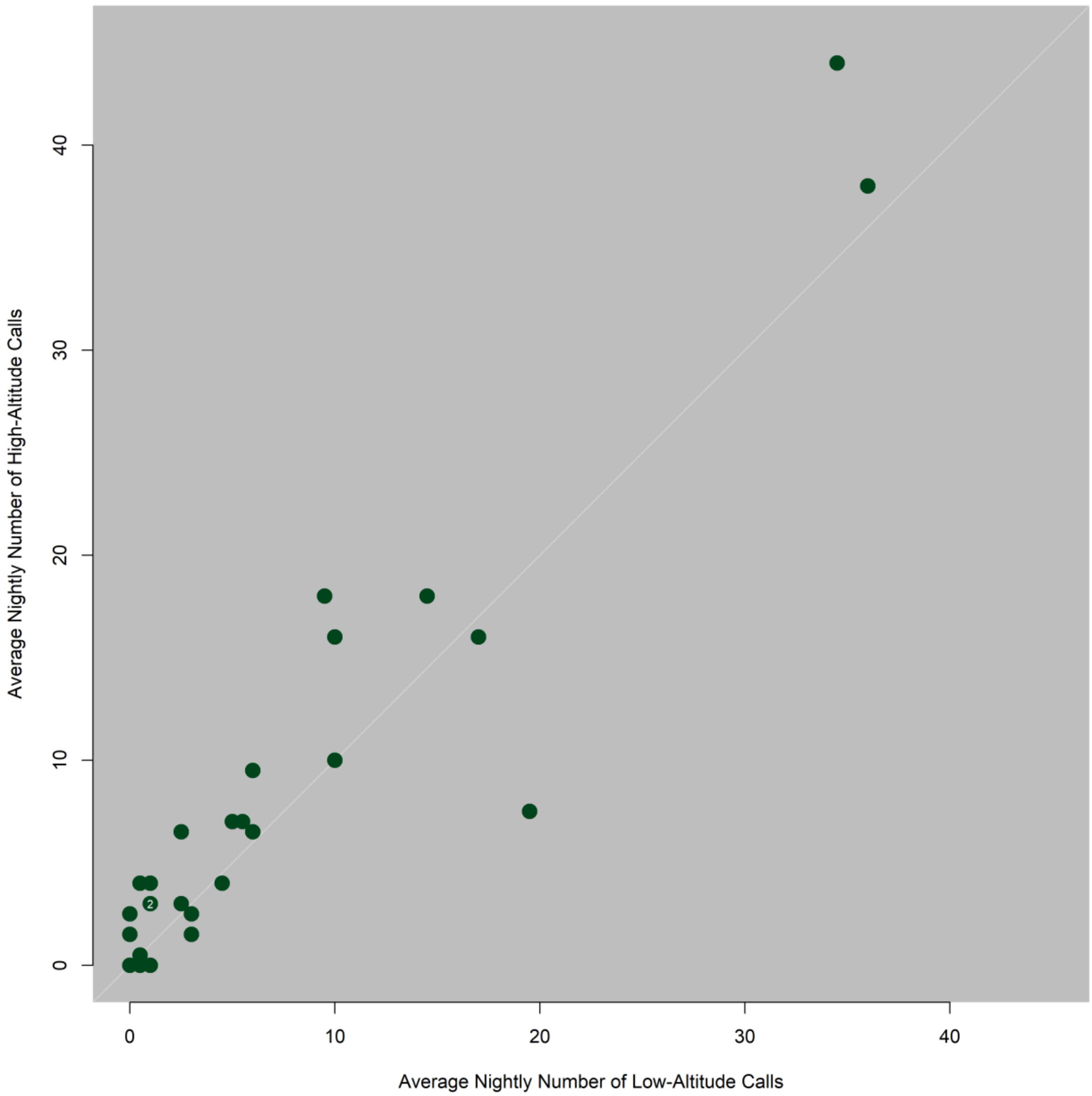

Figure 1: Number of High- vs. Low-Altitude Calls. Each data point represents one night. Each point's coordinate reflects the nightly average value for each altitude. Note that the only nights included in this analysis were nights for which data was gathered from all four detectors (July 19-August 14). One data point that was identical for two nights is labeled "2". The light gray zero-intercept and slope-one line of perfect fit are highlighted.

