remote sensing

Editorial

Radar Aeroecology

Jeffrey F. Kelly [1,*] and Phillip M. Stepanian [1,2]

1 Plains Institute, University of Oklahoma, Norman, OK 73701, USA; p.step@nd.edu
2 Department of Civil and Environmental Engineering and Earth Sciences, University of Notre Dame, Notre Dame, IN 46556, USA
* Correspondence: jkelly@ou.edu

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Aeroecology is an emerging discipline founded by Tom Kunz and colleagues in the early 2000s to address the challenges of studying animal flight in the lower atmosphere [1]. By this time, radar biology had a long history of both site-based studies that employ small specialized radar units [2] and regional studies using weather surveillance radars [3]. This research was largely the purview of a few specialists with access to radar equipment or data from national radar networks. Since that time advances in computing and tracking technologies have revolutionized the possibilities for studying life in the air [4]. Rapid expansion of the utility of radar for understanding flying animals is evinced in the breadth of studies contained in this Special Issue. The diversity of taxa studied has grown beyond what was imagined a decade ago. As impressive as this growth has been, globalization of this research endeavor has been even more profound. Finally, the disciplinary diversity of scientists contributing to radar aeroecology is a harbinger of future growth of this approach to understanding life in the air.

Studies in this issue build upon a rich history of applications in radar biology and demonstrate the breadth of advances in this area. Drake et al. [5] describe how a radar used to collect decades of insect flight data has been refurbished to improve data quality and quantity, as well as extend the elevational range of the sampling area. Further expanding capacity in radar entomology, Hao et al. [6] and Hu et al. [7] both propose innovative new approaches to advance our ability to classify insect detections in terms of taxonomy, morphology, and size. Continuing on the theme of zenith-pointing observations, Stepanian and Wainwright [8] use a vertically-oriented cloud radar to investigate animal flight behavior and atmospheric conditions during a solar eclipse.

Weather surveillance radar has been a primary tool for understanding the aeroecology of birds, bats, and insects, and as this science matures it progresses along several paths that are evident within the papers of this issue. Gauthreaux and Diehl [9] explore the efficacy of polarimetric weather radar observations for bioscatter classification and delineation. Nussbaumer et al. [10] and Kranstuaber et al. [11] both examine bird migration across Europe and are examples of burgeoning use of the OPERA weather radar network to estimate both density and distribution of migration, respectively. Finally, all of these advances in data processing allow a greatly expanded capacity to ask fundamental questions about the ecology of animal movement. The work by Caberera-Cruz et al. [12] demonstrates this potential by relating spatial patterns in bird migration to those of intensity of artificial lights at night. Similarly, Clipp et al. [13] explore the links between synoptic weather patterns and radar-based measurements of bird stopover distributions. Finally, Boero et al. [14] use weather radar data from Argentina to characterize the phenology of a free-tailed bat colony and compare radar observations with those from observers on the ground.

Taken together these studies span the spectrum of radar aeroecology, from hardware improvements and retrieval techniques, to conservation implications and the behavior of flying animals. This body of work represents global efforts, including studies from Australia, South America, Europe, Asia, and North America. Moreover, these research teams demonstrate interdisciplinary collaboration among biologists, engineers, meteorologists, and computer scientists. Looking forward, this breadth of topics, locations, and people bodes well for the future of radar aeroecology.

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