



EchoTrack

When you need to know
**who's moving, where,
when**

Whitepaper

ECHOTRACK™ RADAR-ACOUSTIC™ SURVEILLANCE SYSTEM

Renewable Energy Development and Airborne Wildlife Conservation

Renewable energy developers must meet regulatory requirements to mitigate for potential impacts on birds, bats, and other wildlife, in the pre- and post-construction phases of their development projects. By using standardized, automated data collection methods, wind or solar development can be experimentally tested and verified with pre- to post-construction comparisons that are surveyed automatically, and therefore, without human bias.

Leveraging the strengths of X-band surveillance radar and sound sensors, the EchoTrack™ Radar-Acoustic™ Surveillance System provides high resolution data on the flight behaviour of individual birds and bats. The system can monitor flight activity at any time of the day, and in any light or weather conditions. Because the flight paths include height, developers can optimize their design, layout and operation to align with regulatory requirements, while conserving populations of airborne wildlife, including at risk or endangered species.

EchoTrack provides the best possible technology, designed by a scientist with 30 years direct experience with the agencies charged with policing the industry. The regulators require a substantiated estimate of the risk the developer will pose on wildlife, and demand use of the best available technology, which includes radar and acoustics. The data that EchoTrack provides consistently meets regulatory requirements; it is accurate and defensible. The quality and volume of data delivered is unbiased by human observation, and the collection process is repeatable for a better prediction of risk. In addition, the flight path and species information can be interpreted using Geographic Information Systems (GIS), mathematical modeling and statistics of focal species. EchoTrack retains all of the original images and data to enable incident review or for future legal representation.

EchoTrack Inc.

E rmillikin@echotrack.com

68 Kinmount Private

T +1 778 927 1691

Ottawa, ON K2T 1K3 Canada

www.echotrack.com

Page 1 of 5
Rev: 2016-01

ECHOTRACK RADAR-ACOUSTIC SURVEILLANCE SYSTEM

The EchoTrack Radar-Acoustic Surveillance System is about observing and conserving airborne wildlife populations. Centered on advanced radar and acoustic technologies, EchoTrack uses unique and patented algorithms to identify what animals are present and to isolate the flight paths they are taking. The result is a comprehensive census of the airborne wildlife and its flight behaviour.

Three components comprise the EchoTrack surveillance system:

- Acoustic sensing and leading edge waveform (sound) analysis that identifies and locates species, and their direction of travel.
- Radar sensing that uses adapted signal generation and sophisticated data interpolation to derive a full four dimensional path (location and altitude over time) from what is conventionally thought of as a two dimensional sensor.
- EchoTrack Diary, an electronic field diary used primarily on Environmental Assessment (EA) projects throughout the field sampling regime to capture project level information, such as plots and turbine locations, and daily readings for factors, such as site conditions, sampling equipment positions, weather conditions, focal species sightings, and more.

Used independently, the radar and acoustic capabilities can provide valuable insight into migratory and flight behaviour. Coupled together, they enable the EchoTrack surveillance system to correlate the location data to determine not just "who is there" or "where they are going" or "when they are moving", but to combine all these criteria by providing "who is going, where, when." The surveillance system identifies the flight paths, migration paths and uncontrolled flight paths of all airborne wildlife from small songbirds and bats to large birds such as raptors and pelicans.

A mobile field lab, independently powered and ruggedly built for all terrain, is used for field surveys and investigative applications. The EchoTrack Radar-Acoustic Surveillance System is housed in a small trailer, which is moved between sites to sample a larger area in a stratified sampling method.



With adapted signal projection, the radar establishes a surveillance zone 4 kilometers across the landscape and up to 1900 meters above ground. Automated, unattended recording, which can run 24/7, captures time, location (including height) and direction of individual flight paths. The radar can provide unlimited simultaneous tracking of airborne species in 360 degrees.

Automated radar monitoring may be synchronized with traditional human-based field observation. When directly compared to results with binoculars, the radar tracked an average of 108 [$\pm 22(29)$ SE(n)] birds per hour versus an average of 49 [$\pm 23(29)$ SE(n)] visually-recorded. The radar covers a larger landscape than visual observation for a better analysis of habitat use to guide setback from these features (Fig 1).