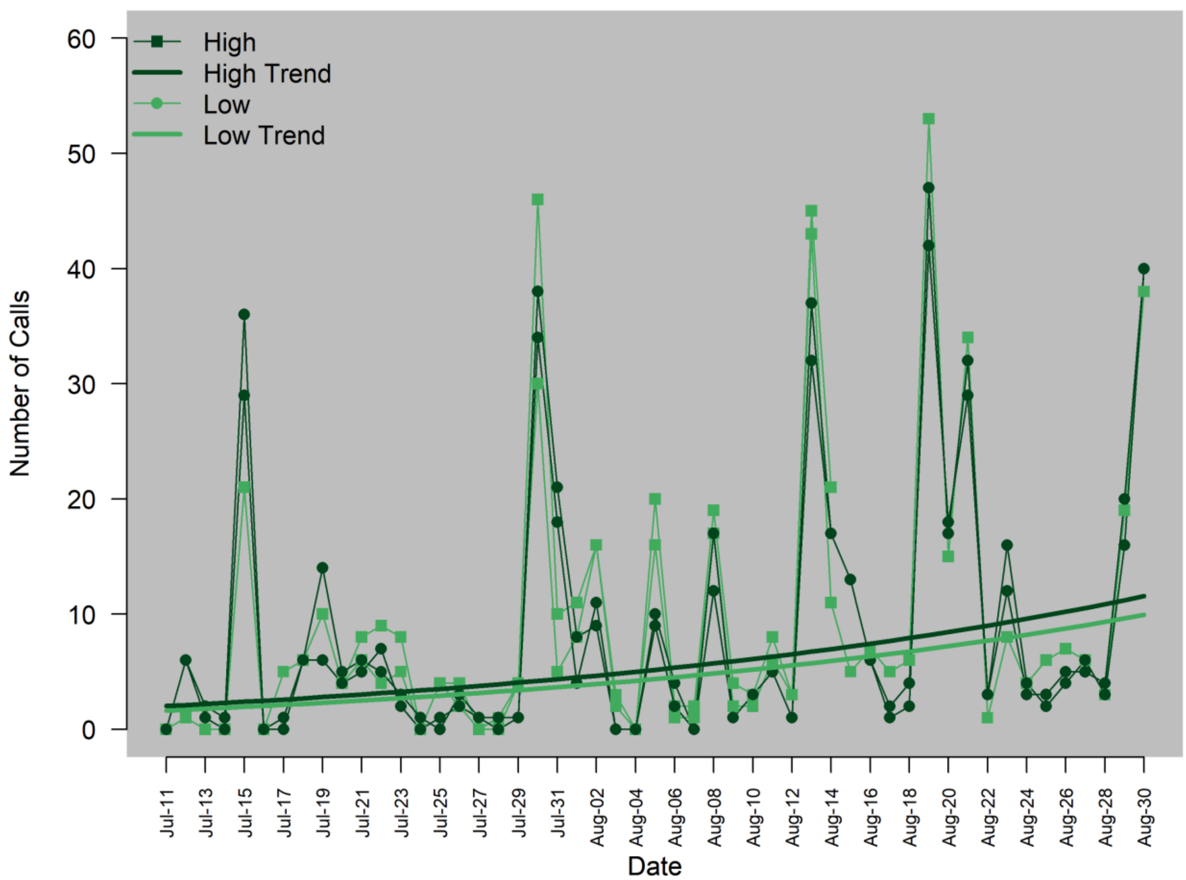

Figure 2: Number of Calls versus Date for High and Low Altitudes at Each of Two Detectors. Each night records the number of bat calls up to four distinct points, with two detector points for High Altitude and two for Low Altitude. The trend lines depict the temporal trends for each altitude, using the model from the covariance analysis that retained altitude, as well as date (the "second-to-last" model, see text).

Icebreaker Windpower, Inc.
Case No. 16-1871-EL-BGN
Testimony
September 6, 2018

Attachment REG-3

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

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IN REPLY REFER TO:

FWS/AES

MAR 12 2018

Gary Obermiller
Assistant Director
Ohio Department of Natural Resources
2045 Morse Road
Columbus, Ohio 43229

Dear Mr. Obermiller:

The U.S. Fish and Wildlife Service (Service) has provided technical assistance for the Icebreaker project since the early stages of project development. Service input has included Endangered Species Act consultation, migratory bird related technical assistance, and NEPA comments on the Department of Energy's (DOE) Draft Environmental Assessment. The intent of this coordination has been to promote pre- and post-construction data gathering and analyses sufficient to understand and minimize project impacts. It is important to clarify the Service's role in this process. Particularly for non-listed migratory birds (not including eagles) and bats, various authorities provide us with the responsibility to provide technical assistance and recommendations, but we are not decision makers in this context.

