POST-CONSTRUCTION WILDLIFE MONITORING AT THE ATLANTIC CITY UTILITIES AUTHORITY-JERSEY ATLANTIC WIND POWER FACILITY

PERIODIC REPORT COVERING WORK CONDUCTED BETWEEN 1 JANUARY AND 30 SEPTEMBER 2008

Submitted to:

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New Jersey Clean Energy Program
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INTRODUCTION

The following narrative describes activities New Jersey Audubon Society (NJAS) engaged in during its post-construction wildlife monitoring study conducted at the Jersey Atlantic Wind, LLC (JAW)/Atlantic City Utilities Authority (ACUA) wind power facility. The period covered by this report is 1 January - 30 September 2008 and is the second report submitted for this project. This document and attachments satisfy project reporting requirements described in the Memorandum of Understanding (MOU) between NJAS and JAW. Furthermore, the activities described herein conform to task descriptions outlined in the Scope of Work defined as part of said MOU. Finally, this report supports payment of NJAS mid-term invoice (see attached # 09-010), according the said MOU.

GOALS AND OBJECTIVES

The goal of this project is to evaluate incidents of bird and bat mortality at JAW/ACUA wind wind power facility and assess relationships between mortality and flight dynamics (e.g., magnitude, altitude, direction). Specifically, our objectives are to (1) document mortality at the facility, (2) quantify nightly magnitude of bird/bat passage through the project area (3) quantify altitudes and flight tracks relative to the height and rotor swept area of the wind turbines (4) investigate correlations between mortality and flight dynamics and (5) investigate meteorological conditions that may affect these response variables. To accomplish these objectives we will use ground based surveys to monitor mortality at the project sites and a dual marine radar system to monitor the various measures of flight behavior. This two-pronged approach is rarely used in evaluating potential impacts of wind turbines on birds and bats.

METHODS

Nocturnal Flight Monitoring using Radar

We used two 25 kW Furuno X-band marine radars (frequency = 9410 GHz, wavelength = 3 cm, model # FAR2127BB, Furuno Electric Company, Nishinomiya, Japan) operating simultaneously to monitor various measures of flight behavior and dynamics (Figure 1). Each radar is fitted with standard 6.5' open array antenna, which produces a fan-shaped electromagnetic beam 1.23˚ x 20˚. The radars' pulse lengths can be set from 0.07 - 1.2 μsec and detection ranges from 0.125 - 96 nautical miles (nm). For both radars we used a 0.15 μsec pulse length and a 1.0 nm detection range. Short pulse lengths provide better target resolution and more accurate location and distance estimates. Similarly, short detection ranges result in improved resolution of small passerine or bat-sized targets. Additionally, data we collected during previous studies suggest that small target detection drops off markedly between 0.75 and 1.0 nm from the radar. The radar features color-coded target representation that indicates return signal strength. This allows for discrimination of weak reflectors that could be insects. The radar units also are equipped with integrated global positioning systems (GPS) and target tracking feature that allows us to determine each target's coordinates and quantify target flight directions.

One radar unit operated with the antenna rotating in the horizontal plane, describing a 360˚ arc every 2.5 seconds. Data collected in this mode provided target density (i.e., targets/unit volume) and passage rate (targets/km/hr) estimates (Figure 2). The second radar's antenna rotated in the vertical plane. This is accomplished by mounting the antenna turning unit perpendicular to the ground (Figure 1). In this mode, the radar monitors the altitudinal distribution of targets and passage density/rates. The antenna sweeps from the eastern to the western horizons, describing a 180˚ arc above radar level (arl), 20º wide (Figure 3). To avoid spurious target propagation, the radar does not transmit when the antenna is pointing toward the ground. We anticipated that the radar's orientation (i.e., facing northward, antenna sweeping approximately east to west) would maximize the number of target detections along the predominantly north/south axis of bird migration.

