Appendix L-2
WEST Bird and Bat
Annual Report 2018

Icebreaker Wind Bird and Bat Monitoring
Lake Erie, Ohio

Annual Report
February 20, 2018

Prepared for:

Icebreaker Windpower, Inc.

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REPORT REFERENCE

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INTRODUCTION

This first annual status 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) dated July 12, 2017. The MOU sets forth the avian and bat monitoring protocols, 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 8 to 10 miles (mi) 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 first annual report covers all activities undertaken by the WEST team related to items described in the MOU and associated Monitoring Plan (MP) during 2017. It encompasses the activity reported in the first two quarterly reports, submitted in September and December of 2017 pursuant to the MOU, and additional activities undertaken during December, 2017 and January, 2018. The report includes a comprehensive summary of all MOU-specified activity on the Project by the WEST team that has occurred through early February, 2018. This report summarizes, but does not fully recapitulate all of the detail contained within the previously submitted quarterly reports. Activities covered in the current report include bat acoustic monitoring surveys, conducted between March and November, 2017, ongoing aerial waterfowl and waterbird surveys initiated in mid-October, 2017, and ongoing research, meetings, and deliberations aimed at finalizing several components of the MP that were contemplated in the MOU. These include collection of baseline data using surveillance radar, exploration into emerging technologies for collision fatality monitoring in the offshore environment, and the completion of an initial draft of the Bird and Bat Conservation Strategy (BBCS) which includes committed impact avoidance and minimization measures, as well as an adaptive management plan for the Project.

BAT ACOUSTIC MONITORING

WEST conducted acoustic bat call monitoring using protocols and sampling designs developed in coordination with ODNR and USFWS, and described in the MOU. This effort entailed gathering recordings at five offshore recording points (four "standard" and one "experimental" point[1]) during the 2017 potential bat activity season, defined by ODNR as extending from March 15 through November 15, using full spectrum bat recorders from Wildlife Acoustics (SM3 and SM4 models). The Final Bat Acoustic Monitoring Report was submitted to the ODNR and USFWS on February 15, 2018 and is attached as Appendix A.

In summary, this effort resulted in 469 successful detector-nights of recordings gathered and analyzed for the 2017 season, which included a total of 10,114 bat passes, including passes recorded by redundant detectors at each recording location. 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, bat pass rates represent an index of bat activity, and do not represent numbers of individuals at each recording location. 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 overall success of recording, defined as the percentage of the total nights between March 15 and November 15 for which recordings were successfully gathered at each of the four "standard" recording stations was 90.4%, with single-station success rates ranging from 82.5% to 96.8% for each of these stations. In addition, a fifth experimental station with microphones mounted at a 10m height on a carbon fiber pole resulted in 100% recording success during a smaller deployment period during the peak bat activity period (51 nights from July 11 through August 30). The overall average bat pass rate documented during this effort for all stations combined was 6.8 ± 0.7 bat passes per detector night, with single station averages ranging from 0.8 to 16.2 bat passes per detector night. Peak bat activity was recorded during the late summer/early fall period (roughly mid-July through early October), consistent with a well-documented pattern at terrestrial sites. Four common and widespread bat species accounted for the vast majority (<99.9%) of identified calls documented during this effort. The total numbers of passes unambiguously assigned to each bat species were as follows: *Lasiurus borealis* (eastern red bat) – 4097 passes; *Lasiurus cinereus* (hoary bat) – 2454 passes; *Lasionycteris noctivagans* (silver-haired bat) – 1545 passes; *Eptesicus fuscus* (big brown bat) – 1210 passes; *Perimyotis subflavus* (tri-colored bat) – 13 passes; *Myotis lucifugus* (little brown bat) – 1 pass. 1884 passes were classified as confirmed bat passes but could not be unambiguously identified to species. None of the calls recorded during this effort was classified

[1] WEST also performed a statistical analysis that demonstrated that the results from the "experimental" station (the 10 m pole at the Project site) were very similar to the results from the standard station at the project site. This analysis is included with the final bat acoustic survey report.

as potentially belonging to a federally listed species. Surveys completed at most on-shore wind facilities, and surveys previously completed for Icebreaker by Tetra Tech used Anabat detectors. Songmeter SMx units have more sensitive microphones than do Anabat units, and therefore record approximately 3x more bat passes than do Anabat units under conditions of identical bat activity (Adams et al. 2012). Therefore, bat pass rates collected with SMx detectors cannot be directly compared with data collected at on-shore projects using Anabat detectors to assess if rates of activity were low or high relative to other projects. Regarding the implications of these results for potential risk to bats from the development and operation of the Project, the patterns of bat activity recorded at the Project are consistent with the conclusions of the risk assessment, and suggest that the Project is likely to generate per turbine or per megawatt bat fatality rates within the range of those that have been documented at land-based wind energy facilities within the Great Lakes region, affecting primarily the four species documented at the site, and not likely to affect any federally listed species. Please see Appendix A for full detail on the sampling locations, methods, results, and interpretation.

AERIAL WATERBIRD SURVEY

WEST initiated aerial surveys for diurnal birds, primarily expected to include waterfowl and waterbirds, using protocols and sampling designs developed in coordination with ODNR and USFWS, and described in the MP and MOU. This effort entails conducting biweekly (every two weeks) bird surveys using live observers aboard a fixed wing aircraft. Surveys are conducted from October 15 through the end of May during the non-breeding season for most waterfowl and waterbirds. This seasonal sampling frame was recommended by USFWS because it is the season when the largest number of bird individuals and species occur in Lake Erie. After an observer training program was conducted on October 13-14, 2017, the first survey was flown on October 16, and surveys have been conducted every two weeks subsequently for a total of 9 regular surveys flown up to and including the latest data included in the present report, which is from the survey conducted on February 5, 2018. In addition to these 9 surveys, a supplemental survey was flown on January 4 to document patterns of bird use in association with ice formation on the Lake.

Each survey was performed using the prescribed double-observer approach identified in the study plan, with 3 observers aboard each survey flight. The survey vehicle was a Cessna 185 high-wing four-seat aircraft, and was flown at 76 meter elevation and 150 km/hour speed during surveys. The survey area covers 146 km^2, including all of the Project turbine locations plus a buffer of at least 5 km in all directions. The survey route flown within this area during each survey consisted of seven 10-km straight-line transects perpendicular to the turbine array, with transects spaced at 2.2 km intervals to minimize the likelihood of double counting. Beginning with the third survey effort (Mid-November), additional bird data was gathered from “off-transect” areas over the Lake during each survey flight. The off-transect flight paths over the Lake are the path taken by the aircraft in between the Lorain County airport and the survey area, when arriving and departing. While the off-transect area sampling effort encompasses substantially less transect length than the survey area, it is located closer to the south shore of Lake Erie and gives additional information about waterbird activity closer to shore.

In summary, after 9 regular surveys, this effort has resulted in 2098 total individual bird observations within the primary survey area during the regular surveys, representing at least 11 bird species, for an average of 233 individual birds observed within the primary survey area per survey (equivalent to an average bird observation rate of 3.3 bird observations per linear km of survey). In addition, 7 surveys closer-to-shore in the off-transect areas resulted in 3812 total individual bird observations, representing at least 10 bird species, for an average of 545 individuals birds per off-transect survey (equivalent to an average bird observation rate of 13.8 bird observations per linear km of survey). For each survey, abundance of birds per kilometer was greater at off-transect sites than within the project area. The supplemental ice survey conducted during freeze-up on January 4 documented 131 total observations of at least 6 bird species within the primary survey area, and 185 observations of at least 4 bird species in the off-transect survey. The total numbers of birds identified to species within the primary survey area during the regular and ice surveys through February 5, 2018 survey are as follows: *Larus argentatus* (Herring Gull) – 260 observations; *L. delawarensis* (Ring-billed Gull) – 253 observations; *L. marinus* (Great Black-backed Gull) – 38 observations; *Chroicocephalus philadelphia* (Bonaparte's Gull) – 35 observations; *Mergus serrator* (Red-breasted Merganser) – 30 observations; *Phalacrocorax auritus* (Double-crested Cormorant) – 17 observations; *Bucephala clangula* (Common Goldeneye) – 9 observations; *Gavia immer* (Common Loon) – 6 observations; *Clangula hyemalis* (Long-tailed Duck) – 2 observations; *Bucephala albeola* (Bufflehead) – 1 observation; *Mergus merganser* (Common Merganser) – 1 observation. Of the 2229 total individual bird observations recorded within the primary survey area (regular surveys plus one ice survey), 1577 (70.7%) were identified solely to genus (e.g. Scoter (*Melanitta spp*), Merganser (*Merganser spp*), loon (*Gavia spp*)), or a higher taxonomic or functional group (e.g. "waterfowl sp." or "gull sp."); unidentified gulls, most likely a mix of Herring/Ring-billed, accounted for 40.7% of all birds. Only 0.6% of bird observations in the primary survey area, and 0.2% of off-transect observations could not be identified to major group, and these individuals were classified as unidentified large birds.

The patterns of bird use of the Project area and nearby offshore environments is largely consistent with the patterns documented by the two-year waterbird aerial survey effort conducted by Norris and Lott (2011) and summarized within the Icebreaker Wind risk assessment, showing an overall pattern of low bird density and low species richness within the Project area relative to areas near the shoreline based on our preliminary review of data collected to date. Estimates of birds per linear kilometer within the Project area (0.2 – 13.4 birds/km) are on the low end of those observed previously by ODNR and FWS during 2009-2010 their surveys over Lake Erie (0.6 – 83.8 birds/km) (Lott et al. 2011). None of the birds recorded during this effort are protected by the Endangered Species Act (ESA) or BGEPA. Please see Appendix B for full detail on the survey areas, methods, and results obtained through February 5, 2018.

COLLISION MONITORING

Collision monitoring in the offshore environment presents a challenge that must be addressed to better understand the impacts of offshore wind on wildlife, as a basis for decision-making regarding potential future growth of the US offshore wind industry. Innovative technologies and methods are now being explored and proposed in Europe and the U.S. Ever since WEST was initially contracted to develop a bird and bat post-construction monitoring plan for the Project in August, 2016, WEST's biologists have been exploring options for collision monitoring technologies/methodologies with the objective of producing robust annual bird and bat fatality rate estimates for the Project once constructed. While such estimates are routinely gathered at land-based wind energy facilities using bias-corrected data from systematic carcass searching efforts, WEST and the IWP team recognize that no such estimates have ever been gathered at an offshore wind energy facility, as traditional carcass searching is not possible in open water.

Collision monitoring remains one of the most important objectives of this small demonstration project due to the importance of characterizing bird/bat turbine-related fatality rates in the offshore environment of Lake Erie, and in the spirit of generating the greatest scientific value as a U.S. Department of Energy funded demonstration project. The MP associated with the MOU specified that technologies for implementing a robust bird/bat collision monitoring program during the Project's operational phase would continue to be explored as the technologies continue to evolve, and that the most viable collision monitoring technology would be selected at the time such decision had to be made to ensure installation of the technology at the time of construction. Once this suitable technology/methodology was identified and selected, including any necessary validation, testing, algorithm development, or other associated methods necessary to obtain scientifically robust fatality rate estimates from the collected data, a fully developed collision monitoring protocol would be prepared and amended to the MP. In this report, we summarize the information that has been gathered to date on the various collision monitoring systems under consideration.

IDStat: This system is in an early stage of development by ecologist Bertrand Delprat, of the small French consultancy, Calidris, and was reviewed by Dirksen (2017). It relies on acoustic detection of collisions using microphones that listen for airborne sounds inside the blades (compare with blade-mounted vibration sensors in the WT-Bird and "thunk detector" systems, described below). At present, this is the only sensor within the system; there is no photographic sensor for obtaining images of colliding animals (in contrast to WT-Bird and "thunk detector" systems). This system has promise as the basis of a viable collision monitoring technology, but in order to be a stronger candidate for application to the Project, the sound-based detection must be demonstrated and validated, additional sensing capacity must be added to obtain images of colliding animals, and the system's development must progress to a more advanced stage, where viability and robust functional capability are demonstrated.

Batfinder: This is a system in a very early stage of development by Polish ecologist, Michal Przybycin, who presented the concept at the Conference on Wind and Wildlife held in Portugal in September, 2017, and who has a year of funding to advance the development of the system.

It was not covered in Dirksen's (2017) review, as it has only very recently been created and presented. Unlike other collision detection systems, it relies not on detecting the collisions, themselves, but on detecting animals falling from the rotors to the ground, which it does through a series of tower-mounted cameras that look out horizontally. When an animal is detected sequentially by the upper, and then lower systems, the system's signal processing software documents it as a collision. Though this system is being developed primarily for bats and for land-based application, in principle, it could work for both birds and bats in the offshore environment, as it does not rely on ground-based carcass searching. The principal limitations for applicability to the Project at present are twofold. First, it is in a very early stage of development. Second, the extent to which some collision victims are expected to blow away from the towers as they fall, particularly birds, may pose a substantial challenge for the system's tower-mounted cameras.

Exposure detection systems: Several remote sensing technologies that have been developed for the primary purpose of bird and bat exposure characterization have also sometimes been identified as promising systems for collision monitoring at wind energy facilities. The common element shared by these systems is that their sensors and signal processing software are focused on detecting animals flying within a certain airspace, usually encompassing at least a kilometer radius from the sensor, toward the primary objective of documenting the passage of flying animals through an airspace in which they may be exposed to collision risk from wind turbines (Dirksen 2017). The most advanced exposure monitoring systems include additional technology to obtain high resolution images of the detected animals in the interest of identifying the taxonomic identity of the animals. If an animal flying within a wind farm were to collide with a rotor while the sensors of this type of exposure monitoring system were tracking that animal, it is possible that the system would document the collision, hence it has been suggested that such systems could be useful for collision monitoring.

In order to explore whether or not such a system might be able to satisfy the collision monitoring objectives of the Project, WEST has investigated three of the most advanced exposure monitoring systems, pursuing conversations with the developers of each system. The exposure monitoring systems explored by WEST to date are the following:

- MUSE System: (DHI)
- Thermal Tracker System: (BRI-PNNL)
- Identiflight System: (RES-Boulder Imaging)

After investigating each of the above systems, WEST has concluded that, at this time, none are completely capable of satisfying the Project's collision monitoring objective of providing robust bird/bat annual fatality rate estimates. All of them are capable of characterizing the potential exposure of flying animals to wind turbines, as indicated by the passage of flying animals through a certain airspace, and all of them are capable of incidental documentation of some collisions of flying animals with wind turbine rotors if such a collision were to occur on an animal that was being tracked by the system's sensors at the time of the collision. However, the downside of these systems is that, at this time, none of them possess sensors or signal processing algorithms that are focused on wind turbine rotors or systematic detection of collisions. Therefore, with any of these systems, an unknown proportion of collisions of untracked flying animals would remain undetected, hence determination of robust annual collision fatality rates would not be possible. To a great degree, this reflects an inevitable tradeoff between having sensors and signal processing algorithms focused on detecting flying targets in an airspace rather than having sensors and algorithms focused on detecting collisions with rotors. In principle, it would be possible to develop a combined system, in which exposure detection was combined with collision detection, but none of the exposure monitoring systems investigated to date by the Project team have yet incorporated such a design.