Regarding potential take of federally listed species, DOE has determined that LEEDCo's Project Icebreaker is not likely to adversely affect Indiana bat, northern long-eared bat, piping plover, rufa red knot, and Kirtland's warbler. The Service concurred with these determinations.

For pre-construction radar monitoring, a USGS expert (Dr. Robert Diehl) recently completed a report (December 2017) analyzing various radar proposals and identifying which vendor's proposal would have the likelihood of the most accurate data. Based on Dr. Diehl's report, LEEDCo subsequently worked with the preferred vendor (Accipiter Radar) to address specific concerns and recommendations. We appreciate that LEEDCo is working with the vendor to address concerns and incorporate recommendations from Dr. Diehl and the Service to increase the reliability of the monitoring program. Accipiter provided LEEDCo with a second proposal that would include placing the radar on a fixed platform, at a water intake crib a few miles offshore. The Service believes both proposals have trade-offs (i.e., vessel based at the project site vs. fixed platform several miles away) and uncertainties related to data collection and interpretation. However, both proposals have the potential to contribute meaningfully to migratory bird and bat exposure data for the project.

The Service agrees with stakeholders that post-construction fatality monitoring is of particular importance to the project. This is because pre-construction monitoring will indicate if birds and bats are flying in or near the project area, whereas post-construction monitoring will help determine if birds and bats are actually struck by the turbines. In recent discussions, LEEDCo indicated there have been advancements in fatality monitoring detector technology. LEEDCo shared with the Service an Oregon State University proposal to further develop this technology and implement research at the project site. LEEDCo noted another research proposal is pending from the Netherlands. The Service is encouraged that there is progress in this realm of technological development. The Service continues to recommend implementation of post-construction monitoring (whether it be this technology if shown to be effective or another valid method) as soon as the wind turbine project is operational.

The Service acknowledges that Icebreaker is a relatively small-scale demonstration project consisting of six turbines and as such has limited direct risk to migratory birds and bats. The Service's interest is in both reducing the risk to birds and bats from this project and also gaining useful data from the pre- and post-construction monitoring of the operation of Icebreaker to inform any future off-shore wind developments in the Great Lakes so that risk to birds and bats from such projects can be avoided or minimized.

We recognize that for an off-shore project such as Icebreaker, any pre- and post-construction monitoring strategies will have technological challenges and uncertainties as a result of the environmental conditions under which the project will operate. Based on LEEDCo's ongoing efforts to incorporate expert input for pre- and post-construction monitoring, the Service believes the monitoring will inform our understanding of project impacts on birds and bats. It will also advance the understanding of radar capabilities and monitoring strategies in an off-shore environment. We expect that pre- and post-construction monitoring will be tied to a strong adaptive management plan so that any necessary changes can be made as monitoring results are acquired to reduce impacts to birds and bats.

Thank you for the opportunity to provide input on the technology for the pre- and post-construction monitoring for the Icebreaker project. If you have any questions regarding this letter, please don't hesitate to contact me.

Sincerely,

Lori H. Nordstrom

Lori H. Nordstrom
Assistant Regional Director
Ecological Services
Midwest Region

cc: Dan Everson, Ohio Ecological Services Field Office, USFWS

Icebreaker Windpower, Inc.
Case No. 16-1871-EL-BGN
Testimony
September 6, 2018

Attachment REG-4

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TECHNICAL MEMORANDUM

DATE: 31 August 2018

FROM: Western EcoSystems Technology, Inc. (WEST; Rhett Good, Jennifer Stucker)

TO: Icebreaker Windpower (IWP; Beth Nagusky and Lorry Wagner)

RE: 2018 – Quarter 3 - Status Report for the Aerial Avian Survey, Radar, and Other Activities

PROJECT BACKGROUND

This memorandum provides a third-quarter status update on the 2017-2018 Aerial Avian Survey effort for the Icebreaker Wind Project and the Ohio Department of Natural Resources (ODNR) – per Icebreaker's MOU. This update also includes project activities from June, July and August, 2018. The memorandum fulfills the requirement to provide quarterly updates to ODNR on project status and preliminary findings.