Each radar's processor unit was connected directly to a computer equipped with a PCI frame grabber circuit board. Using proprietary scheduling software, we automatically captured a user-defined number of consecutive radar sweep images as bitmap files at any interval and for any period.

Radar data collection typically followed a "five days on," "two days off" sampling protocol. We collected five consecutive radar sweep images, every 10 min, continuously for five consecutive days (~720 images/night/radar). We chose 10 min intervals because we believe this insures total turnover of targets between samples. If minimum target air speed is 20 mph, then it will take 6 min to cross the widest part of our sample area (i.e., two nautical miles).

Collision Incident Monitoring

We conducted systematic searches on the ACUA facility for birds and bats that apparently collided with on-site wind turbines. Searches were conducted around each turbine site (Figure 4) by a single, trained NJAS staff person and consisted of walking in parallel transects 5 m apart within an overall search area of 130 m x 120 m (i.e., 15,600 m^2/turbine) centered on each turbine tower (Figure 5). Search areas and transects were laid out in a geographic information system (GIS) and marked on site using a global positioning system (GPS) and rangefinder. Low lying marsh areas within a turbine's search area were not surveyed because tidal inundation regularly prevented access to these sections (Figure 6). To some extent this was the case at all turbine sites except at turbine #3 (Figure 6). If a building fell within the search area, rooftops were surveyed when accessible. Clarifying and mixing ponds, and other water bodies were also surveyed using walkways, gangways and dikes to gain access. Collision incident estimates will be corrected for the proportion of the total area around each turbine that was searched.

Searches were conducted at each turbine sampling plot every other day (i.e., typically Mondays, Wednesdays, Fridays) and started approximately 1 hour after sunrise to insure sufficient illumination for detecting potential collision victims. To reduce the chance of turbine plots regularly being surveyed at the same time of day, the order they were searched was alternated systematically on each survey day as was the starting transect at each turbine. While walking each transect, the searcher used the unaided eye to conduct the survey, alternately scanning an area that extended for 2.5 m on either side of his/her track.

The observer recorded start and end times for surveys at each turbine and meteorological conditions (e.g., cloud cover, wind direction and velocity). When an apparent collision incident was encountered, the observer performed a thorough investigation and documentation of the incident. This included assigning an incident number, recording its location using a GPS, assessing the condition of the carcass (e.g., intact, scavenged, feather spot) and recording the date and time. A range finder and compass were used to determine distance and bearing from the tower.

Carcasses are photographed in the position they are found using a digital camera. When possible, carcasses are identified to species, age and gender. Additionally, the observer performed an examination to determine the nature and extent of any injuries, and whether any scavenging or insect infestation occurred. When dismemberment was evident, the observer searched the vicinity to locate all body parts. In situations involving avian species, all loose feathers were collected in order to avoid identifying the feathers as an additional kill during the next survey of the tower.

With respect to birds, feathers or clumps of feathers with flesh attached were recorded as fatalities. Loose feathers were not considered fatalities unless we found several primary or tail feathers together that would represent more than would be expected to be lost during normal molting. Small feathers (e.g., body contour, down) were also not recorded, since these most likely were lost as a result of normal preening or molt.

Carcasses were placed plastic bags (i.e., one/bag) that were labeled with date, species, tower number, and incident report number. Carcasses were temporarily stored in a cooler and then transferred the same day to an ultra cold freezer at NJAS's Center for Research and Education to be stored at -35° C. When carcasses were found at times and locations outside of standardized surveys conducted as part of this study, they were processed as above but classified as an "incidental" find.

If an injured animal is found, the searcher will record the same data collected for a carcass, noting however, that it was an injury and not a fatality. The searcher will then attempt to capture and restrain the animal in a manner that avoids either further injury to the animal or injury to the surveyor. Once secured, the animal will be transported to a wildlife rehabilitator or veterinarian as soon as the daily survey is completed.