OSU "Thunk Detector": With U.S. Department of Energy funding support, researchers at Oregon State University have developed a multisensor collision detection system that appears to hold promise for satisfying the collision monitoring objective of the Project. This system, referred to herein as the "thunk detector," (referred to by Dirksen 2017 as "wind turbine sensor unit for monitoring of avian and bat collisions") includes a combination of vibration sensors installed within the blades to detect the physical impacts of bird/bat collisions, combined with camera sensors focused on the blades to capture images of the animals upon collision, with signal processing software that enables the system to save image sequences from immediately before, to immediately after each collision, to allow for potential identification of the animals that collide. WEST has been discussing the applicability of the thunk detector to the collision monitoring objectives of Project with the system's chief designer, Dr. Roberto Albertani, since early 2017. Although the system's development and validation testing have advanced substantially since Dirksen's (2017) review, the discussions between Dr. Albertani and the Project team have identified the need to further improve, refine, and validate the system's function beyond that which has already been successfully demonstrated, in two principal areas. Specifically, to suit the monitoring needs of the Project, the system needs to be proven to successfully detect smaller animals, and it needs to function at night. Regarding the first need, the system has been shown to successfully detect collisions of objects as small as 50g tennis balls, roughly equivalent to the mass of a bird slightly heavier than a Northern Cardinal but lighter than an American Robin. However, for this Project, many of the birds and bats that may potentially be exposed to collisions weigh less than 50g. The very lightest of such species (e.g., *Myotis* bats and hummingbirds) may be 3-5g, and many potentially exposed species weigh on the order of 10-30g, including many species of warblers, vireos, flycatchers, and sparrows. Regarding the second need, the thunk detector has only been tested with visible light cameras to date. For IWP, as much of the potential collision exposure will occur at night (e.g. for bats or nocturnally migrating birds), the system needs to be adapted to use sensors capable of documenting collisions at night.

The previous two quarterly progress reports described the discussions between Dr. Albertani and the IWP team to seek new funding from the National Renewable Energy Laboratory (NREL) for Project-specific refinement and further testing of the thunk detector, along the lines of the two needs described above. The effort to obtain NREL funding was not successful. Icebreaker recently received and is currently reviewing a proposal from Dr. Albertani for additional refinement and testing of the thunk detector, intended to enable the system to satisfy the Project's collision monitoring objective.

WT Bird: This system, developed by ECN in the Netherlands, is similar in concept to the thunk detector, and was also covered in Dirksen's (2017) recent review. After some initial information gathering on this system, reported in the most recent quarterly report, WEST organized a teleconference, held in December, 2017, with a spokesperson for the system from ECN, Hans Verhoef, and the IWP team, to explore the suitability of the WT Bird system for satisfying the collision monitoring objectives of the Project. Similar to the thunk detector, the minimum mass of flying objects for which successful collision detection has been demonstrated to date is 50g, hence there is a need to further refine the system and demonstrate successful collision detection with flying animals of smaller mass for IWP's purposes. However unlike the thunk detector, the WT Bird system is already capable of nocturnal function, as it possesses night vision sensors to capture images of the collisions. A further advantage of WT Bird relative to the thunk detector is that it has already been deployed at an offshore wind farm; the Egmond Aan Zee offshore wind farm in the Netherlands, to monitor Vestas wind turbines very similar to the ones that have been selected for this Project. Subsequent to the December teleconference, the IWP team has been following up with Mr. Verhoef in order to gather additional information about the WT Bird system, including a request for information documenting the validation testing of, and offshore collision monitoring data gathered by, the system to date. At present, we are still in the process of obtaining this information to more fully evaluate the suitability of the WT Bird system for the IWP.

VESSEL-BASED RADAR EVALUATION

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.[2] After a long series of discussions with ODNR and USFWS, the IWP team proposed conducting vessel-based radar monitoring at the Project site as a solution for satisfying the Agencies' informational objectives. IWP issued a Request For Information (RFI) for providing vessel-based radar monitoring in the spring of 2017 to three radar technology and service providers who had been selected after screening a broader field of candidate providers. The RFI incorporated the specific sampling parameters and data gathering/analysis requirements that had been recommended by the USFWS, and was reviewed and approved by USFWS before being issued to the three radar providers. In response to this RFI, each of the three providers provided a fully developed proposal to provide the requested vessel-based radar monitoring services. After reviewing the proposals, the IWP team and the USFWS could not agree whether any of the proposals would satisfy the defined informational objectives. In order to resolve this disagreement, ODNR, USFWS and IWP agreed to obtain the opinion of a third

[2] We note that the recently released Bureau of Ocean Energy Management (BOEM) Guidelines for avian and bat pre-construction surveys do not require collection of radar data.

party radar expert, and contacted Dr. Robb Diehl of the US Geological Survey (USGS), who agreed to perform the review. The language from the MP associated with the ODNR-IWP MOU regarding this agreement is as follows:

"The ODNR, USFWS and IWP 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."

In recognition of this agreement, the Ohio Power Siting Board (OPSB) suspended its consideration of IWP's application of a certificate of environmental compatibility until the Diehl report was received and the radar monitoring issue resolved.

Dr. Diehl submitted his 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 has discussed the report with Dr. Diehl and expressed its willingness to move forward with the approach recommended by him. However, notwithstanding the parties' agreement to solicit Dr. Diehl's expert opinion and the conclusions expressed in his report, the USFWS has maintained its objections to the viability of vessel-based radar.

In the interest of reaching consensus on radar monitoring to be performed for the Project, the IWP team arranged a meeting with representatives of the USFWS, IWP, WEST, and Locke Lorde, LLC, at the USFWS Region 3 headquarters in Bloomington, Minnesota on January 9, 2018.

After a productive meeting, IWP remains in discussions with USFWS Region 3 leadership regarding potential methods for implementing vessel-based radar or other practicable approaches that would provide the survey data sought by the wildlife agencies and address the USFWS's concerns.

BIRD AND BAT CONSERVATION STRATEGY (BBCS)

The MOU refers to the BBCS in the "Adaptive Management and Mitigation" section, describing the understanding between IWP and ODNR regarding these elements with the following statement, "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)." 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. While the current 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), the adaptive management and mitigation sections of the BBCS are still in development, as specific impact thresholds and adaptive management measures will be dependent upon the precise nature of the post-construction monitoring data objectives. IWP expects to complete the development of this section of the BBCS in the coming months, in coordination with the ODNR, USFWS, and other stakeholders.

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Appendix A

2017 Final Bat Acoustic Survey Report

Icebreaker Wind Bat Activity Monitoring

(March 21 to November 14, 2017)

Lake Erie, Ohio

Final Report

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):

- “Seven-mile” lower: Located within the Project at roughly one meter (m) above water level on a seven-mile buoy[1]
- “Seven-mile” elevated: Located within the Project at 10 m elevation on a second seven-mile buoy.
- Three-mile lower: Located outside the Project at roughly one m above water level at a three-mile buoy
- Crib elevated: 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

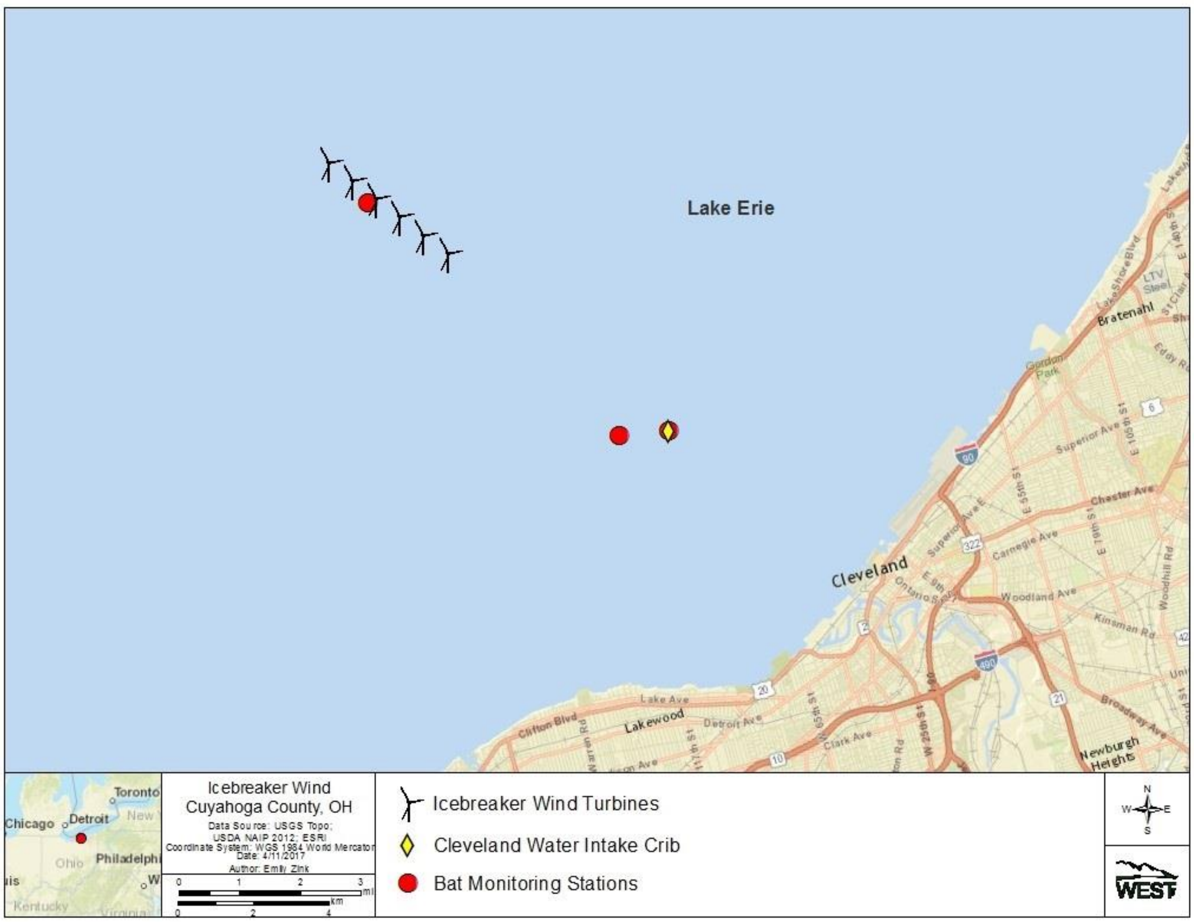

Figure 1. Acoustic sampling locations at the Icebreaker Wind Energy Project in 2017. The red dot among the turbines is the "seven-mile" location, where two buoys containing ultrasound microphones are located in close proximity to one another, and the red dot to the west of the Cleveland Water intake 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, bat pass rates represent an index of bat activity, and do not represent numbers of individuals at each recording location. 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

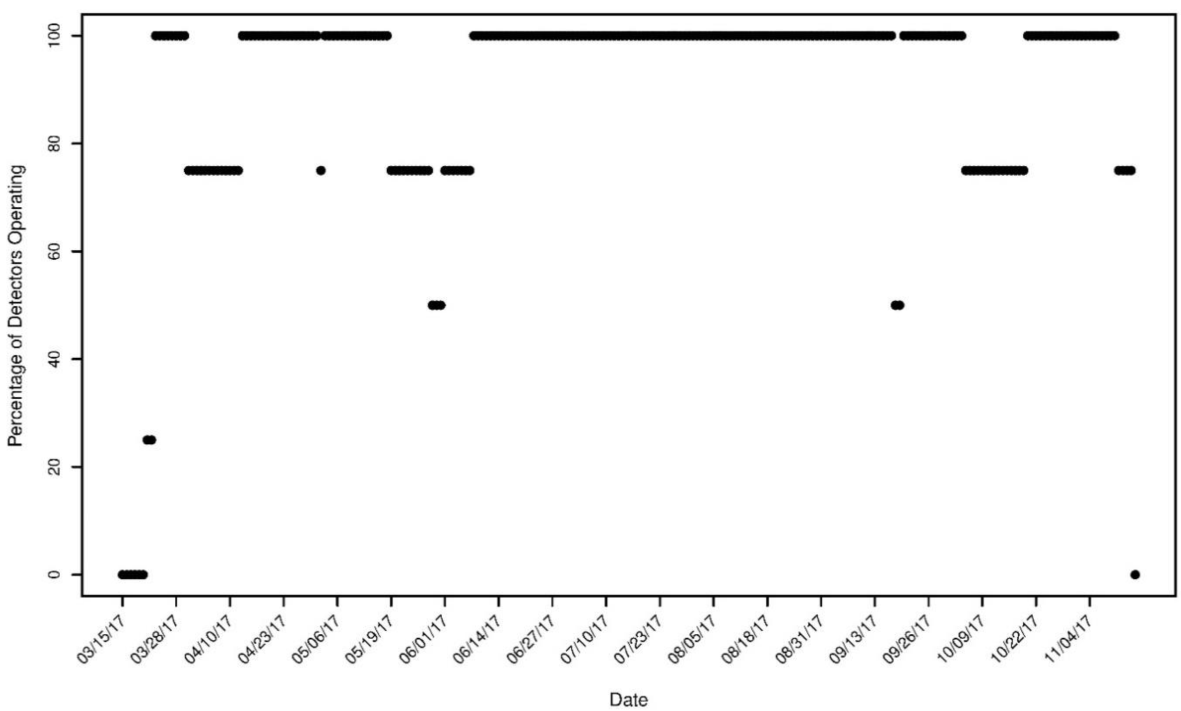

Figure 2. Operational success defined by successful station nights at the seven-mile lower, three-mile lower, crib elevated, and crib lower stations at the Icebreaker Wind Project Bat Survey Area during each night of deployment from March 15 to November 15, 2017. This does not incorporate the seven-mile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

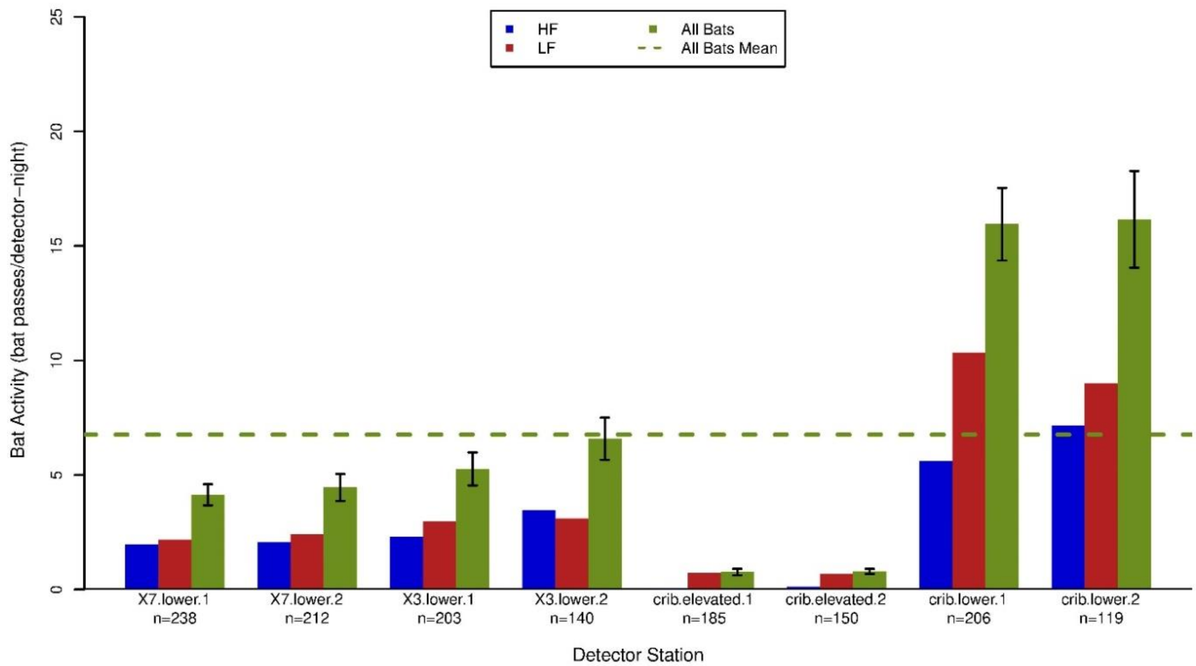

Figure 3. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at all detectors and stations at the Icebreaker Wind Project Bat Survey Area from March 21 to November 14, 2017.