AERIAL SURVEY REPORT

The aerial survey effort follows the Aerial Waterfowl and Waterbird Study Plan dated August 8, 2017 that was developed for inclusion in the IWP Monitoring Plan and submitted to the Ohio Power Siting Board on August 18, 2017. The objective for the 2017 – 2018 survey effort was to characterize avian use, particularly waterfowl and waterbird species, numbers, distribution, and use of the Project area from fall through spring, the non-breeding season. The aerial survey field efforts are complete, and the final report, was submitted 60 days following the completion of field efforts to the Ohio DNR on July 30, 2018. Due to the low number of bird observations within the 14,950 hectares survey area, the statistical models for developing density maps failed to converge. Consequently, density maps will not be submitted at this time.

In summary, the aerial surveys documented 16 species, and one unique genus-level taxa, *Scaup* spp., for a total of 1,649 groups (i.e., a group includes one or more individuals) of birds that included 12,185 bird observations. Within the survey area, gull species constituted 71% of all documented birds, including herring gull (22%), ring-billed gull (12%), great black-backed gull (3%*),* and Bonaparte's gull (1%), with the remainder consisting of unidentified gulls (*Larus* spp). The remaining observations in the survey area included waterfowl (23%), mergansers (less than 4%), waterbirds (less than1%) loons (less than 0.5%). Outside the survey area, gulls (58%) composed the majority of observations, followed by mergansers (20%), waterfowl (18%), waterbirds (less than 5%), and loons (less than 0.1%). The largest of flocks were gulls, with up to 600 individuals, were seen outside the survey area.

Abundance of Birds in Relation to Distance from Shore

We summarized the relative abundance of birds (prior to correcting for detection probability) relative to the distance from shore (see the "Relative Abundance in Relation to Distance from Shore and Water Depth" subsections of the Methods and Results sections of Stucker et al. 2018) in the annual report. The analysis included in the report summarized relative bird abundance in 1-km bands radiating from the shoreline and presented results for each season (Figure 7 of Stucker et al. 2018). Here, we present an aggregate summary of these data summarizing relative bird abundance in 1-mile bands radiating from the shoreline. We also converted the units for relative abundance as the average number of individuals counted per square mile surveyed. This revised summary of the data (Figure 1) illustrates a decline in the observed counts of all species, including gulls, as distance from shore increased. WEST's observed pattern in bird distribution is consistent in distribution pattern and distance from shore with the previous findings observed by ODNR (Norris and Lott 2011).