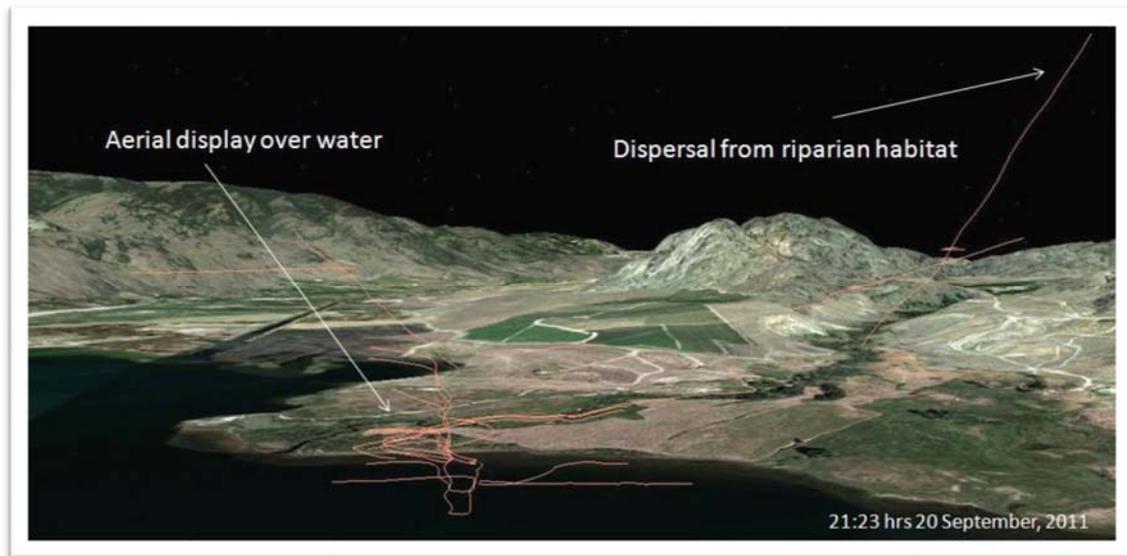


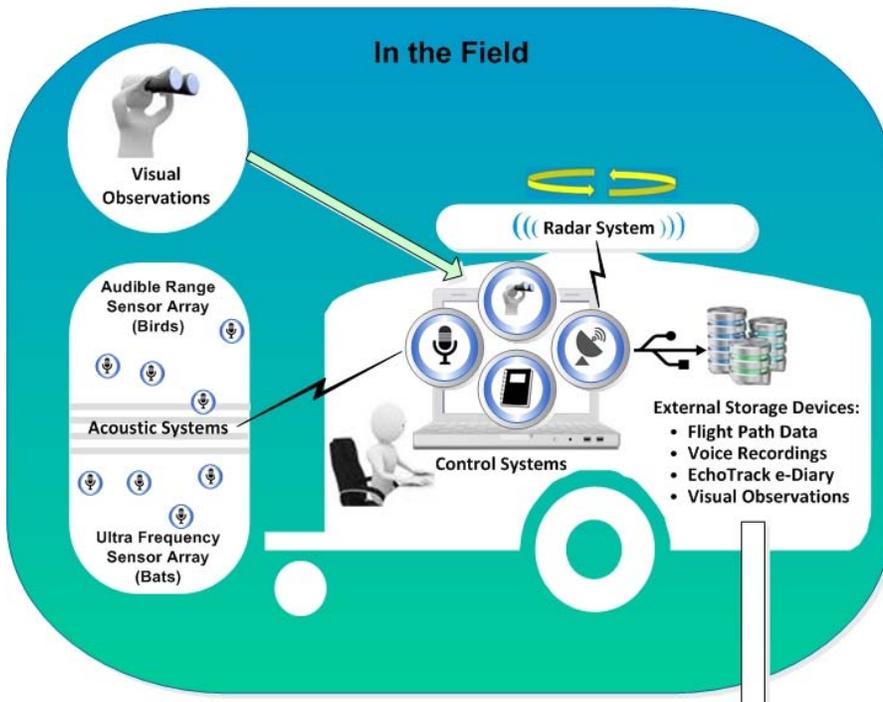
Fig 1. Radar-determined flight paths for a woodcock and night migrant bird.

One radar sampling plot of 2 km radius will fully encompass the horizontal (acreage/concession) and vertical (blade sweep) extent of a 10 MW wind development. In addition, the radar can monitor into night and in poor visibility conditions, when visual observation is limited or not possible.

The EchoTrack Radar-Acoustic Surveillance System utilizes an array of eight microphones: 4 conventional audio sensors for birds and 4 ultrafrequency sensors for bats. The bird microphones are capable of detecting bird calls to 600 m; the omni-directional bat microphones are capable of detecting bat frequencies to 100 m.

Field biologists are familiar with the practice of maintaining an accurate and up-to-date field diary. The EchoTrack Diary is an electronic field diary that utilizes a Microsoft Windows user interface. It is specifically designed for biologists working primarily on EA projects with the EchoTrack Radar-Acoustic Surveillance System. The Diary provides the means for synthesizing the project, and for capturing daily readings under a variety of factors, such as site conditions, sampling equipment positions, weather conditions, species sightings, and more.