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

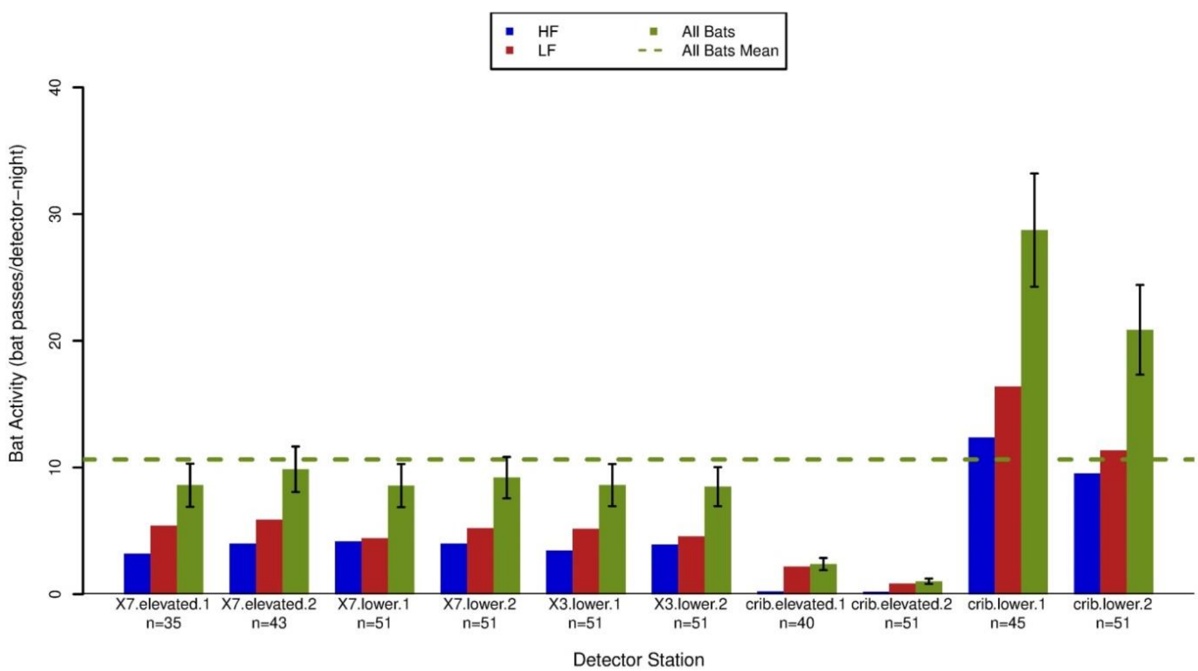

Figure 4. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at all detectors and stations at the Icebreaker Wind Project Bat Survey Area from July 11 through August 30, 2017*.

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
Seven-mile lower 1	LF	0.7	2.9	2.5	3.8
	HF	0.0	0.9	3.8	5.3
	AB	0.7	3.7	6.3	9.1
Seven-mile lower 2	LF	0.7	3.4	2.8	4.3
	HF	0.1	1.1	3.6	5.0
	AB	0.7	4.4	6.3	9.3
Three-mile lower 1	LF	1.7	4.7	2.5	4.0
	HF	0.1	2.3	3.1	4.5
	AB	1.8	7.0	5.6	8.5
Three-mile lower 2	LF	NA	4.4	2.6	3.8
	HF	NA	3.0	3.7	5.0
	AB	NA	7.4	6.2	8.7
Crib elevated 1	LF	0.1	1.7	0.2	0.5
	HF	0.0	0.1	0.0	0.1
	AB	0.1	1.8	0.2	0.6
Crib elevated 2	LF	NA	1.2	0.3	0.3
	HF	NA	0.1	0.1	0.1
	AB	NA	1.3	0.4	0.5
Crib lower 1	LF	4.8	16.0	8.4	14.3
	HF	0.6	6.7	7.9	12.5
	AB	5.4	22.7	16.3	26.8
Crib lower 2	LF	NA	12.4	7.2	8.6
	HF	NA	7.0	7.3	8.1
	AB	NA	19.4	14.5	16.7
Lower Totals	**LF**	**2.0±0.7**	**7.3±1.1**	**4.3±0.7**	**6.5±1.0**
	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**
Elevated Totals	**LF**	**0.1±0.1**	**1.5±0.2**	**0.2±0.1**	**0.4±0.2**
	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**
Overall	**LF**	**1.6±0.6**	**5.8±0.7**	**3.3±0.5**	**5.0±0.7**
	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

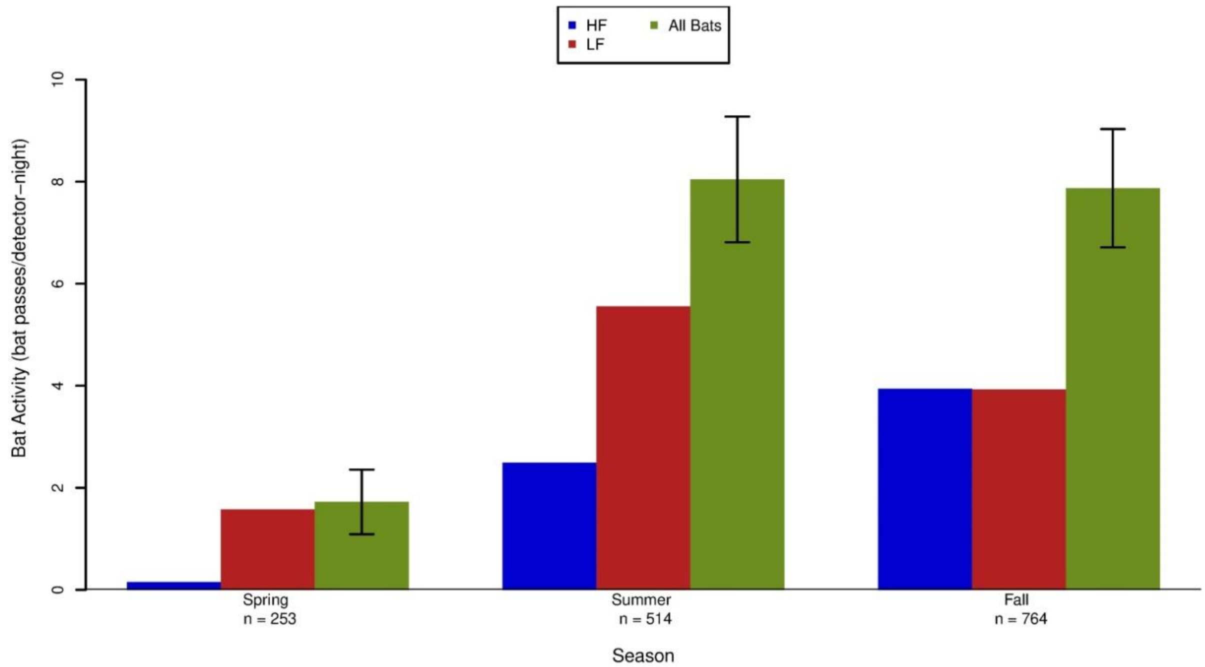

Figure 5. Seasonal bat activity by high-frequency (HF), low-frequency (LF), and all bats at the Icebreaker Wind Project Bat Survey Area from March 21 through November 14, 2017. The bootstrapped standard errors are represented on the 'All Bats' columns.

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

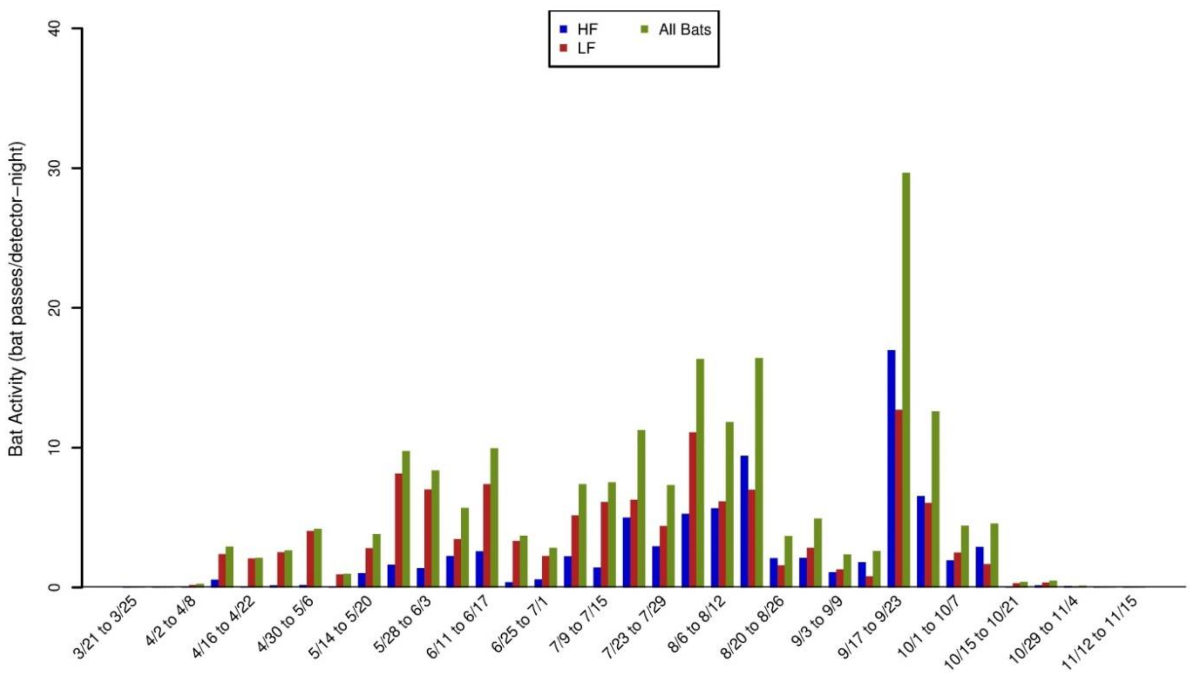

Figure 6. Weekly patterns of bat activity by high-frequency (HF), low-frequency (LF), and all bats at the Icebreaker Wind Project Bat Survey Area from March 21 to November 14, 2017.

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.

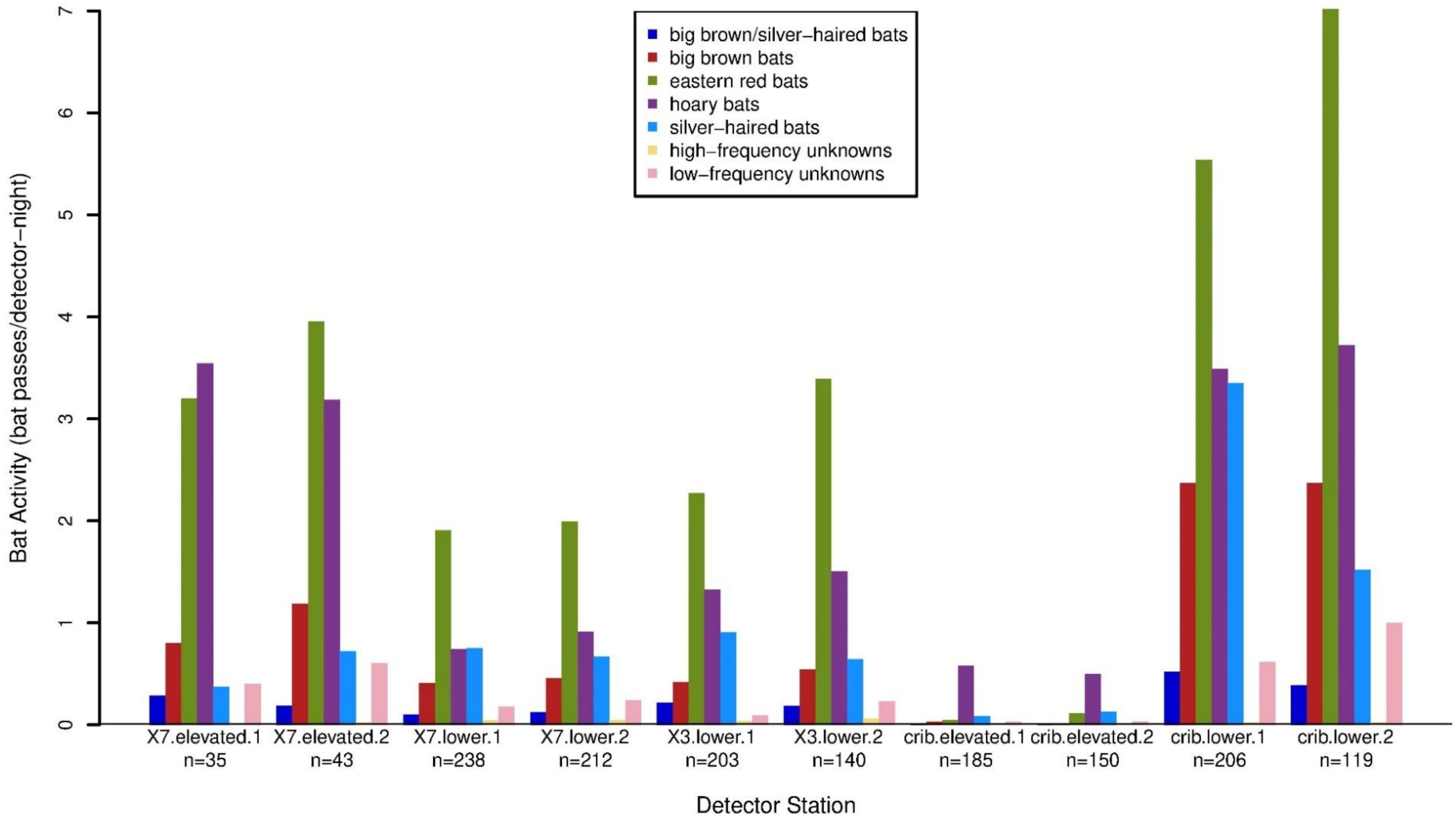

Figure 7. Bat species present at each detector location and station at the Icebreaker Wind Project Bat Survey Area from March 21 to November 14, 2017.

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)

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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,

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WEST, Inc.
512-229-8399
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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.

