

The Great Lakes Bird and Bat Migration Study

Every spring and fall, millions of birds and bats participate in one of the largest migrations on Earth. In the spring, they travel from their wintering grounds as far south as Brazil and Argentina to their breeding grounds throughout the United States and Canada. They then return back to their wintering grounds in the fall. Those that travel along the Atlantic or Mississippi flyways (corridors of migrants similar to our highways) encounter a barrier to their movement in the Great Lakes. These are barriers to most birds and bats because they lack safe places to land and require a great deal of energy to cross. Some birds and bats choose to cross the lakes while others travel a much longer distance around the lakes.



The U.S. Fish and Wildlife Service (USFWS) operates two mobile radar units that have been stationed around the shorelines of the Great Lakes each spring and fall since 2011. These radar units track birds and bats as they fly through the air. By combining radar data with current and historical bird surveys, banding data, weather data, NEXRAD radar, and data collected from acoustic and ultrasonic monitors, the USFWS hopes to

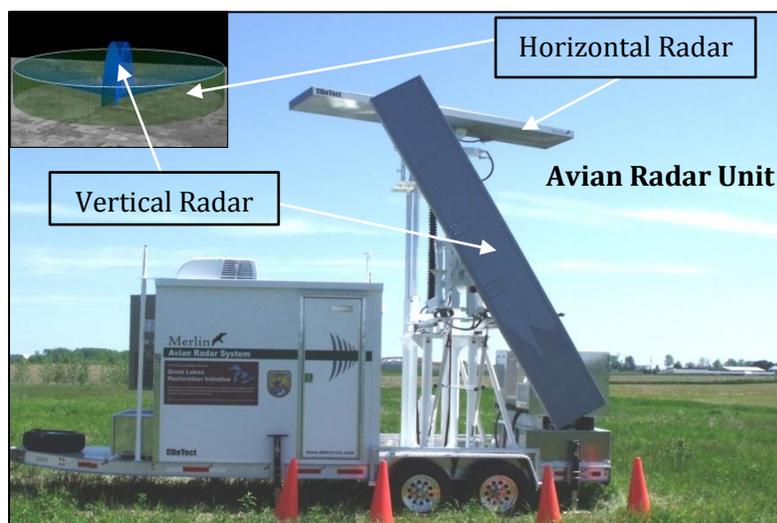
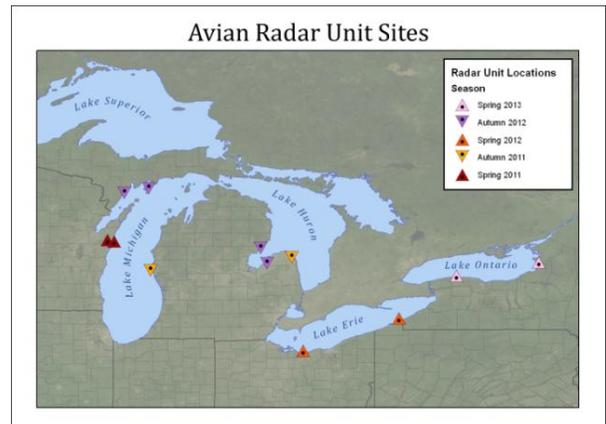
gather data from all across the Great Lakes and also reduce the biases that any single method of data collection has. With all of this information, the USFWS hopes to gain a better understanding of when migration begins and ends, what environmental conditions affect migration, and when birds and bats may be most at risk from collisions with wind turbines, communication towers, and other man-made objects. All of these factors may change between each year, each migration season, and each location. This project also



seeks to determine what areas around the Great Lakes have high concentrations of migrants. This may include stopover habitat where birds and bats refuel and rest before continuing migration as well as areas along the lakeshore that concentrate migrants in the pre-dawn hours.

Avian Radars:

With the exception of hawks, eagles, and waterfowl, the majority of birds and bats travel at night while migrating. This hinders the ability of humans to observe them with their naked eye and requires the use of more sophisticated tools like radar. Two mobile avian radar units have been stationed at 12 locations around four of the five the Great Lakes since 2011. These locations were specifically chosen to evaluate the general patterns of the migration of birds and bats around the Great Lakes. The radar units were in operation for both spring and fall migration each year. In the past year, two sites were visited by each radar unit each season to gain a larger picture of migration. The radar units are often placed within a mile of the lakeshore to evaluate migrant activity over both land and water.



