Nocturnal migrating songbirds drift with crosswinds and compensate near coastal areas

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Horton and former student Phillip Stepanian developed the application used in this study for observing migrant birds during nighttime flight. Credit: Kyle Horton

Using novel, recently developed techniques for analysis of Doppler polarimetric weather surveillance radar data, a University of Oklahoma team examined impediments (crosswinds and oceans) of nocturnally migrating songbirds in Eastern North America. Migrants in flight drifted sideways on crosswinds, but most strongly compensated for drift near the Atlantic coast. Coastal migrants' tendency to compensate for wind drift increased through the night, while no strong differences were observed at inlands sites. This behavior suggests birds adapt in flight and compensate for wind drift near coastal areas.

"The research has taken an innovative and exciting approach in showing how existing weather radar systems can be used to investigate the behavior of migrating birds," said Liz Blood, program director in the National Science Foundation's Division of Environmental Biology, which funded this research. "The ability to use U.S. weather radar network to track migrating birds opens exciting new opportunities to study in real-time billions of birds during their migrations," Blood said.

Kyle Horton, doctoral student in the Department of Biology, OU College of Arts and Sciences; and Phillip M. Stepanian, former meteorology and electrical engineering doctoral student in the Advanced Radar Research Center and OU School of Meteorology, developed the application used in this study for observing migrant birds during nighttime flight. Jeffrey Kelly, professor in the Oklahoma Biological Survey, assisted with the research and served as faculty advisor. Benjamin M. Van Doren, Wesley

M. Hochachka and Andrew Farnsworth, Cornell University, assisted with the research.

"Until now, no studies have captured the large-scale phenomena documented using weather radars," said Horton. "Analyses are based on the detection of millions of migrating birds, as many as 5 million on a single night."

The researchers examined strategies of nocturnally migrating birds using Doppler polarimetric radars at three coastal and three inland sites in the Eastern United States during autumn of 2013 and 2014. Radars collected data every five to 10 minutes, yielding approximately 1.6 million samples from 55 nights. Data collected indicated a greater propensity of birds to drift sideways at inland sites; birds flying near the Atlantic coast increasingly oriented and tracked westward away from the coast. The prediction that migrants compensate more for drift when encountering a migration barrier is consistent with these results.

The researchers show for the first time at a regional scale, in a regularly and heavily traveled airspace of the Nearctic-Neotropic migration system, that birds routinely migrate under crosswind conditions and compensate in a context specific manner. This result is consistent with migrants knowing their location relative to migration barriers while in flight and actively assessing the degree to which they need to compensate for wind.

Increasing automation of radar analysis will further enable exploration and quantification of the full complement of U.S. weather radar data to achieve real-time monitoring of billions of birds during their biannual migrations. The U.S. weather surveillance radar network provides the largest sensor array worldwide for monitoring animal migration, including birds, bats and insects. These analyses fill the gaps in our understanding of migratory behaviors at large scales.

The study paper was published in *Scientific Reports*.

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