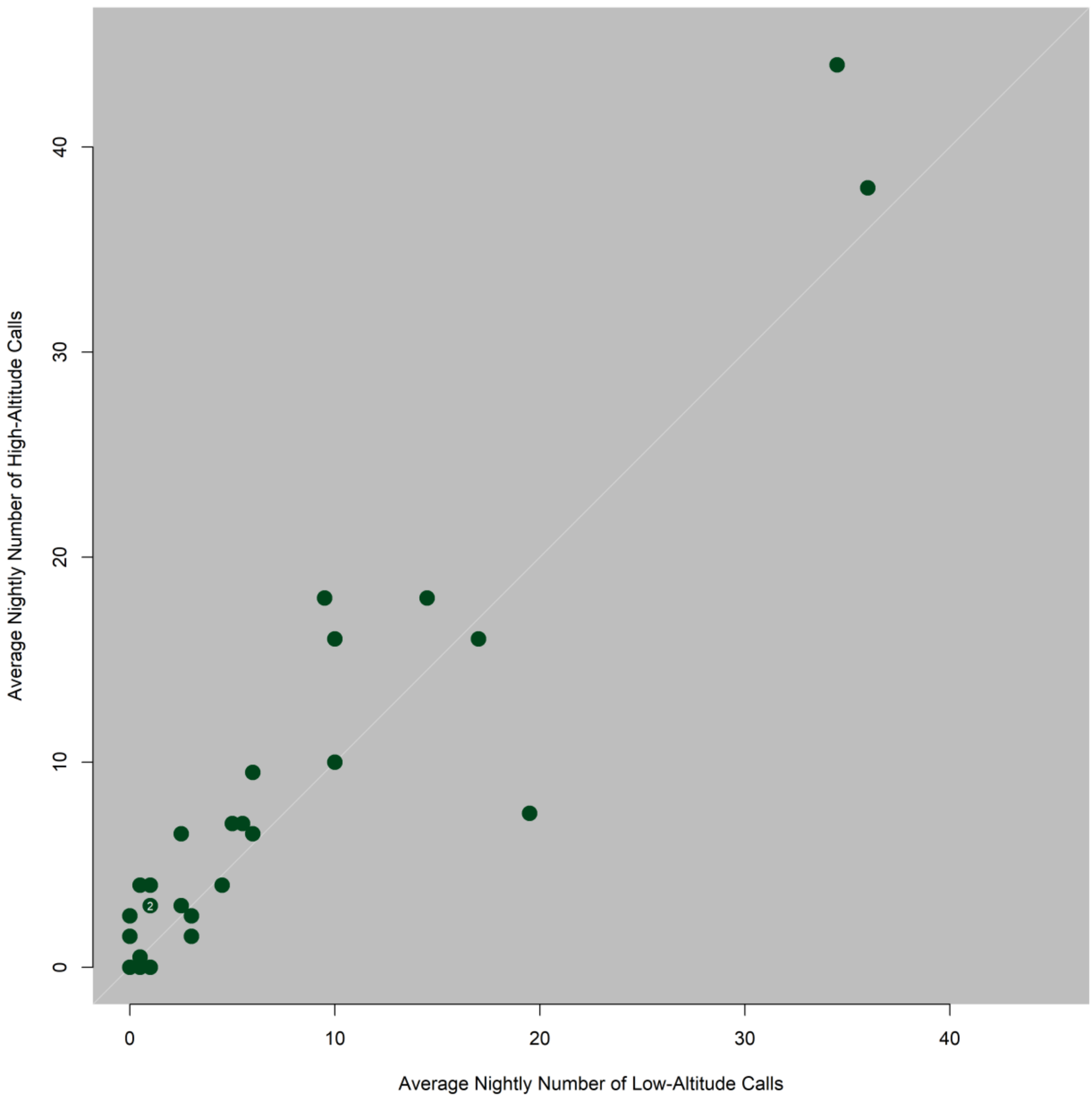


Figure 1: Number of High- vs. Low-Altitude Calls. Each data point represents one night. Each point's coordinate reflects the nightly average value for each altitude. Note that the only nights included in this analysis were nights for which data was gathered from all four detectors (July 19-August 14). 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.

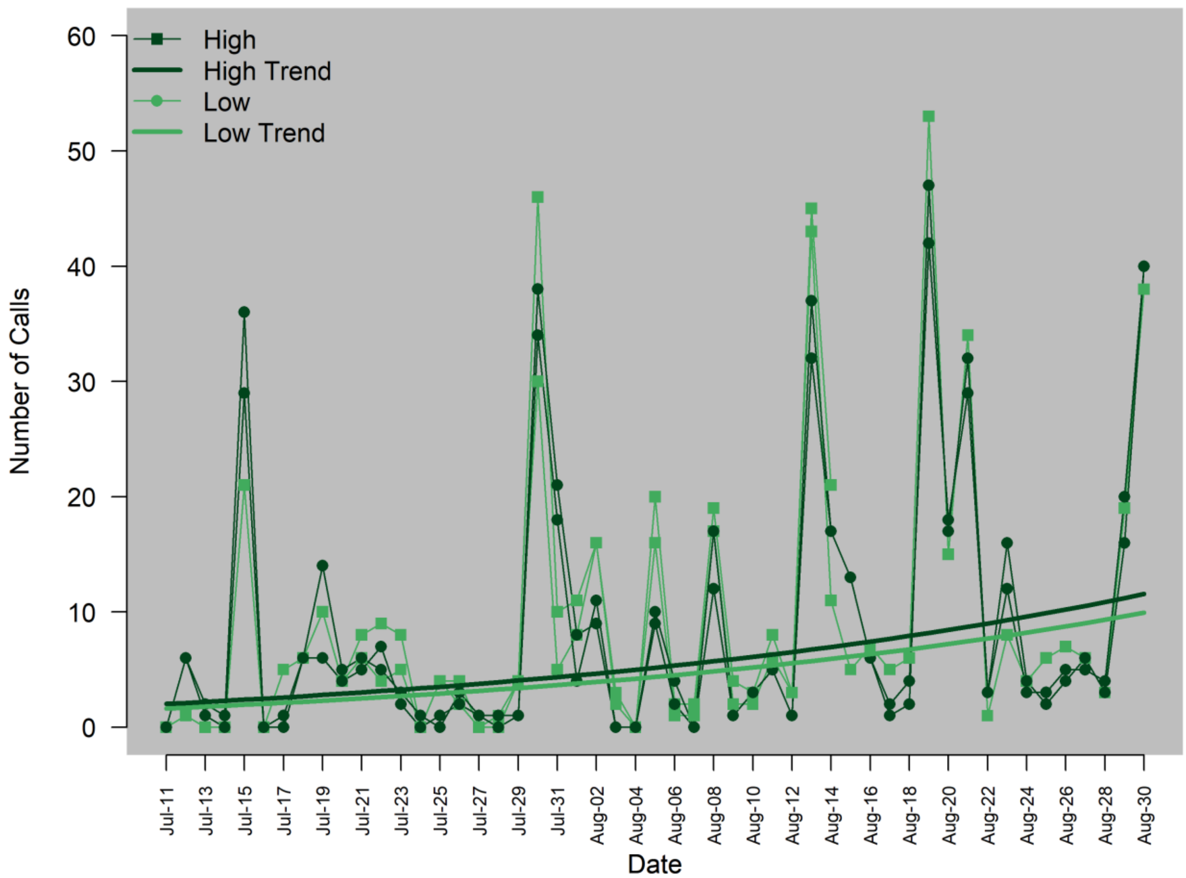
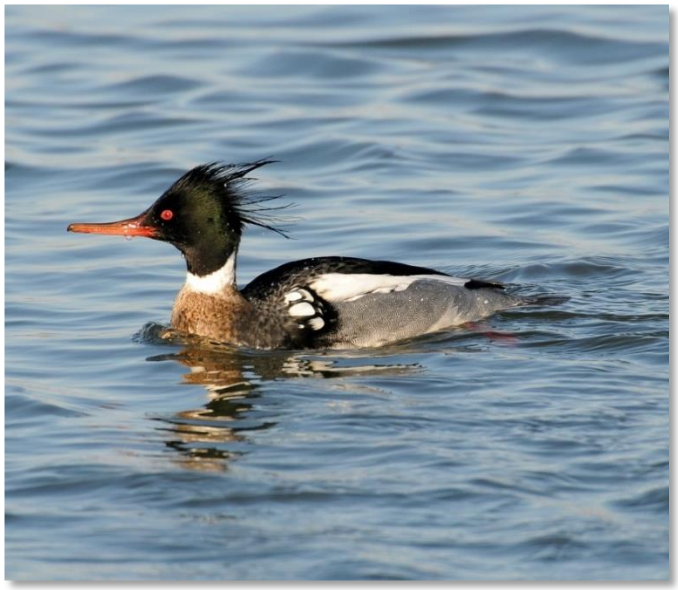


Figure 2: Number of Calls versus Date for High and Low Altitudes at Each of Two Detectors. Each night records the number of bat calls up to four distinct points, with two detector points for High Altitude and two for Low Altitude. The trend lines depict the temporal trends for each altitude, using the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

Appendix B

Aerial Waterfowl and Waterbird Survey Interim Report for the Proposed Icebreaker Wind Project Cuyahoga County, Ohio

Aerial Waterfowl and Waterbird Survey
Interim Report
for the Proposed Icebreaker Wind Project
Cuyahoga County, Ohio



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February 14, 2018

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INTRODUCTION

Icebreaker Windpower, Inc. (IWP or Applicant) is proposing to construct Icebreaker Wind, a 6-turbine offshore wind energy demonstration project (Project) in Lake Erie, approximately 13 – 16 kilometers (km; 8 – 10 miles [mi]) off the shore of Cleveland, Ohio. This report documents the study and field survey efforts for the Aerial Waterfowl and Waterbird study for the period from 16 October 2017 through 5 February 2018. The 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 is to characterize waterfowl and waterbird species, numbers, distribution, and use of the Project area from fall through spring, the non-breeding season.

STUDY AREA

The survey area extends five km (3.1 mi) from the proposed turbines and encompasses 145 km^2 (35,830 acres) of US waters within Lake Erie (Figure 1). Water depths range from 15 – 20 meters (m; 49 – 66 feet [ft]) over mud substrates, with limited areas of sand and clay.

STUDY METHODS

A transect approach was used to sample the survey area using double-observer distance sampling protocol and a fixed-wing aircraft. The double-observer sampling approach was used to aid in resolving variability among observers in bird detection and density estimation. Observers each collected data independently, and isolated from other observers. Orientation of the sampling transects perpendicular to the proposed turbine string follows a gradient design. Parallel transects have been established 2.2 km (1.37 mi) apart, and perpendicular to the orientation of the turbine string (Figure 1). The seven 10-km (6.2-mi) transects were flown during each survey. Surveys were scheduled to be flown every two weeks beginning 15 October 2017 – 31 May 2018, with additional surveys possible during extensive ice cover when the next scheduled survey may not capture the icing conditions. For each regularly scheduled survey, three random assignments were made, including:

- the survey time within daylight hours (early-day [0500-1000H]; mid-day [1000-1400H]; later-day [1400-1900H]),
- the first transect surveyed for the day (transects 1 – 7), and
- initial flight direction (northeast or southwest).

Flights were completed using a Cessna 185 (high-wing, 4-seat plane) with amphibious landing gear. High wing mounts ensure maximum visibility, and amphibious landing gear ensured ability to land on Lake Erie if necessary. Each of the seven transects was sampled completely for each survey. Surveys were flown at 76 m (249 ft) above ground level, at flight speeds of 150 km per hour (hr; 93 mi per hr). Due to minimal observations of birds within the project area during

October, we collected additional observational data during the approach and departure to and from the Project. This additional observational data was collected to ensure that the data set captures the variability and physical conditions of the nearshore environment, and to ensure there are adequate observations to develop the detection models necessary for estimating density within the Project. Off-transect observations cannot be used for density estimation in the off-transect area because the data is not collected on consistent paths/transects. Similarly, during a period of extensive ice cover in late December/early January, an additional survey was flown to document bird use of the survey area and the ice status, with additional off-project aerial observations to capture information on the distribution of waterbirds and ice in the area.

Data collection followed a pre-established field form that is completed verbally and recorded into a voice recorder during the flight (Appendix A). Variables on the field form follow pre-defined variable definitions to aid in the objectivity of the observations. Distance to birds from the transect line were estimated using distance bands and the Dioptra App for Android to determine the angle of observation (Figures 2 and 3). Following the flight, observers immediately transcribed audio observations and referenced Dioptra images to complete the field forms prior to data entry. Field forms were subsequently entered into a relational database to store, retrieve, and organize field observations. All recordings, images, and paper data forms were backed up, and retained for reference.

RESULTS

Regular aerial waterbird surveys began on 16 October 2017 and were completed every two weeks through 5 February 2018 (Table 1). Nine of 17 regular flights have been flown, and one additional ice condition aerial survey was completed on 4 January 2018 to document rapid ice formation within the Project area and surrounding area. Since late December, ice coverage within the project has been variable (0-90%), with most of the ice present in slushy brash to small floes.

The following is an interim summary of the observations to date; data have not been finalized in the formal WEST quality assurance and quality control (QA/QC) process; therefore, details are expected to change and results should be considered as preliminary.

During surveys to date, 13 species were observed during the flights with 11 species confirmed within the Project area (Table 2). Among the observations within the Project area, 68% were identified as gulls, including Herring (11.6%, *L. argentatus*), Ring-billed (11.3%, *Larus delawarensis*), Bonaparte's (1.6%, *Chroicocephalus philadelphia*), and Great Black-backed gull (1.7%, *L. marinus*); unidentified gulls compose 41.8% of all observations with 67% of these unidentified resting on the ice or water, and 29% flying through the Project. In contrast, among the off-transect observations seen between the Project area and the southern Lake Erie shoreline during the approach to, and departure from the Project, mergansers (Common [*Mergus merganser*], Red-breasted [*M. serrator*], and unidentified mergansers) represented 34% of observations; Red-breasted Mergansers comprised 18.5% of all observations not in the project area. To date, no raptors or eagles have been observed during surveys, in the Project area, or over nearby waters.

Sixty-four percent of all bird observations have been outside the project boundary; 36% of all observations were within the project boundary (Figure 4-6; Table 2). Of birds within the Project area, 74.3% of birds were seen singly and 14.2% were observed in small groups (2 – 5 birds). Within the project area, the flock size by species to date is 4.9 birds (18.2 SD). In contrast, observations outside the project, flock size by species is 11.2 birds (41.7 SD), with 56.2% observations having a group size of 1, and 21.8% were observed in small groups (2 – 5 birds). Twenty-two percent of observations outside the project area had a group size of 6-300 birds.

SURVEY AND REPORT STATUS

Eight regularly scheduled survey flights remain in the 2017 – 2018 aerial waterbird survey effort. WEST will continue to monitor icing conditions on Lake Erie for deploying up to two additional ice condition surveys. After completion of the survey effort in May, data will undergo an extensive QA/QC process prior to the analysis, with reporting following.

Table 1. Proposed and completed aerial waterbird surveys including randomly assigned survey window, starting transect, and direction for 2017 – 2018.