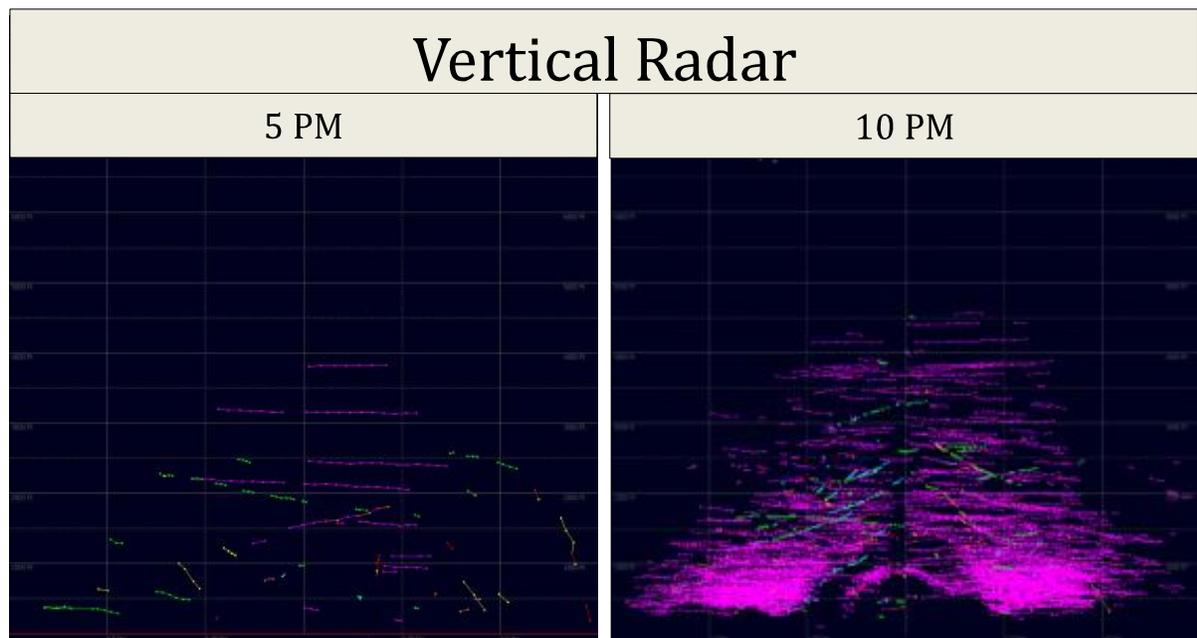
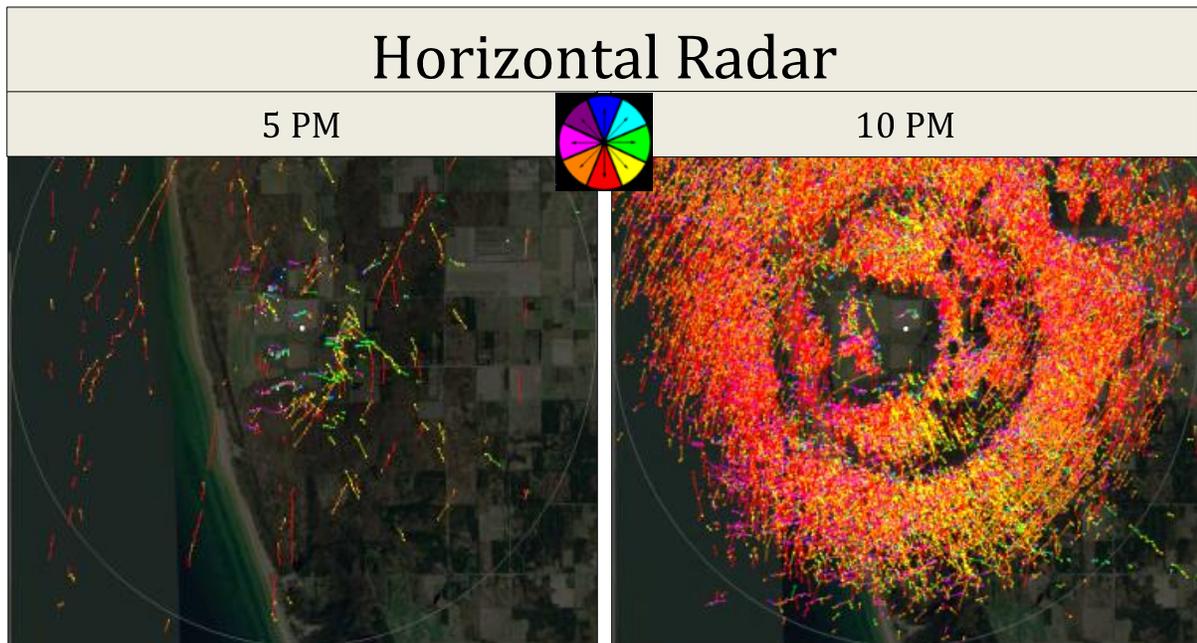
Each radar unit has two antennas for collecting different types of data simultaneously. The horizontal radar looks out 2 nautical miles across the landscape and gathers data on migrant counts and direction of movement. The vertical radar looks directly up into the air and takes a cross section of the airspace and gathers data on migrant counts and flight altitude.