OVERVIEW OF THE PROJECT CYCLE



Project Preparation

1. **Design** a project-specific monitoring regime based on the site and client input.
2. **Train** field staff to operate the surveillance system.

In the Field

1. **Monitor** according to the automated schedule using radar only or radar and acoustics, for the numbers of plots and replicates required.
2. **Observe** the site conditions
3. **Record** the visual observations in a spreadsheet.
4. **Record** the daily activities in the EchoTrack Diary.
5. **Ship** to the lab the external hard drives containing all the data for a single replicate.

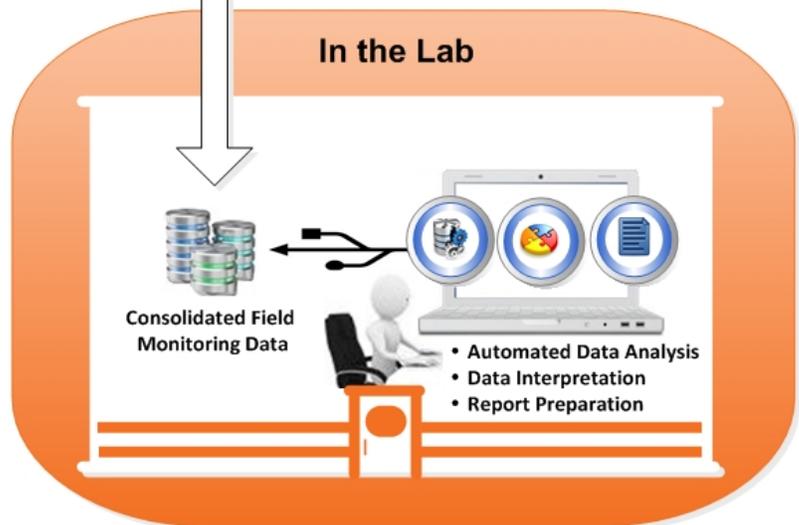
In the Lab

1. **Analyze** the data for each replicate using automated processes to identify individual tracks and their flight characteristics. Analyze the spatial and temporal information for each position along a track.

Once all replicates are complete:

2. **Output** to GIS for analysis of weather and habitat effects, and mathematical modeling and statistics for flight behavior of focal species. (optional)
3. **Interpret** the results of the data analysis processes.
4. **Write** the final report.

Ship Field Data to the Lab



KEY DIFFERENTIATORS

EchoTrack Radar-Acoustic Surveillance System provides unique and powerful capabilities for monitoring airborne wildlife for Environmental Assessment and conservation purposes.

- Simultaneous survey of all concurrent bird and bat flight paths in all light and weather conditions, in a landscape 4 km across and a hemisphere 10 times the volume of a commercial bat sensor beam.
- Accurate mapping of individual flight paths in location and time, with height and focal species flight behavior, to enable landscape-level analysis and to derive options for mitigation derived from weather and habitat correlations.
- Longer distance tracking to elucidate individual flight response to changes in the landscape.
- Constraint mapping with sufficient detail for setback and operational mitigation that other commercially-available systems, acoustic or radar, cannot provide. Species-specific mitigation strategies to meet Endangered Species laws and Best Management Practice guidelines.
- Constant, quantified sampling volume and automated analysis to control for bias and enable BACI (before-after-controlled-impact) assessment.
- Proven increased accuracy of observations beyond traditional visual methods of assessment of risk.
- Custom hemispheric ultrafrequency sensors capable of detecting bats to 100 m so bats can be detected into wind turbine blade height without having to mount the sensors on towers.
- Storage of raw data for re-analysis with changes in development plans.

ABOUT ECHOTRACK INC.

Founded in 2003 in Ottawa, Canada, EchoTrack is committed to providing excellent technology and services to our clients in harmony with our commitment to protect and conserve wildlife.

Our experience includes pre-construction and post-construction Environmental Assessment of all airborne wildlife, although we are especially appreciated for our nocturnal work with night migrant birds and bats, and our diurnal work with focal bird species such as Cape Vulture and Great White Pelicans. EchoTrack has gained a reputation for assisting clients in situations where approval for development is difficult to obtain, for example, at sites adjacent to protected areas or lakeshores where migrations have been historically significant.

EchoTrack is committed to ongoing research in the field of acoustic and radar "sensor fusion" technology. Our goal is to stay in step with technological improvements and stay one step ahead of our competitors.

We welcome landowners and other stakeholders to the portable labs to get a "bird's eye" view of their community and to see the night-time activity that goes on while they're sleeping. Typically, residents gain trust in the sampling process and confidence that the results of this portion of the EA are scientifically-based and complete.