Week Starting	Survey Completed	Survey	Survey Window	Survey Start Time	Transect Start	Direction (Heading)
15-Oct-2017	16-Oct-2017	Reg#1	mid-day (1000-1400H)	1200H	4	NE (55°)
29-Oct-2017	1-Nov-2017	Reg#2	early-day (0500-1000H)	0800 H	6	SW (235°)
12-Nov-2017	13-Nov-2017	Reg#3	later-day (1400-1900H)	1500H	6	NE (55°)
26-Nov-2017	27 Nov-2017	Reg#4	mid-day (1000-1400H)	1200H	5	NE (55°)
10-Dec-2017	11-Dec-2017	Reg#5	early-day (0500-1000H)	0800 H	3	NE (55°)
24-Dec-2017	27-Dec-2017	Reg#6	later-day (1400-1900H)	1400H	2	SW (235°)
Ice#1	4-Jan-2017	Ice#1	early-day (0500-1000H)	1000H	1	NE (55°)
7-Jan-2018	9-Jan-2018	Reg#7	mid-day (1000-1400H)	1100H	1	NE (55°)
21-Jan-2018	25-Jan-2018	Reg#8	early-day (0500-1000H)	0800 H	5	SW (235°)
4-Feb-2018	5-Feb-2018	Reg#9	later-day (1400-1900H)	1500H	3	SW (235°)
18-Feb-2018		Reg#10	mid-day (1000-1400H)	1200H	2	SW (235°)
4-Mar-2018		Reg#11	early-day (0500-1000H)	0800 H	2	SW (235°)
18-Mar-2018		Reg#12	later-day (1400-1900H)	1500H	4	SW (235°)
1-Apr-2018		Reg#13	mid-day (1000-1400H)	1200H	1	SW (235°)
15-Apr-2018		Reg#14	early-day (0500-1000H)	0800 H	4	NE (55°)
29-Apr-2018		Reg#15	later-day (1400-1900H)	1500H	7	NE (55°)
13-May-2018		Reg#16	mid-day (1000-1400H)	1200H	6	SW (235°)
27-May-2018		Reg#17	early-day (0500-1000H)	0800 H	7	NE (55°)
Ice#2	if needed					
Ice#3	if needed					

Table 2. Counts[a] of birds by species observed in the Icebreaker Wind Project (Pr; from seven transects) or during nearby off-transect (OT) flights nearby, with results summarized by date (16 October 2017 – 5 February 2018), and survey type (Regular [Reg] or Ice [Ice]).

		16-Oct	1-Nov	13-Nov		27-Nov		11-Dec		27-Dec		4-Jan		9-Jan		25-Jan		5-Feb	
		Reg#1	Reg#2	Reg#3		Reg#4		Reg#5		Reg#6		Ice#1		Reg#7		Reg#8		Reg#9	
Common Name	**Scientific Name**	**Pr**	**Pr**	**Pr**	**OT**	**Pr**	**OT**	**Pr**	**OT**	**Pr**	**OT**	**Pr**	**OT**	**Pr**	**OT**	**Pr**	**OT**	**Pr**	**OT**
Ring-Necked Duck	*Aythya collaris*				9														
Unid. Scaup	*Aythya spp.*														4				
Black Scoter	*Melanitta americana*						8										5		
Unid. Scoter	*Melanitta spp.*		15			1													
Long-Tailed Duck	*Clangula hyemalis*									2									
Bufflehead	*Bucephala albeola*					1													
Common Goldeneye	*Bucephala clangula*									1		8			45		4		49
Common Merganser	*Mergus merganser*													1					
Red-Breasted Merganser	*Mergus serrator*				1				232	4		14	12 2		365	9	34	3	
Unid. Merganser	*Mergus spp.*					1			300			4	2		230	19	16		94
Unid. Duck				11	5	4	1		205			31		1	201	539	190		54
Bonaparte's Gull	*Chroicocephalus philadelphia*	5	10	2		9	5	6	7	1	4	2			4				
Ring-Billed Gull	*Larus delawarensis*	16	6		3	8	4	20	50	9	16	25	9	39	24	77	10	53	18
Herring Gull	*Larus argentatus*		1			1	1		4	1	3	25	2	32	54	37		163	4
Great Black-Backed Gull	*Larus marinus*											10	1	5	38	11		12	11
Unid. Gull	*Larus spp*	65	14		8	34	9	8	170	11	61	12	49	15	104	74	72	704	10 57
Common Loon	*Gavia immer*		1	4	1	1	1		1										
Unid. Loon	*Gavia spp.*					1													
Double-Crested Cormorant	*Phalacrocorax auritus*	12	3		1			2	12										
Unid. Passerine							2												
Unid. Large Bird								1			1			1		11			
Raw Count*		98	50	17	28	61	31	37	981	29	85	131	185	94	1069	777	331	935	1287
Survey distance (km)		70	70	70	24	70	29.7	70	32.5	70	32	70	40	70	100.5	70	26.4	70	32

[a] Counts include observations by two of the three observers in plane (front right and rear left) and does not represent the unreconciled final double-observer survey results. Results presented are the number of individual birds observed per survey without double counting

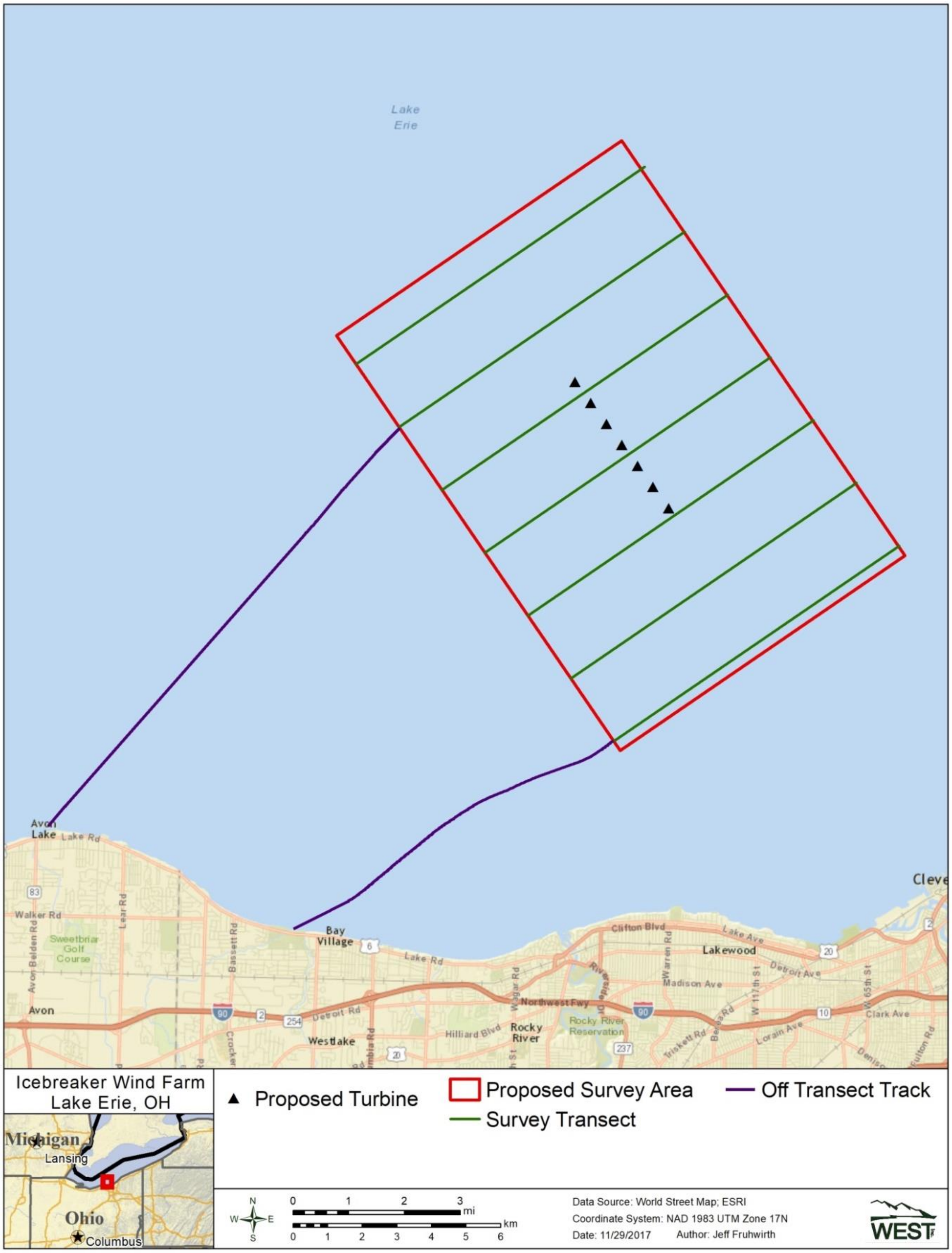

Figure 1. Location of the aerial survey area (red), survey transects (green), and example off-transect survey areas sampled on 13 November 2017 (purple) for Icebreaker Wind.

Figure 2 Example of Dioptra App image from aerial survey on 27 November 2017 Icebreaker Wind regular survey. Image documents location within yellow circle of one loon swimming near Transect #7 in the project.

Figure 3 Example of Dioptra App image from aerial survey on 9 January 2018 Icebreaker Wind regular survey. Location documents two Great Black Back Gull adults resting on "ice cake" ice type off-transect, outside the project.

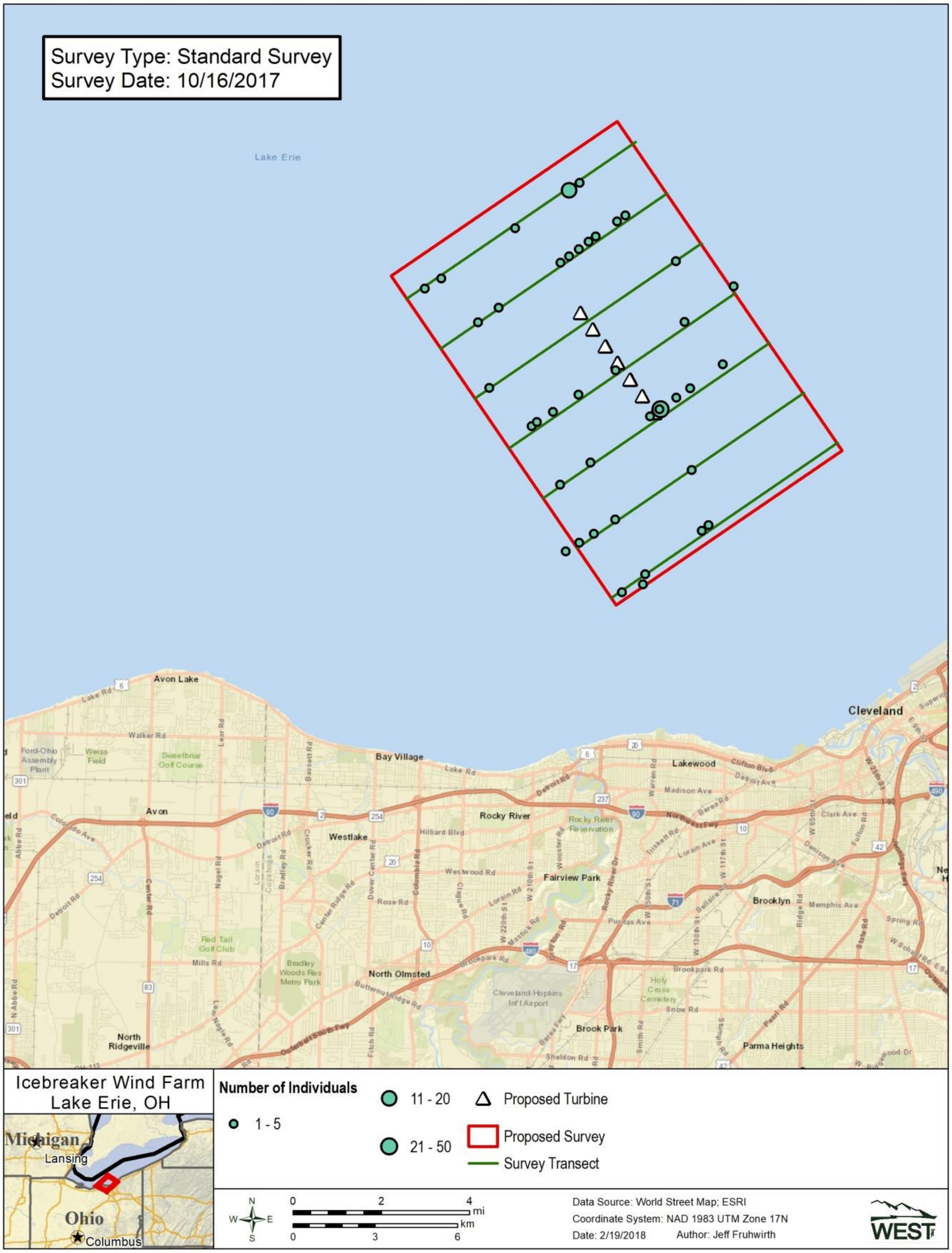

Figure 4. Location of the aerial survey area (red), survey transects (green), and number of birds (green; size of symbol indicates count) observed on October 16, 2017 for Icebreaker Wind. Counts include observations by two of the three observers in plane (front right and rear left) and do not represent the unreconciled final double-observer survey estimates.

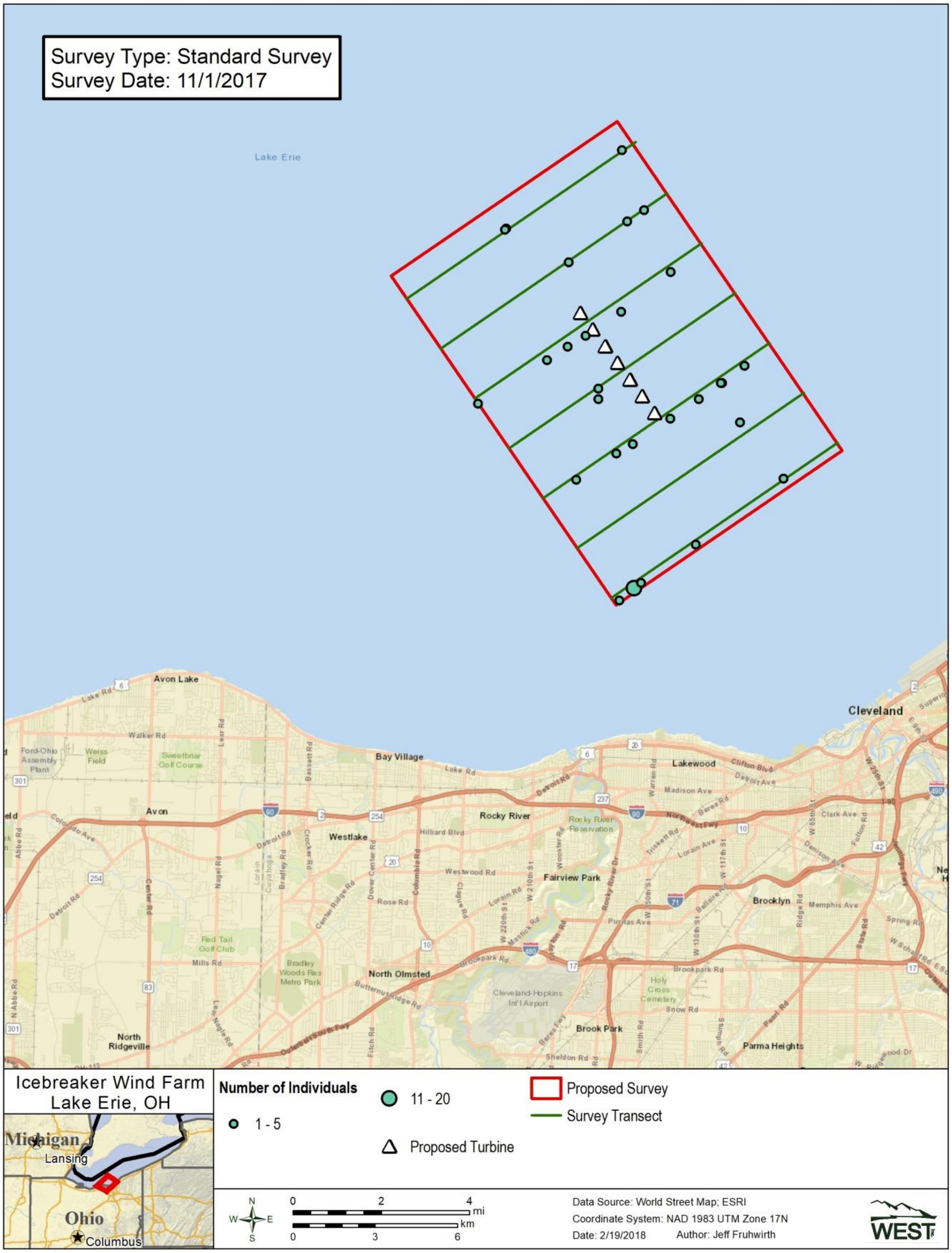

Figure 5. Location of the aerial survey area (red), survey transects (green), and number of birds (green; size of symbol indicates count) observed on November 1, 2017 for Icebreaker Wind. Counts include observations by two of the three observers in plane (front right and rear left) and do not represent the unreconciled final double-observer survey estimates.