These are the same solid state marine antennas used to detect ships but have extensive software modifications. Complex algorithms are used to distinguish the radar signatures of birds and bats from other things in the airspace such as rain, insects, and planes.



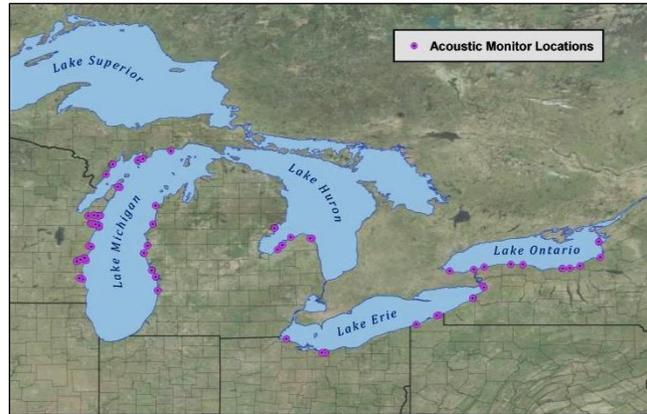
Daily Patterns:

The radar units operate 24-hours a day and are able to show the relatively low activity during the day, a buildup of movement around sunset, massive movements at night peaking around midnight, and a decline back to lower activity at dawn. In the graphics below the activity on the each radar is shown at two different time periods at the same location. During the 5pm hour there is little movement on either radar and no general direction on the horizontal radar. During the 10pm hour activity is greatly increased to over 5000 targets per hour and most targets are moving in a southerly direction. Color of a target indicates its direction of movement corresponding to the direction in the same color on the compass rose for the horizontal radar.



Acoustic Monitors:

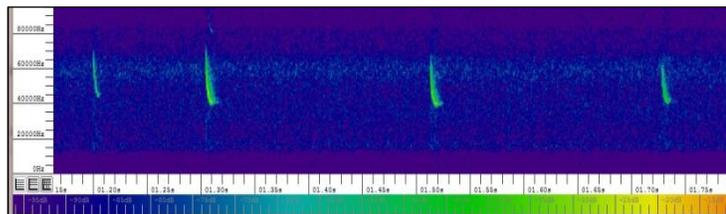
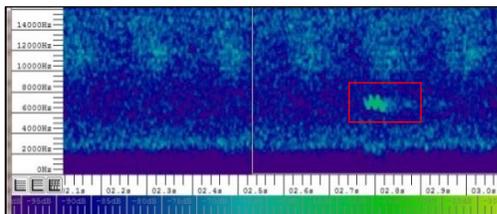
The USFWS, in conjunction with the University of Minnesota and the U.S. Geological Survey, have placed over 35 acoustic and ultrasonic monitors along the shores of the Great Lakes at almost 50 locations. The monitors listen passively for the audible (acoustic) sounds that birds make as they migrate and the ultrasonic vocalizations that bats make as they feed. Each monitor has up to a 100m range within which it can detect calls with the ultrasonic microphone tending to have a shorter range. The monitors are active from approximately dusk until 2.5 hours after dawn to capture the dawn chorus of birds singing. These monitors are also placed in conjunction with the radar units to better compare the methods.



An acoustic monitor

USFWS Biologists change the batteries and data cards

The recordings from the monitors are run through filters that pick out bird and bat calls from background noise. Each call set is then verified by a human observer. The calls of birds and bats are very distinctive and can be distinguished down to the specific species that made them, however we are just beginning to analyze the bat calls and have not done so with the bird calls yet. Below on the left is the call of a bird as it flies at night. On the right are the ultrasonic calls of a bat.



Weather data collection:

Each of the radar units is equipped with a weather station that gives a detailed picture of many environmental variables at the center of our study area. Data is collected on temperature, wind speed and direction, rain, humidity, and barometric pressure. There is a relationship between weather patterns and migration and by gathering this data the USFWS can further investigate this relationship by using the acoustic monitors nearby the avian radar units.