Observer Efficiency and Carcass Removal Evaluation

The fact that estimates of animal fatalities at wind power generating facilities can be affected dramatically by differences in observer efficiency and from carcass removal by a variety of scavengers is widely acknowledged (Morrison 2002). Consequently, estimates of total bird or bat fatalities can only be determined after correcting for searcher and carcass removal biases.

Observer efficiency is generally affected by vegetation type and height, bird size and decomposition state. Throughout this study, we will conduct searcher efficiency trials in the vegetation types typical of the tower farms, using a variety of carcass sizes. Carcasses of various types (i.e., bird, bat) and sizes will be placed at random locations throughout turbine sample sites (Figure 3) at densities that are similar to those recorded during standardized collision incident surveys. Each carcass will be discretely marked so that it can be identified as part of an observer efficiency trial. Observers conducting standard carcass searches will not know when efficiency trials are being conducted. The number and location of trial carcasses found during standard carcass searches will be recorded and compared with the number placed.

To assess carcass removal rates, we will randomly place carcasses of various types and sizes in areas outside the carcass search areas to avoid confusing trial carcasses with actual communications tower fatalities. Carcasses will be checked for approximately 30 days, checking every day for the first 7-10 days and less often (e.g., every other day) later in the trial.

To the extent possible, searcher efficiency and carcass removal trials will be conducted concurrently. That is, carcasses will be placed on the study site 1-2 hours before the observer arrives on the study site. Observers will complete the survey and determine the proportion of carcasses detected in the observer efficiency trial. Carcasses used in the trial will remain on the study site for inclusion in a carcass removal trial.

Estimates of mortality will be adjusted (i.e., C_{corr}) using the following equation and calculations suggested by Strickland et al. (2000) that incorporate estimates of observer efficiency and carcass removal by scavengers,

$$C_{corr} = \frac{A * I * C}{(a * t * p)},$$

where *A* is the total search area around each turbine, *I* is the interval between searches in days, *C* is the total number of collision incidents detected during a particular period, *a* is the mean area searched around each turbine, *t* is the mean time interval a collision victim remains in the study area before being removed and *p* is the searcher efficiency. We will calculate the variance in the corrected collision estimate using the variance of a product formula (Goodman 1960) and the variance of a ratio formula (Cochran 1977).

Point Count Surveys

We conducted systematic point count surveys to determine abundance and distribution of residents and transient birds. These data will provide an index of general site use patterns that can be used as a backdrop for understanding patterns of collision incidnets.

Surveys began at sunrise and were conducted at five points, each randomly selected within the general area of a turbine. We followed standard point count data collection protocols which included recording observations in 2-, 3-, and 5- minute sampling periods, and recording distance and direction of each detection. sta surveys (minimum twice/week).

WORK PERFORMED

<u>Task 1 - Monitor bird and bat flight patterns using dual mobile radar system</u>

From 1 January through 30 September 2008, we collected data with our dual marine radar system (i.e., horizontally- and vertically-oriented) on approximately 165 days, 24 hours/day.

Data were collected two days/week during January and February and five days/week between March and August. This resulted in the collection of approximately 120,000 data images for each radar during this period.

In general, data collection went smoothly during the reporting period. However, on three occasions we experienced short term (e.g., 3-5 hours) data loss in the early morning hours (i.e., after 3:00 AM). The problem appeared to be related to a feature of the Windows XP operating system that automatically downloads system updates, installs them and then reboots the computer to effectively implement them. The rebooting process shut down our automated data collection program, which must be initiated manually. Once we were able to identify the problem, we disabled the "automatic update" feature of the operating system.

During the reporting period we completed processing the image data collected with the vertically oriented radar during the August-December 2007 sampling period. We used NJAS proprietary software to generate night-specific templates that identify stationary reflectors (e.g., wind turbines, buildings) and ground clutter in data images. Following this procedure we used our proprietary software to (1) remove unwanted propagation from images and enumerate bird and bat targets from the vertically oriented radar, (2) enumerate targets (i.e., birds and bats and (3) determine target altitudes.