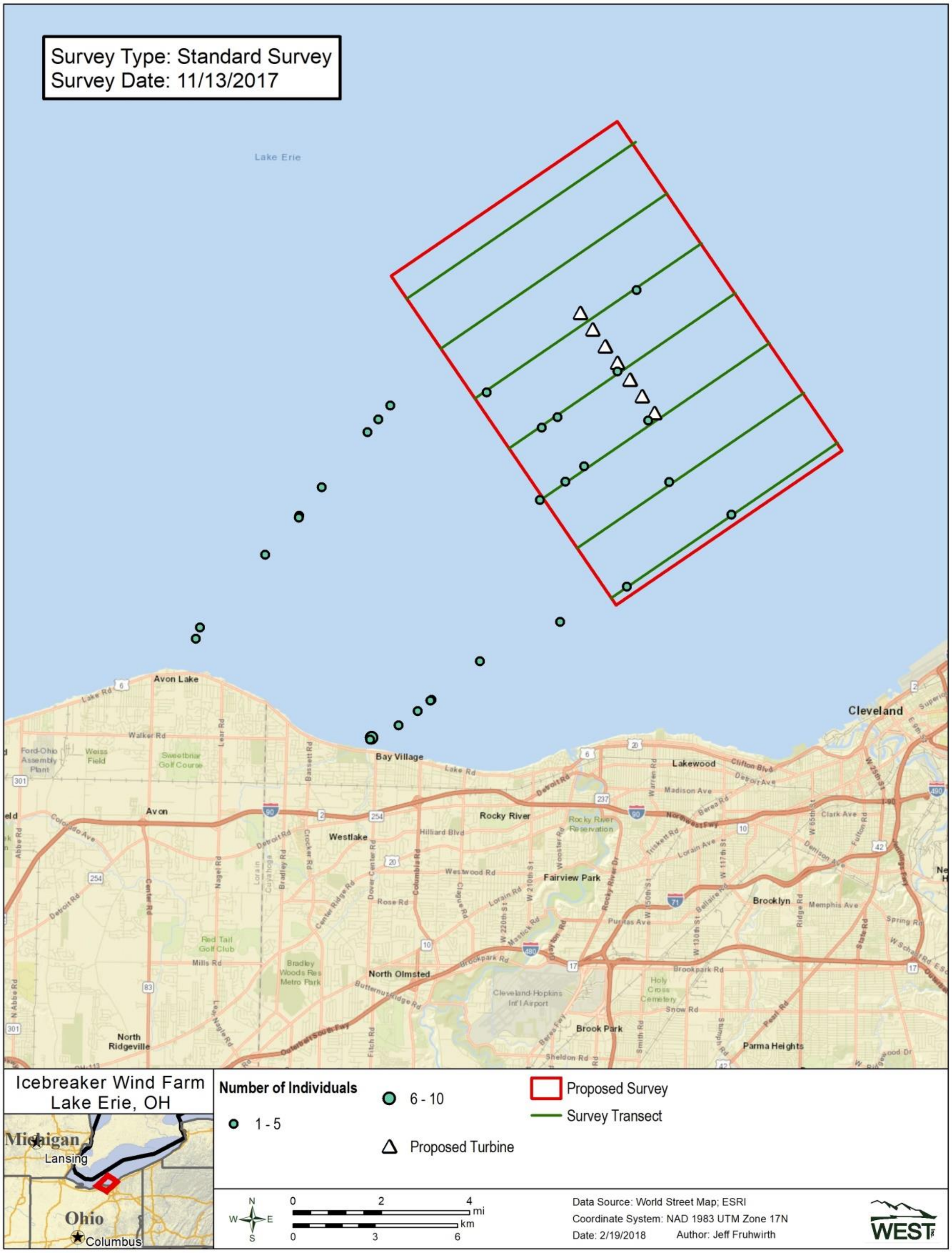

Figure 6. Location of the aerial survey area (red), survey transects (green), and number of birds (green; size of symbol indicates count) observed on November 13, 2017 for Icebreaker Wind. Counts include observations by two of the three observers in plane (front right and rear left) and do not represent the unreconciled final double-observer survey estimates.

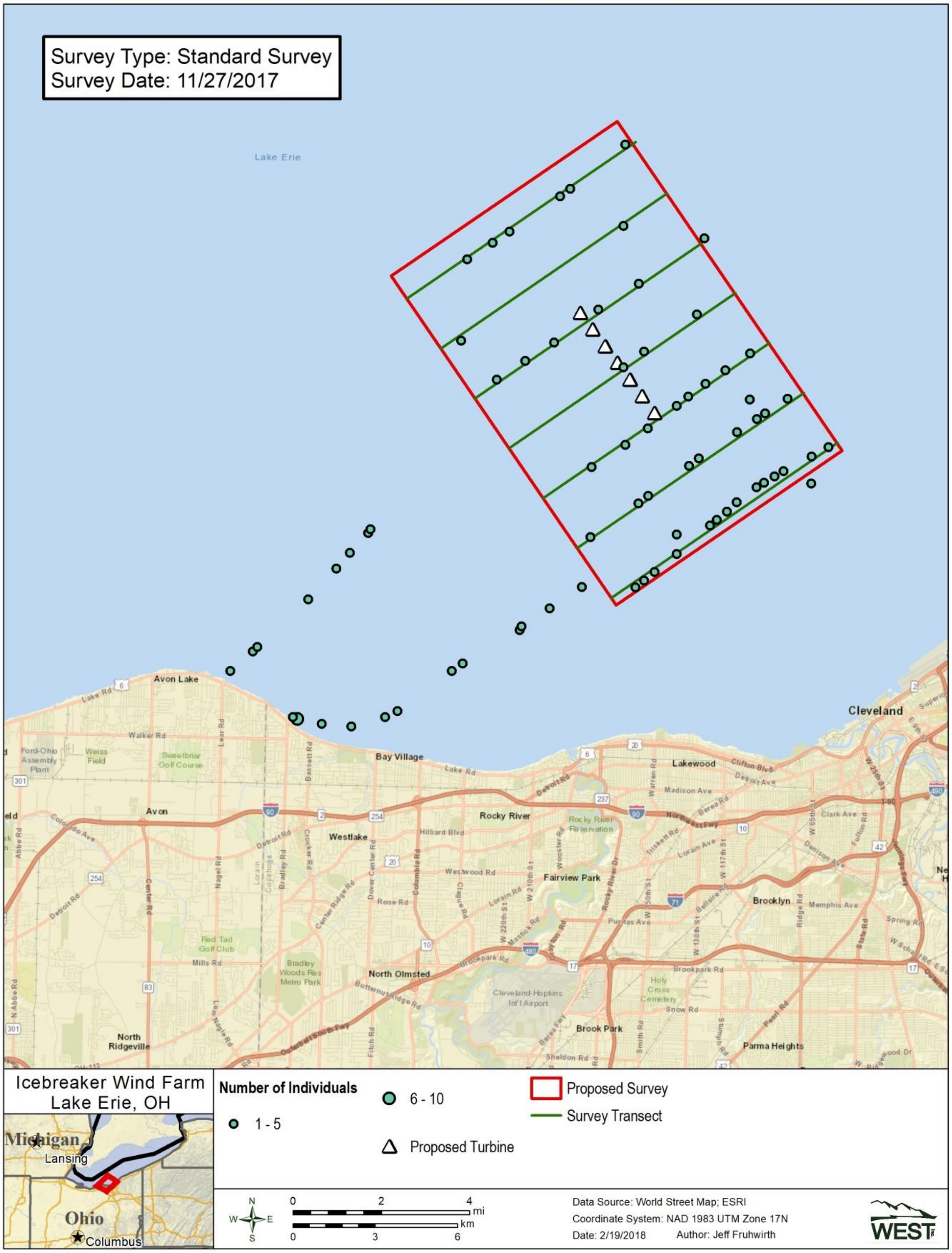

Figure 7. Location of the aerial survey area (red), survey transects (green), and number of birds (green; size of symbol indicates count) observed on November 27, 2017 for Icebreaker Wind. Counts include observations by two of the three observers in plane (front right and rear left) and do not represent the unreconciled final double-observer survey estimates.

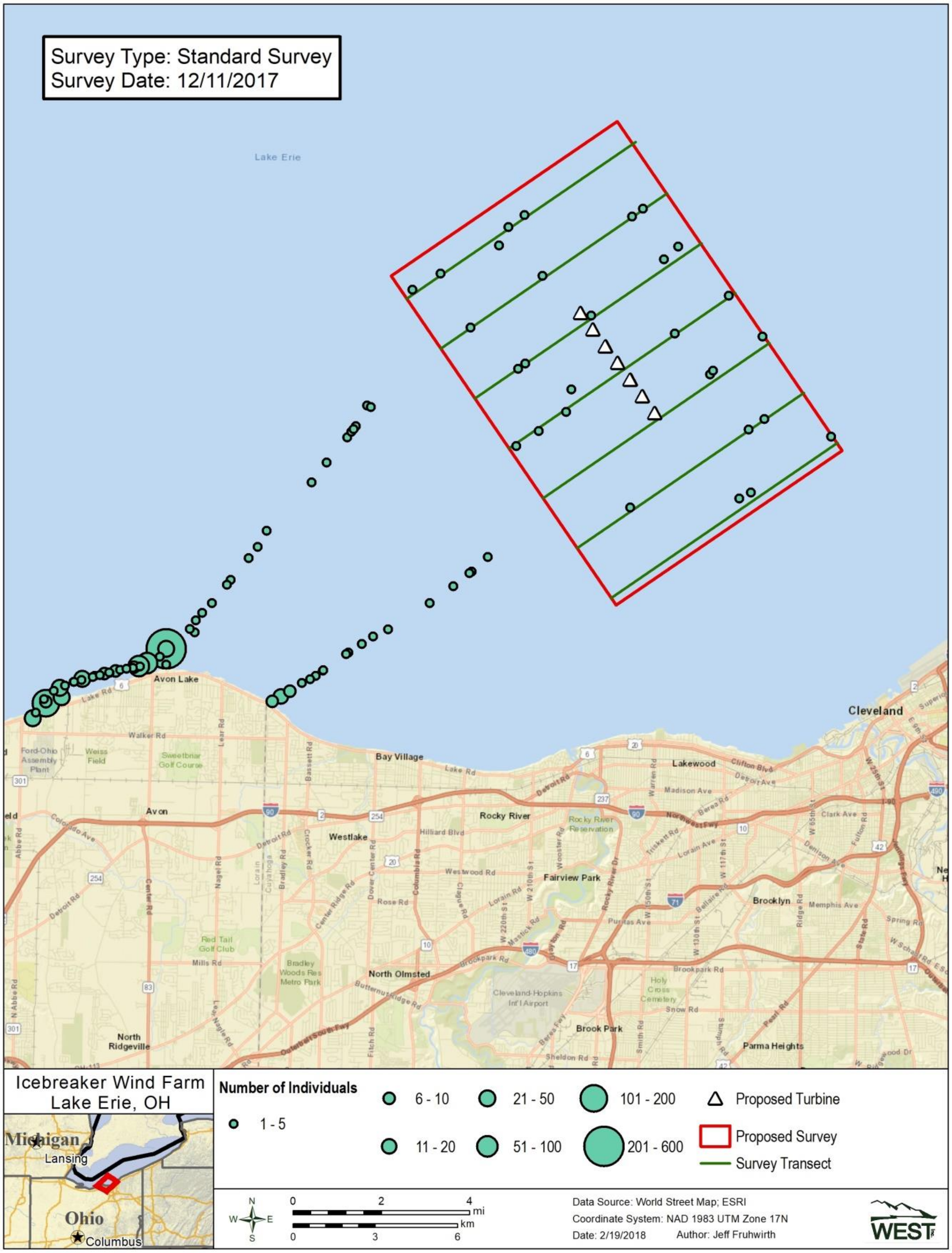

Figure 8. Location of the aerial survey area (red), survey transects (green), and number of birds (green; size of symbol indicates count) observed on December 11, 2017 for Icebreaker Wind. Counts include observations by two of the three observers in plane (front right and rear left) and do not represent the unreconciled final double-observer survey estimates.