Bird Surveys and Banding:

In addition to monitoring with the use of technology, more traditional means of on the ground bird surveys and banding data were used to get an idea of what birds were moving through the area at what time. This involved current surveys by USFWS personnel as well as obtaining historical bird survey and banding data from areas across the Great Lakes.

Scheduled surveys by USFWS biologists were conducted along with investigative surveys to look into any interesting patterns detected by the radar units. These investigative surveys allowed for detection of large daily movements of gulls, blackbirds, and geese to and from feeding grounds. By identifying these daily movements, they can be separated from the analysis of migration.

By interpreting the changes over time in the composition of birds encountered on these surveys or at banding stations, the USFWS can be sure that the birds and bats tracked by the radar are actual migrants moving through the area and not simply local birds flying back and forth from a specific area.



A USFWS biologist conducts a bird survey

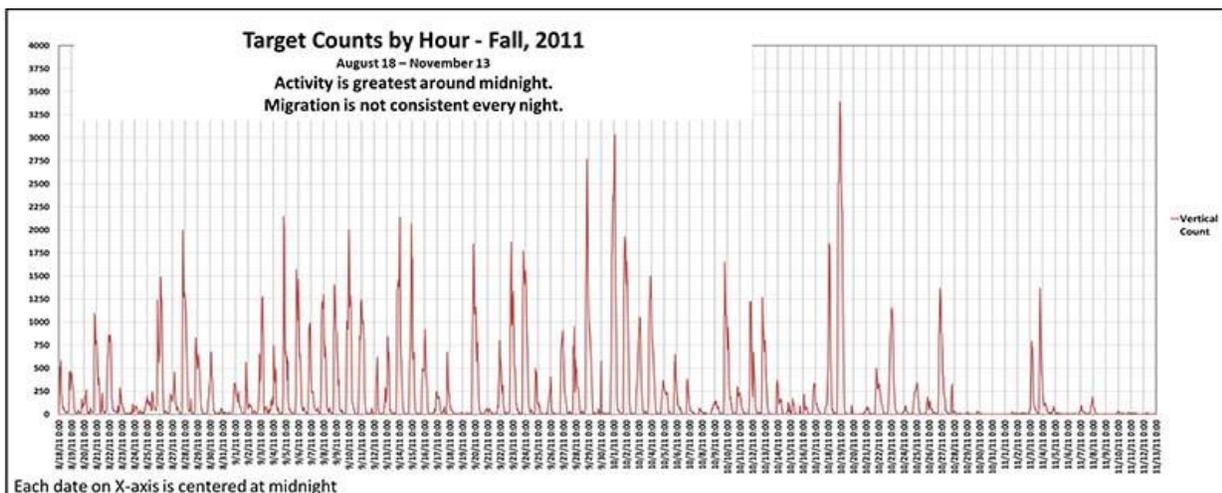


Eastern Bluebird

Nate Rathbun

Seasonal Patterns:

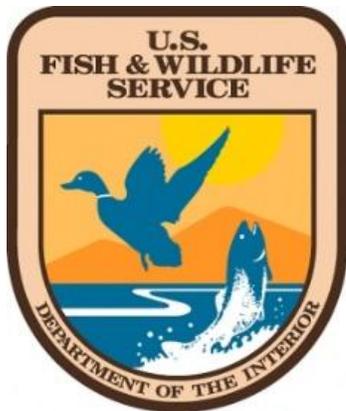
From our study so far, we can tell that migration occurs in pulses. On most nights during the migration season, migrant numbers build up just after sunset, peak around midnight, and decline before dawn. This pattern happens only on a few nights at the beginning and end of the migration while it occurs almost every night during the height of migration. The numbers of migrants passing through each night is also greatest during the height of migration. Below is a graph of the total numbers of targets (birds and bats) counted by a radar unit over the course of a migration season.



Summary:

At the end of this project, the USFWS hopes to identify major patterns of migration around the Great Lakes and identify important areas that concentrate migrants around the Great Lakes. With this wealth of information, the USFWS will be able to formulate guidelines for when and under what environmental conditions wind turbines can operate without risking collisions with migrating birds and bats and causing fatalities. As human populations expand and the demand for renewable energy and living space grows, so does the need to make environmentally sustainable decisions that will benefit both people and wildlife.

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www.fws.gov/radar

A sincere thank you to the many organizations and volunteers who assisted in the placement and maintenance of our acoustic monitors and also to the private landowners who allowed the use of their lands for the placement of the radar units and acoustic monitors.