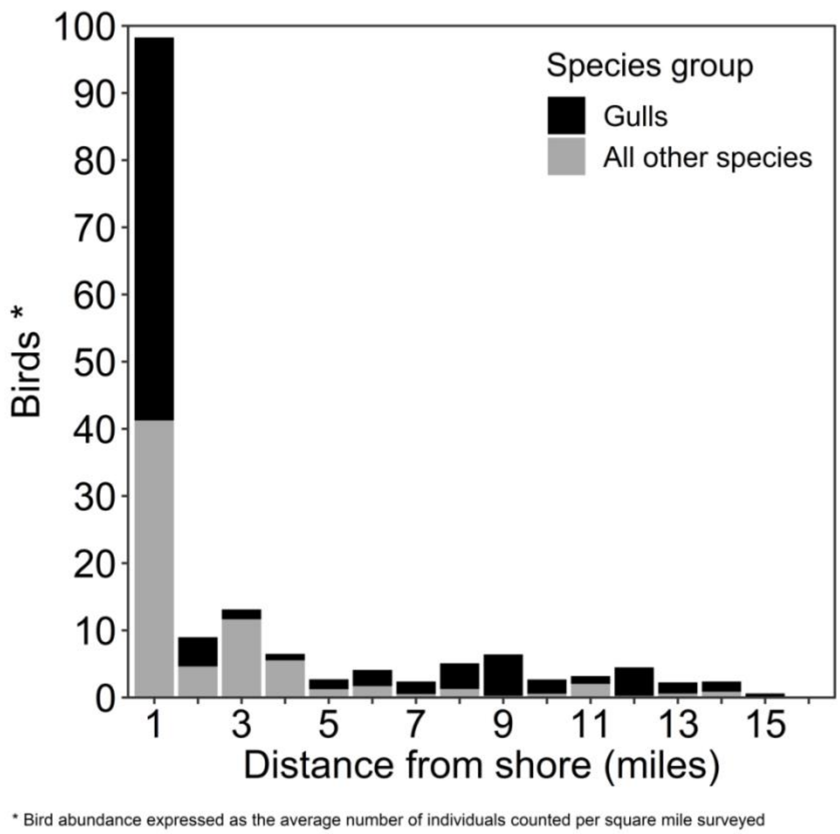

Figure 1. Mean relative abundance (birds per square mile surveyed) for two taxonomic groups (gulls, all other species) in relation to distance from shore (miles), for the 17 regular surveys Based on reconciled observation data from the aerial avian surveys over Lake Erie 2017-2018, which have not been corrected for detectability. Includes observations made while commuting to the survey area and while surveying transects within the survey area.

OTHER ACTIVITIES

Radar Monitoring Protocol

WEST worked closely with ODNR staff to develop a radar monitoring protocol that meets the objectives as outlined within the Memorandum of Understanding and criteria that had been presented by the ODNR and USFWS during discussions over the past two years with the agencies. Coordination involved two separate meetings with ODNR staff on April 17 and May 18, 2018 as well as conference calls. A final radar survey protocol incorporating comments from ODNR staff was submitted for the ODNR's final approval on June 26, 2018.

Bird and Bat Conservation Strategy

WEST and IWP submitted a draft of the Bird and Bat Conservation Strategy (BBCS) to the USFWS on June 11, 2018 and to the ODNR on June 12, 2018 for review and discussion. To date no comments have been received on the revised BBCS. The BBCS described IWP's proposed approach for avoidance and minimization and adaptive management of potential impacts to birds and bats.

Collision Monitoring Technologies

WEST and IWP continue to evaluate collision monitoring technologies. The Department of Energy (DOE) recently announced the availability of funding to further the development and validation of offshore wind monitoring technologies. WEST and IWP partnered on the submittal of three concept papers to the DOE to improve and validate offshore collision monitoring technologies. WEST partnered with The Energy Research Centre of the Netherlands (ECN) (ECN), the National Renewable Energy Laboratory (NREL), and the University of Dayton Collision Laboratory to submit a concept paper that describes the development of a multi-sensored approach for detecting bird and bat collisions. The proposal will include engineering refinements to the WTBird® collision monitoring system. WTBird® has been successfully used to monitor collisions of large birds at the Offshore Wind Farm Egmond aan Zee in the Netherlands for two years, during which a number of bird collisions were detected with a high degree of certainty (H. Verhoef, ECN, pers. comm.). WTBird® will be improved to detect collisions of small birds and bats, and paired with improved camera systems and acoustic detectors to assess species occurring as collisions. DOE reviewed the concept paper and encouraged the team to submit a full proposal for review.

WEST and IWP also are part of a team led by The Pacific Northwest National Laboratory (PNNL) that submitted a second concept paper to DOE. The system, called the Virtual Bird-Bat Net (VBN), would visually "catch" animals thrown from turbines in a virtual net using a series of high definition cameras. The VBN concept paper was also encouraged to submit a full proposal to DOE. Oregon State University's Dr Albertani was also encouraged to submit a full proposal to DOE for their work with the Thunk Detector.

PLANNED ACTIVITIES FOR NEXT QUARTER

In the next three months WEST expects to:

1. Submit full proposals to the DOE to develop and validate offshore collision detection technologies
2. Present the results of the Aerial Waterbird and Waterfowl survey to The Wildlife Society conference in Cleveland on October 10.
3. Prepare and present expert witness testimony to the Ohio Power Siting Board for hearings scheduled to begin September 24th in support of the Icebreaker permit application.

REFERENCES

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Stucker, J. H., J. D. Carlisle, D. Pham, and W. P. Erickson. 2018. Icebreaker Wind Aerial Waterbird Survey Report: October 16, 2017 – May 29, 2018, Cuyahoga County, Ohio. Prepared for Icebreaker Windpower, Inc. Cleveland, Ohio. Prepared by Western EcoSystems Technology, Inc. (WEST), Golden Valley, Minnesota; Laramie, Wyoming; and Fort Collins, Colorado; Cheyenne, Wyoming. July 30, 2018.