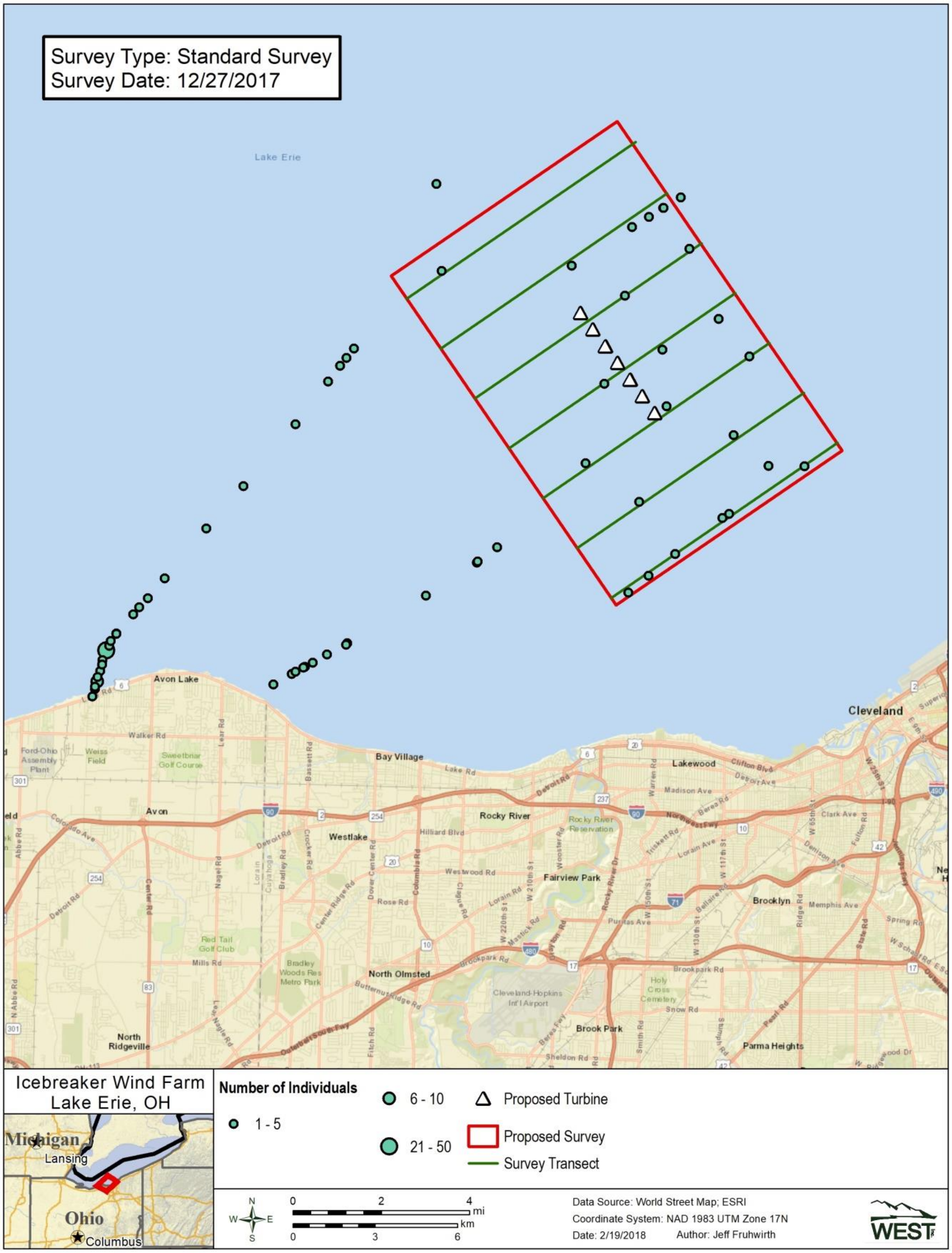

Figure 9. Location of the aerial survey area (red), survey transects (green), and number of birds (green; size of symbol indicates count) observed on December 27, 2017 for Icebreaker Wind. Counts include observations by two of the three observers in plane (front right and rear left) and do not represent the unreconciled final double-observer survey estimates.

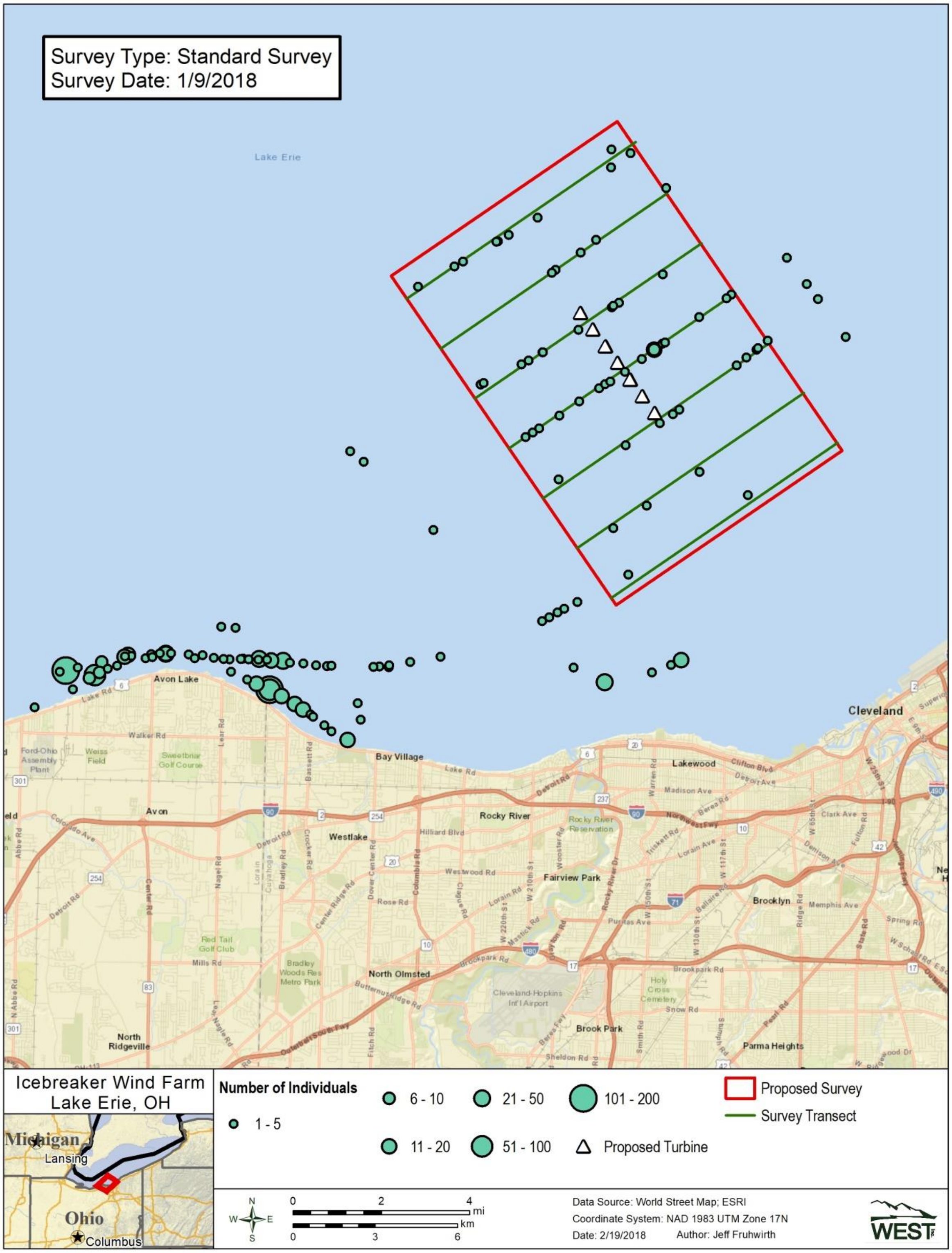

Figure 10. Location of the aerial survey area (red), survey transects (green), and number of birds (green; size of symbol indicates count) observed on January 9, 2018 for Icebreaker Wind. Counts include observations by two of the three observers in plane (front right and rear left) and do not represent the unreconciled final double-observer survey estimates.

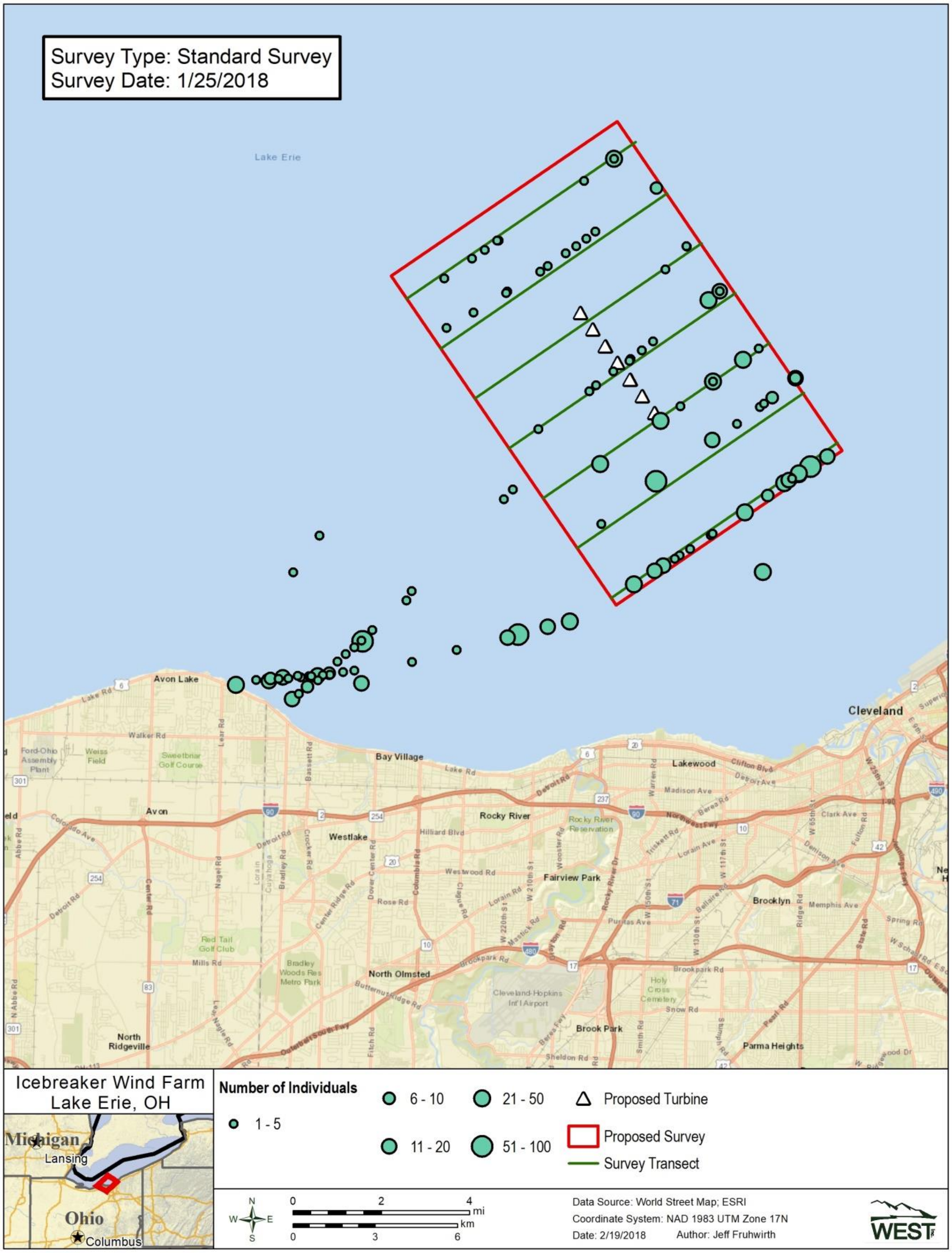

Figure 11. Location of the aerial survey area (red), survey transects (green), and number of birds (green; size of symbol indicates count) observed on January 25, 2018 for Icebreaker Wind. Counts include observations by two of the three observers in plane (front right and rear left) and do not represent the unreconciled final double-observer survey estimates.

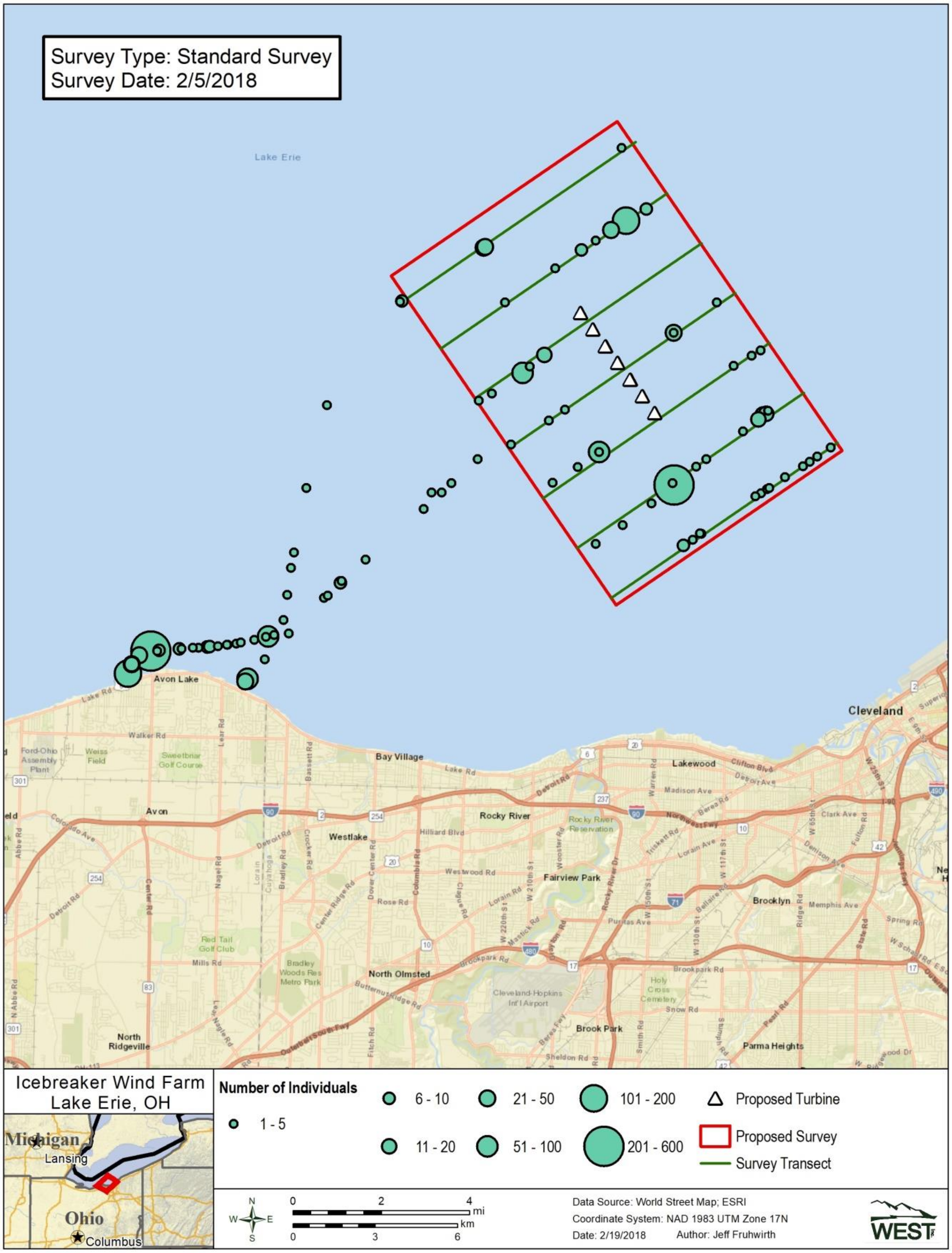

Figure 12. Location of the aerial survey area (red), survey transects (green), and number of birds (green; size of symbol indicates count) observed on February 5, 2018 for Icebreaker Wind. Counts include observations by two of the three observers in plane (front right and rear left) and do not represent the unreconciled final double-observer survey estimates.