Review of output results from processed data suggested that an unacceptable amount of interference was not removed with our image processing algorithms. The nature of the unwanted interference is in part the reason why our algorithms were not as effective at its removal than we anticipated.

The radar unit is parked on the site within 100' of the turbine. Additionally, the other four turbines are well within the radar's field of view. Consequently, we have a considerable amount of radar energy reflecting off the rotating turbine blades, which show up distinctively in the data images. Generally, this kind of unwanted propagation is not a problem to remove if it occurs regularly in the same location throughout a sample period. However, because the turbine blades are spinning and frequently change their velocity and orientation within a given sample period (i.e., over the course of a night's data collection), they are more difficult to remove using a search protocol designed to remove unwanted "stationary" objects.

At the time of this report we completed the beta testing of modifications to our algorithms. Based on the test results, we made additional modifications to our target detection and enumeration software and believe we have resolved most of the issues related to unwanted propagation and false detections. We anticipate that processing of data from 2007 and the first six months of 2008 will be completed by the next reporting period.

<u>Task 2 - Monitor evidence of bird and bat collisions with wind turbines</u>

During the reporting period, we conducted systematic searches three days per week on the ACUA facility for birds and bats that apparently collided with on-site wind turbines. Searches were conducted around each turbine site by a single, trained NJAS staff person. This resulted in approximately 100 days and 500 hours (approximately five hours/search day) of searching.

We also conducted six searcher efficiency and scavenger removal trials during the reporting period. A detailed justification for this activity and it's particular methods and protocols also are included in our previous report. The fact that estimates of animal fatalities at wind power generating facilities can be affected dramatically by differences in observer efficiency and from carcass removal by a variety of scavengers is widely acknowledged (Morrison 2002). Consequently, estimates of total bird or bat fatalities can only be determined after correcting for searcher and carcass removal biases.

The following is a preliminary account of the birds and bats we encountered during our searches for collision events. The numbers of carcassses we report here are uncorrected for observer efficiency or scavenger removal. Additionally, these estimates are not corrected for the area around turbines not searched because they were inaccessible (Figure 1). Correcting for these biases will increase our estimates of collision mortality.

Since the beginning of the project (i.e., August 2007) searches have located 23 birds of at least 14 species (Table 1) that appear to have collided with wind turbines on the site. Laughing gull (*Larus atricilla*) was the species most frequently encountered (i.e., seven times) during collision event searches, followed by osprey (*Pandion haliaetus*) with two encounters (Table 1). This is noteworthy because osprey is listed as a "threatened" species in New Jersey. All other species were encountered only once during our searches (Table 1).

Fifty-one bats also were located during our searches since the start of the project (Table 2). To date, we have encountered only two species: Eastern red bat (*Lasiurus borealis*) and hoary bat (*Lasiurus cinereus*). During our searches, we located more than three times as many red bats as hoary bats and our data suggest that 90% of all bat collision events occur during August and September (Table 2).

Our data also suggest that collisions are not evenly distributed among turbines. Carcasses found at Turbines #3 and #4 (see Figure 1) accounted for 38% and 30%, respectively, of the total found during the study period (Table 3). Conversely, carcasses found at Turbines #1 and #5 accounted for only 11% and 7% respectively. It is important to note that the searchable area around each turbine differs. Only Turbine #3 is searchable in 100% of the survey area. Search areas around the other four turbines ranges from approximately 60-70% (Figure 1). However, we believe that these differences cannot explain the majority of variation in carcass detection around each turbine.

<u>Task 3 - Monitor temporal and spatial bird abundance and distribution patterns on the ACUA wind power facility</u>

We conducted weekly, systematic point count surveys to determine abundance and distribution of residents and transient birds throughout the reporting period. Surveys began at sunrise and were conducted at five points, each randomly selected within the general area of a turbine. We followed standard point count data collection protocols which included recording observations in 2-, 3-, and 5- minute sampling periods, and recording distance and direction of each detection. Seasonal variation in total birds detected since the start of the project are shown if Figure 2.