UW College of Agriculture and Natural Resources
Global Perspectives Grant Program
Final Report

PROJECT INFORMATION

Trip Date:	March-June 2023
Principle Investigator(s):	Jonathan “Patrick” Kelley
Department:	Zoology and Physiology
Email:	jkelle24@uwyo.edu
Project Title:	“Building capacity in ecological artificial intelligence in Panama and Wyoming”

Non-technical summary:

This project focused on understanding the complex biotic interactions of birds in tropical rainforests, which are ecosystems that are vulnerable to environmental changes like changing climate and habitat loss. The study examined mutualistic relationships (foraging aggregations of birds), which are known to have important impacts on biodiversity and ecosystem stability. The project used advanced artificial intelligence (AI) to analyze bird sounds and other ecological data to track these interactions across habitats differing primarily in precipitation. By expanding our existing research program in Panama, the project aimed to develop AI tools to efficiently map these relationships and teach students how to use AI for ecological research. The goal was to improve conservation efforts, support biodiversity monitoring, and provide students with valuable skills in AI and ecological science, which could benefit agriculture and environmental management in other regions.

TRIP REPORT

Main results:

This CALSNR Global Perspectives grant enabled me to visit Panama and support three students—one undergraduate and two UW M.Sc. students—with data collection and analysis that were crucial to the project's goals. However, due to funding and logistical constraints, such as ants damaging the protective membranes of our waterproof microphones and deforestation at three sites, we were unable to collect data at all 24 planned locations. Additionally, unexpected challenges prevented a second trip to Panama for the AI Methods workshop (Objective #2), leading me to return the funds allocated for that initiative. Despite these setbacks, we made significant progress toward the project's primary field goals by studying three related ecological systems across four large, intact forest sites. We collected over 600 hours of audio data (from about 120 field days) on army ant-following bird flocks, which includes call and song data from all species in the flock, along with data on swarm size, speed, and bird species. These recordings are being processed and used in various undergraduate projects. We also collected nearly 450 hours of bioacoustic and video data at army ant swarm bivouacs, where birds visit to assess if a large raiding party is forming. Analysis by my current M.Sc. student is complete, and the data is being processed by an undergraduate for use in a separate AI image classification workflow. Lastly, my other M.Sc. deployed automatic acoustic loggers in two rounds (May and June) at Limbo plot in central Panama, a site with the longest-running bird census in the Neotropics, to gather data on species richness from avian point counts conducted earlier in the year; these data are currently being combined with the census data and prepared for publication.

Future plans: This funding provided me and my lab team with foundational expertise that has paved the way for applying this knowledge to develop a myriad new projects to advance field ecology. Building on this foundation, I am now focused on the development of innovative remote behavioral sensors (e.g. 3D localization of animals in the tropical forest) and machine learning applications to understand biotic interactions, monitor biodiversity and support ecological research. Not only has this grant enabled my lab to move towards enhancing UW's capacity for cutting-edge field research, but this work will strengthen our 2026 NASA ROSES (Biodiversity) grant submission by addressing feedback from our 2021 proposal, which emphasized the need for improved model validation and fine-scale movement and animal interaction data.

Potential impacts:

Benefits to CALSNR: This project integrated acoustic recordings of bird communities, cutting-edge AI models, and advanced ecological network analyses to develop models that will be valuable to stakeholders monitoring biodiversity and restoring habitats in both intact and modified ecosystems, including agricultural systems. This aligns with several of CALSNR's Strategic Goals. It provided students with hands-on experience at the intersection of artificial intelligence, computer science, and ecological sciences, which will have broad applications in agricultural ecosystems (e.g., managing and analyzing drone-based image data), thus improving job placement prospects. The data collected will contribute to building expertise in both field and AI-based techniques in ecological sciences, fostering interdisciplinary collaboration across departments and colleges, and leading to more groundbreaking publications.

Benefits to the University of Wyoming and the State of Wyoming: The completed work addressed one of UW's Grand Challenges, specifically in building state-of-the-art capacity for rapidly and accurately monitoring the impacts of both natural and anthropogenic changes on biodiversity and ecosystem function (Grand Challenge: "Biodiversity and Earth System Change"). The work will benefit local research entities in Panama, such as the Smithsonian Tropical Research Institute, ADOPTA, and AviFauna, as well as conservation biologists worldwide, including those in Wyoming. Additionally, the project aligns with the mission of the Zoology & Physiology department, which focuses on creating a high-quality research environment with an emphasis on contextual learning relevant to the demands of the 21st century. The combination of fieldwork and novel computational methods provided multiple training opportunities for four undergraduate students (two in the field and two in the lab) and two graduate students. The funds received supported the acquisition of equipment now being used by six undergraduates conducting independent research, as well as five graduate students engaged in field research in Panama.

Photos:

Photo 01: *Hylophylax naevioides* (Spotted Antbird). This species is a follower of *Eciton burchelli* army-ant swarms and is one of the species that my lab studied during the CALSNR funded project in 2023 in Panama. Photograph by UW M.Sc. student Michael Castano.

Photo 02: *Phaenostictus mcleannani* (Ocellated Antbird). This species is an obligate follower of *Eciton burchelli* army-ant swarms and is one of the species that my lab studied during the CALSNR funded project in 2023 in Panama. Photograph by UW M.Sc. student Michael Castano.

Photo 03: One of the many acoustic recording devices that my lab deployed in 2024 to collect acoustic data from antwren flocks during the CALSNR funded project in 2023 in Panama. Photograph by Patrick Kelley.

Photo 04: UW M.Sc. student Michael Castano presenting the poster –based on his work on army-ant bivouacs (and the birds that are associated with them) at the 2nd Ornithological Congress of the Americas in Gramado, Brazil in August 2023. Photograph by Patrick Kelley.