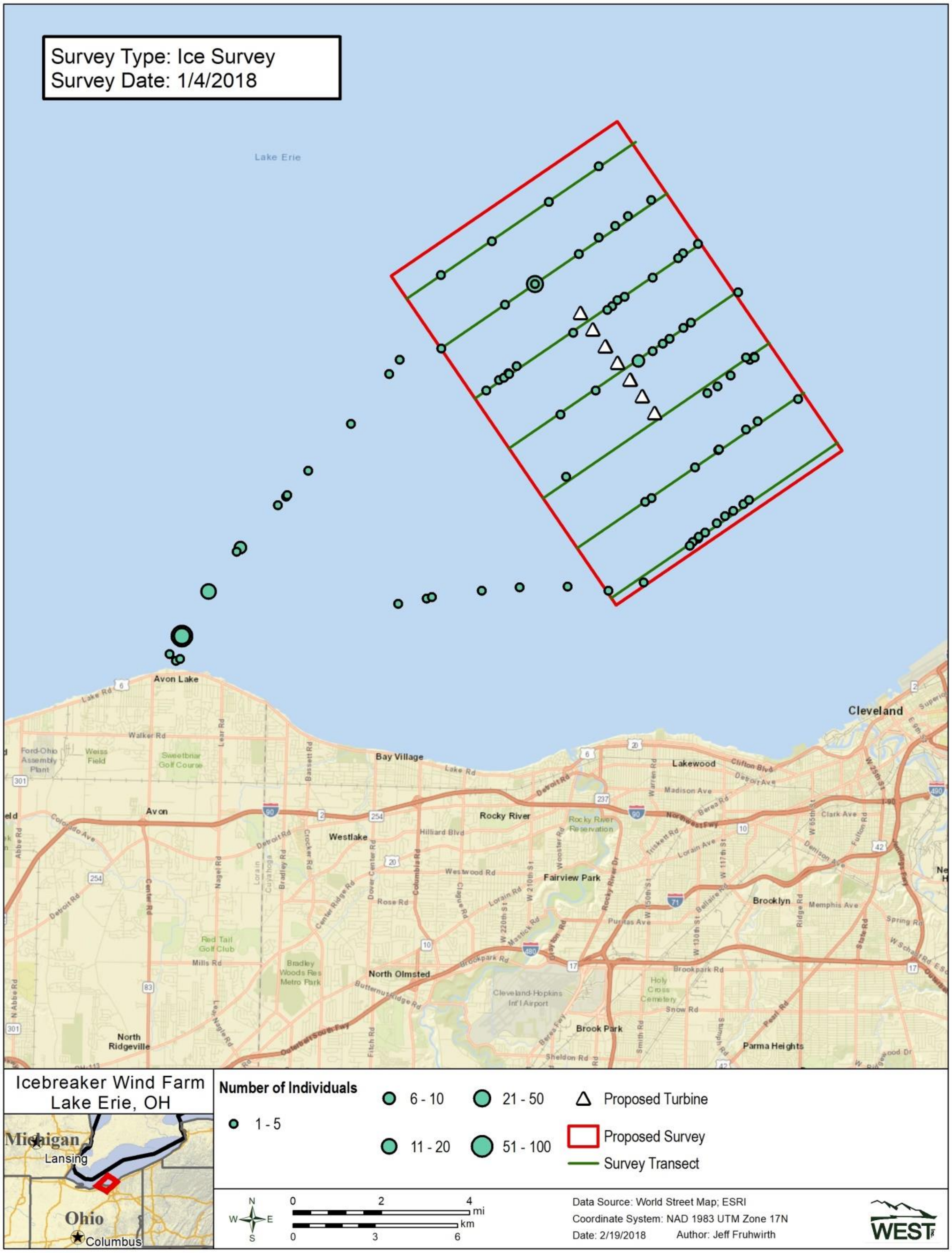

Figure 13. Location of the aerial survey area (red), survey transects (green), and group size of birds (green; size of symbol indicated count) observed during ice concentration survey on Jan 4, 2018 for Icebreaker Wind. Counts include observations by two of the three observers in plane (front right and rear left) and do not represent the unreconciled final double-observer survey estimates.

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Appendix A. Western EcoSystems Technology, Inc. Datasheet and Variable Definitions Used in the Icebreaker Wind Aerial Surveys

Icebreaker – Aerial Survey Transects Datasheets for Waterfowl/Waterbirds
Datasheet Instructions

In brief

- Data Sheets should be completed for each transect (9 transects, 1-7 + Wander during every survey.)
- Each of the 3-people flying has the responsibility of completing a set of data sheets (at least 7 sheets).
- After the flight, you will transcribe your voice recording to complete the rest of the datasheet, do a QAQC of your data, QAQC someone else's data, and complete data entry.
- Scan data sheets to Google Drive before submitting datasheets to crew leader.
- Crew Leader will mail already scanned and entered datasheets to Jennifer Stucker by priority mail to WEST's Minneapolis office.

Data sheet variables – for each transect

Field	Explanation	Source
Header Fields		
Survey Type	Choose 1. Regularly Scheduled Survey or special survey to document birds and ice	Crew Leader/Schedule
Transect#	Number/Letter **1 – 7** **W- W**ander for off-transect and ice flight	Call out - Crew Lead – Pilot GPS
Survey Direction	Choose 1.	GPS or Dioptera (center)
Observer	Observer initials	
Seat (in plane)	Choose 1. Front Right, Back Left, Back Right	
Date	MM/DD/YYYY	
Start/End time	24HR - Time of transect start or end	Pilot/Crew lead announces
Cloud Cover	Estimate nearest 10%	Observation
Glare	Your perception for TRANSECT 1-4	Data sheet
Beaufort #	Choose1: 1 - 4	*see* Beaufort Scale Sheet
Wind Direction	Choose 1. N, NE, E, SE, S, SW, W, NW	Burke Lakefront Airport - weather
Wind Speed	Average, min, max(gust) **mph**.	Burke Lakefront Airport - weather
Temperature	Temperature in **F°**	Burke Lakefront Airport - weather
Body Fields		
Time	24H **HH:MM.SS**	Dioptera - picture
Latitude	41.XXXXXX	Dioptera - picture
Longitude	-81.XXXXXX	Dioptera - picture
Ice%	Percentage of ice cover at bird observation	*See* Ice Concentration Sheet
Ice Type	Characteristics/Form of Ice 0-12	*See* Ice Form Sheet
Observer Angle	Perpendicular Observation Angle to bird	Dioptera – picture (right)

Distance Band	Estimated distance to bird (flock) in **m** **X *for non-standard survey altitude*.**	**Rulers** (by -seat/altitude) **Marks** on wing supports
Flock/Grp ID	Sequential numbers to each “flock”	Assign during transcription
Mixed Flock	Yes or No. If group is more than one species &/or sex it is mixed = yes	
Spp/Obs ID	Sequential numbers to each species/sex within the Flock/Group ID	Assign during transcription
Species	Species observed – 4-letter codes @ transcription	*see* Icebreaker List of Expected Species
Sex	Male, Female, Unknown	
Age	Juvenile, Immature, Adult, Unknown	
Behavior 1	First or dominant behavior observed	*see* Behavior Reference
Behavior 2	(optional) a 2nd behavior seen	
Associated With	Feature in/on water (air) that birds are seen with	*See* Associated with Reference
Comments		

Icebreaker

Survey Type Standard | Ice **Transect#** ______ **Survey Direction** NE | SW **Observer:** *(Initials)* __________

Seat ☐Front-R ☐Back-L ☐Back-R

Date: *(MM/DD/20YY)* ______/______/20___ **Start time** (24hr) ___:___ **End time** (24hr) ___:___ **Cloud Cover:** ____% **Glare**

- ☐ 0 none
- ☐ 1 slight/grey
- ☐ 2 Bright on the observer's side
- ☐ 3 Bright forward of the vessel

Wind Dir: N | NE | E | S | SE | SW | W | NW **Max Visibility:** ______ *km* **Temp:** ____*°F* **Beaufort#** _____

Average Wind Speed: ______ **Wind Speed Range:** *(min-max)* ______–______ *mph*

Time 24 h HH:MM.SS	Latitude (41.xxxxxx)	Longitude (-81.xxxxxx)	Obser. Angle (xx°)	Dist. Band	Flock/Grp ID	Spp/Obs ID	Mixed Flock	Species	# Individuals	Sex	Age	Behavior1	(Behavior 2)	Assoc. With	Ice %	Ice Type	Comments
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									
___:___.__	41.______	-81.______	___					____									

from Dioptra App.; *Grayed out fields complete during transcription*

Transcription ________ Paper QAQC ________ Computer/Paper QAQC ______

1 Record @ each transect start:

- Your name
- Date & Time
- Transect #
- Seat in plane

2 Record @ Each Observation

Dioptra

Distance Band

Mixed Flock

Species

 # Individuals by spp/sex

Sex

Age

Behavior(s)

Assoc. With

Ice %

Ice Type

Mergansers	common merganser
	hooded merganser
	red-breasted merganser
	unidentified merganser
Grebes	horned grebe
	red-necked grebe
	unidentified grebe
Loons	common loon
	red-throated loon
	unidentified loon
Cormorant	double-crested cormorant
Coot	American coot
Gull	unidentified gull
	Bonaparte's gull
	glaucous gull
	great black-backed gull
	lesser black-backed gull
	ring-billed gull
Scoter	white-winged scoter
	black scoter
	surf scoter
	unidentified scoter
Diving	lesser scaup
	greater scaup
	unidentified scaup
	long-tailed duck
	common goldeneye
	ruddy duck
	bufflehead
	ring-necked duck
Dabblers	American black duck
	American widgeon
	mallard
	northern pintail
	redhead
	canvasback
	unidentified duck

Goose	Canada goose
	cackling goose
	unidentified goose
Swan	trumpeter swan
	tundra swan
	mute swan
	unidentified swan
Tern	common tern
	Caspian tern
	black tern
	unidentified tern
Jaeger	long-tailed jaeger
	pomarine jaeger
	parasitic jaeger
	unidentified jaeger
Heron	great blue heron
	great egret
	snowy egret
	black-crowned night-heron
	green heron
Crow	American crow
Vulture	turkey vulture
Eagle	bald eagle
	unidentified eagle
Shorebird	Unid.shorebird
	Unid.passerine
Hawk	red-tailed hawk
	northern harrier
	unidentified buteo
	unidentified accipiter
	unidentified raptor
Pigeon	rock pigeon
	unidentified pigeon
	unidentified dove
Unknown	Unid. bird (small)
	Unid. bird (medium)
	Unid. bird (large)

BEHAVIORS

(FL) Flapping flight

(SW) Sitting on water

(CI) Milling - Circling - Gliding

(FE) Feeding

(SC) Scavenging

(KL) Kleptoparasitizing

(CA) Carrying fish

(DI) Diving (on surface to under water)

(PL) Plunge Diving (Foraging by plunge diving)

(TO) Take-off

(LA) Landing

(RE) Resting/Sleeping

(UA) Under Attack - (predation or kleptoparastism)

(FO)Following - (following a boat)

(IN) Injured or unwell

(OI) Oiled

(DE) Dead

ASSOCIATED WITH

(FI) Fish

(WF) Water front (two water masses - river mouth/bay)

(LI) Litter (plastic and human garbage, debris)

(DE) Debris (non-human - trees/branches)

(NI) Near ice

(OI) On ice

(NP) Near with a Platform (e.g. turbine or crib)

(OP) Sitting on a platform

(NB) Near/on a buoy

(BF) Near a fishing vessel (commercial/recreational)

(BR) Near recreational water craft (motor or sail)

(BS) Near shipping vessel

(SV) Submerged Aquatic Veg

(NO) Near/In oil slick

SEX

Male

Female

Unknown

AGE

Adult

Juvenile

Immature

Unknown

DISTANCE BANDS

A: <60 m

B: 60-100m

C: 100-150m

D: 150- 200m

E: 200- 250m

F: 250- 300m

G: 300- 350m

H: 350- 400m

I: 400-450m

J: 450-500m

K: >500m

X: Non-standard survey altitude

Ice Concentration

Code	Concentration %	Description	
0	< 10%	"open water"	
1	20-30%	"very open drift"	
2	40%	"open drift"	
3	50%	"open drift"	
4	60%	"open drift"	
5	70-80%	"close pack"	
6	90%	"very close pack"	
7	100%	"compact"	

modified from: Gjerdrum, C., D.A. Fifield, and S.I. Wilhelm. 2012. Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. Canadian Wildlife Service Technical Report Series No. 515. Atlantic Region. vi + 37 pp. (http://publications.gc.ca/collections/collection_2012/ec/CW69-5-515-eng.pdf)

Ice Form

Code	Name	Description
0	New	small, thin, newly formed, dinner plate-sized pieces
1	Pancake	rounded floes 30 cm - 3 m across with ridged rims
2	Brash	broken pieces < 2 m across
3	Ice Cake	level piece 2 - 20 m across
4	Small Floe	level piece 20 - 100 m across
5	Medium Floe	level piece 100 -500 m across
6	Big Floe	level, continuous piece 500 m - 2 km across
7	Vast Floe	level, continuous piece 2 - 10 km across
8	Giant Floe	level, continuous piece > 10 km across
9	Strip	a linear accumulation of sea ice < 1 km wide
10	Belt	a linear accumulation of sea ice from 1 km to over 100 km wide
11	Beach Ice or Stamakhas	irregular, sediment-laden blocks that are grounded on tidelands, repeatedly submerged, and floated free by spring tides
12	Fast Ice	ice formed and remaining attached to shore

modified from Gjerdrum, C., D.A. Fifield, and S.I. Wilhelm. 2012. Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. Canadian Wildlife Service Technical Report Series No. 515. Atlantic Region. vi + 37 pp. (http://publications.gc.ca/collections/collection_2012/ec/CW69-5-515-eng.pdf)

Codes for Sea State and Beaufort Wind Force

Wind Speed (knots)	**m p h** (l o w)	**mph** (high)	**kmh** (low)	**kmh** (low)	**Sea state code and description**	**Beaufort wind force and description**
0	0	0	0	0	**0** Calm, mirror-like	**0** calm
01 – 03	1	3	2	6	**0** Ripples with appearance of scales but crests do not foam	**1** light air
04 – 06	5	7	7	11	**1** Small wavelets, short but pronounced; crests do not break	**2** light breeze
07 – 10	8	12	13	19	**2** Large wavelets, crests begin to break; foam of glassy appearance; perhaps scattered white caps	**3** gentle breeze
11 – 16	13	18	20	30	**3** Small waves, becoming longer; fairly frequent white caps	**4 moderate breeze**
17 – 21	20	24	31	39	**4** Moderate waves with more pronounced form; many white caps; chance of some spray	**5** fresh breeze
22 – 27	25	31	41	50	**5** Large waves formed; white foam crests more extensive; probably some spray	**6** strong breeze
28 – 33	32	38	52	61	**6** Sea heaps up; white foam from breaking waves blows in streaks in direction of wind	**7** near gale
34 – 40	39	46	63	74	**6** Moderately high long waves; edge crests break into spindrift; foam blown in well-marked streaks in direction of wind	**8** gale
41 – 47	47	54	76	87	**6** High waves; dense streaks of foam in direction of wind; crests of waves topple and roll over; spray may affect visibility	**9** strong gale
48 – 55	55	63	89	102	**7** Very high waves with long overhanging crests; dense foam streaks blown in direction of wind; surface of sea has a white appearance; tumbling of sea is heavy; visibility affected	**10** storm
56 - 63	64	72	104	117	**8** Exceptionally high waves; sea is completely covered with white patches of foam blown in direction of wind; edges blown into froth; visibility affected	**11** violent storm
64 +	74	>74	119	>119	**9** Air filled with foam and spray; sea completely white with driving spray; visibility seriously affected	**12** hurricane

modified from Gjerdrum, C., D.A. Fifield, and S.I. Wilhelm. 2012. Eastern Canada Seabirds at Sea (ECSAS) standardized protocol for pelagic seabird surveys from moving and stationary platforms. Canadian Wildlife Service Technical Report Series No. 515. Atlantic Region. vi + 37 pp. (http://publications.gc.ca/collections/collection_2012/ec/CW69-5-515-eng.pdf)