Autonomous Recording Units

Application of ARUs on Military Lands

— *Content Authors: Andrew Sharp, Rich Fischer*

Department of Defense
Partners in Flight

Our Mission

Providing expertise on the management and conservation of birds and their habitats to sustain and enhance the military mission

Contacts

Richard Fischer, Ph.D.
National Coordinator
Richard.A.Fischer@erdc.dren.mil

Andrew Sharp, M.Sc.
Andrew.j.sharp@erdc.dren.mil
Jake Jung, Ph.D.
Jacob.f.jung@erdc.dren.mil
Technical Coordinators

This project is supported by the Department of Defense's Legacy Resource Management Program.

Overview

Traditional methods used to inventory and monitor bird populations, such as point counts or transect counts, can be too time and labor intensive to be applied at large scales. Point-count surveys involve physically maneuvering to each point and remaining for the duration of the count (typically 5-10 minutes). The relatively narrow time frame for conducting these kinds of surveys (starting at sunrise and ceasing 4-6 hours after sunrise) and the minimum spacing of points (typically ≥ 250 meters) means that relatively few points-counts can be conducted in a single day. Additionally, for effective estimates of occupancy, observers must replicate point-counts at least three times during the stationary period in question. To add to these difficulties, especially on DoD lands, strategic areas may be closed to biological monitoring for much of the year due to training and other military activities, making replication of point-counts difficult or impossible. To overcome these issues, DoD natural resource managers may hire seasonal crews to conduct point-counts or may limit the geographic or temporal scope of their surveys.

Autonomous (or acoustic) Recording Units (ARUs) can be a time/labor-effective way of monitoring bird populations on DoD lands. ARUs are deployable units that record sound and store it for analysis. The main benefit of ARUs is that they are capable of collecting a large quantity of data with limited manual effort. For example, one technician could deploy dozens of ARUs in a single day. Those ARUs could collect enough data to be the equivalent of dozens of human observers conducting numerous daily point counts at each location for months. There are several different models of ARU available for purchase, and technologically savvy individuals can even construct their own. Available models vary widely in price, design, durability, and reliability. At their most basic, most models are comprised of a power source, a microcontroller, one or more microphones, and an SD card for storing sound files on board. Some ARUs can be easily programmed to record at specific intervals, such as "record for 10 minutes every hour during daylight hours". Currently, there are no commercially available ARUs capable of transmitting data remotely. All data are stored internally.

ARU mounted to a tree in the Delta National Forest, Mississippi (photo: Andrew Sharp)

Autonomous Classification

The data-rich nature of ARUs can be a double-edged sword, as staff that do not have time to log thousands of survey hours likely do not have time to listen to thousands of hours of recordings to denote the species that occur within the recording (i.e., classification). However, machine-learning algorithms recently have been developed that are capable of processing recordings from ARUs and

Autonomous Recording Units

Application of ARUs on Military Lands

Department of Defense
Partners in Flight

Our Mission

Providing expertise on the management and conservation of birds and their habitats to sustain and enhance the military mission

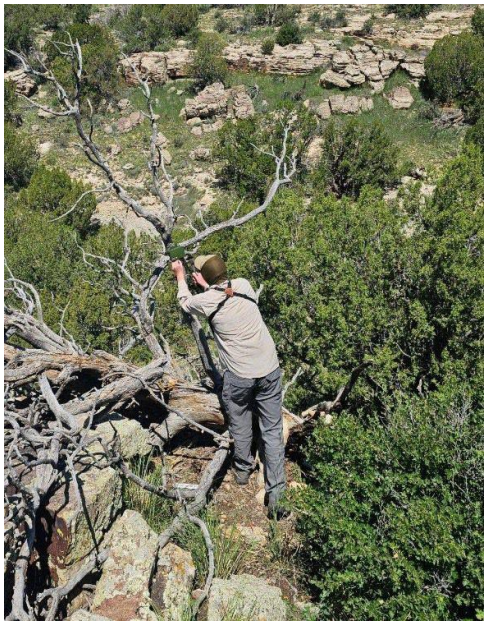
Contacts

Richard Fischer, Ph.D.
National Coordinator
Richard.A.Fischer@erdc.dren.mil

Andrew Sharp, M.Sc.
Andrew.j.sharp@erdc.dren.mil
Jake Jung, Ph.D.
Jacob.f.jung@erdc.dren.mil
Technical Coordinators

This project is supported by the Department of Defense's Legacy Resource Management Program.

generating species classifications. Although these autonomous methods are not as accurate as a human expert listening to sound files, ARUs combined with autonomous classification can allow the user to collect and analyze much more data than traditional methods, and in a fraction of the time. The two most popular auto-classifier software programs, Merlin and BirdNET, operate completely offline, so all data stays on the local machine on which it is being processed.



Installing an ARU on a DoD installation. Photo by Jake Jung.

Applications within DoD

ARUs have several obvious uses within DoD. First and foremost, ARUs can be a valuable inventory tool for natural resource managers. Biologists can strategically deploy and recover ARUs across their DoD landscapes and inventory their local bird populations using fewer human-hours relative to accomplishing the same goal using traditional methods. Additionally, biologists only have to access areas twice (once to deploy ARUs and once to recover them) in order to gather an entire season's worth of data. Second, ARUs may be especially effective for nomadic, rare, or transient species. For example, Pinyon Jays (*Gymnorhinus cyanocephalus*) may have annual home ranges as large as 20 square miles. A series of traditional point counts spread out over several months may not detect this species, even within a regularly used part of their home range. Alternatively, an ARU that is placed within a regularly used portion of the home range and that operates every day is likely to detect this species. DoD PIF has extensive expertise with ARU deployment and sound file analyses, and can be a resource for installations interested in establishing a monitoring program using ARUs.

Weaknesses of ARUs

ARUs are not a perfect technology and in some situations may not be the right tool for species inventory. As discussed, ARUs collect vast amounts of data that require long hours of manual classification if autonomous classification methods are not used. If autonomous classification methods *are* used, the resulting classification will incur a higher false-positive and false-negative rate than would be expected from an equivalent traditional method (i.e. a point-count conducted by a trained expert) and may require further manual verification. Additionally, it is difficult to determine abundance from sound recordings. In traditional point-counts, by contrast, an observer can determine the number of vocalizing individuals of each species. Analytical methods are currently in development that aim to ameliorate this weakness. Lastly, like any technology, ARUs can malfunction, which can result in a loss of data, especially if ARUs are being deployed for long periods without being checked for proper functioning.