Developing bird migration tracking with call detection technology

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A research team primarily based at New York University (NYU) has achieved a breakthrough in ornithology and artificial intelligence by developing an end-to-end system to detect and identify the subtle

nocturnal calls of migrating birds.

This advancement enhances bird migration tracking, potentially equipping conservationists with new data to bolster avian protection efforts.

In a recent paper published in *IEEE Transactions on Audio, Speech and Language Processing*, the researchers—from NYU, Cornell Lab of Ornithology and École Centrale de Nantes in France—present their BirdVoxDetect system, detailing the core machine learning algorithms that drive this innovative bird call detection technology. The paper caps off the team's eight-year study of the topic.

"We're now able to extract incredibly subtle patterns from these audio recordings that the human ear might miss," said Juan Pablo Bello, the team lead.

Bello is an NYU professor with appointments in both the Tandon School of Engineering (Computer Science and Engineering and Electrical and Computer Engineering Departments) and the Steinhardt School of Culture, Education and Human Development (Department of Music and Performing Arts Professions). He is the director of NYU's Music and Audio Research Lab and a member of NYU Tandon's Center for Urban Science and Progress.

The system can detect bird calls, identify species and discard corrupted audio with greater accuracy than prior work, potentially allowing for more precise tracking of migration patterns.

"This is like having a little army of expert birders with superhuman hearing and endless patience listening to the night sky," said Bello.

These advancements build upon earlier work published in the *Journal of*

Applied Ecology, where the research team first demonstrated BirdVoxDetect's capabilities to predict the onset and species composition of large migratory flights. That study analyzed a full migration season's worth of audio data from microphones in upstate New York—over 4,800 hours of recordings.

The system uses advanced machine learning techniques to analyze terabytes of audio data collected by networks of microphones, automatically picking out the brief "chirps" that many birds use to communicate during nocturnal migration.

Traditional methods of studying migration, like radar and volunteer birdwatcher observations, have limitations. Radar can detect the flight's biomass but can't identify species, while volunteer data is mostly limited to daytime sightings and indicative of occupancy rather than flight.

Acoustic monitoring fills crucial gaps, allowing researchers to detect which species are migrating on a given night and more accurately characterize the timing of migrations. The research shows that data from a few microphones can accurately represent migration patterns hundreds of miles away.

The researchers have made their system freely available as open-source software, allowing other scientists to apply it to their own data. This could enable continental-scale acoustic monitoring networks to track bird migration in unprecedented detail.

"We're entering a new era where we can monitor migration across vast areas in real-time," Bello said. "That's game-changing for studying and protecting valuable, and potentially endangered, wildlife."

Such data could prove crucial for conservation efforts. Many migratory bird populations are in steep decline due to habitat loss, climate change

and other factors. Better understanding of migration timing and routes could help inform protection strategies.

The authors suggest that acoustic monitoring should become an integral part of efforts to study and conserve migratory birds. The technology is particularly promising for remote or inaccessible areas where traditional observation is difficult.

"Acoustic sensors are relatively inexpensive and can operate autonomously for long periods," said Bello. "This opens up exciting possibilities for monitoring migration in places we've never been able to study before."

More information: Vincent Lostanlen et al, BirdVoxDetect: Large-Scale Detection and Classification of Flight Calls for Bird Migration Monitoring, *IEEE/ACM Transactions on Audio, Speech, and Language Processing* (2024). DOI: 10.1109/TASLP.2024.3444486

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