**Project Goal:** The fundamental goal of this project is to identify areas along the Great Lakes that are ecologically important for populations of migratory birds and bats.

**Research questions:**
1. Do migrants concentrate along the lakeshores?
2. What is the pattern and duration of migration?
3. What environmental factors affect migration?

**Researcher Sites:**
- **Acoustic Monitor Sites**
- **Avian Radar Unit Sites**
- **Horizontal Radar**
- **Vertical Radar**

**Typical hourly patterns of detection during peak migration periods**

**Applications:**
1. Convey reliable information to the wind industry and other stakeholders to facilitate environmentally sustainable development of renewable energy.
2. Provide supporting data for USFWS Land-Based Wind Energy Guidelines.
3. Support USFWS decisions related to safe operation of wind facilities without risk to migratory birds or bats.

**Gather migration data from three sources:**
1. Avian Radar – seasonal migration of birds and bats
2. Acoustic Monitors – seasonal migration of bats
3. Historical Data – digitize historical bird surveys

**Radar data collection bias**
Radial beams expand as they travel away from the source, creating different sampling widths depending on distance from the radar unit. Close to the ground, the radar may miss targets flying perpendicular to the beam due to the small diameter of the beam. At high altitudes, the radar samples a wider area, but may not have the return energy to detect small targets. Optimal detection occurs in between high and low altitudes. The Rotor Swept Zone has a small sample area and the target counts in this area may be under represented. At 30 m the beam is 14 m wide. At 130 m the beam is 60 m wide. Orienting the vertical radar slightly off perpendicular to the expected direction of travel can give targets at low altitude a longer window within the radar beam. These biases must be kept in mind while analyzing radar data.

**Monitoring migration of birds and bats using acoustic data**
Over 30 acoustic monitors (right) were in operation from March – June and August – November of 2011 and 2012 around the Great Lakes. The monitors were model SM2BAT+ (Wildlife Acoustics Inc.) and included both an acoustic (5 m high) and ultrasonic microphone (1 m) that recorded simultaneously. The monitors turned on 30 minutes after local sunset and turned off 2.5 hours after local sunrise. Acoustic monitors help to determine what species of birds or bats are migrating and when. This helps determine what temporal, diurnal, or meteorological variables promote migration of birds and bats.

**Relating bat vocalization and radar data**
Ultrasonic monitors were placed within a few kilometers of the radar units. By comparing the count of bat passes with the target passage rate below 30 m on the vertical radar over a 1 km front we can see that both methods show similar peaks and duration. The differences in counts may be when more birds are moving than bats since the radar cannot distinguish between birds and bats and we present only the bat data for the ultrasonic monitors here. Comparisons such as these can provide information on the different migratory strategies of birds and bats. Data shown is from only one of the two monitors associated with the radar unit.

**Applications:**
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**This poster provides a background and overview for an additional USFWS presentation on initial findings of the study and a second poster on bat activity and meteorological data.**