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# Acoustically Monitoring the Rhythms of Biodiversity in Agroecosystems

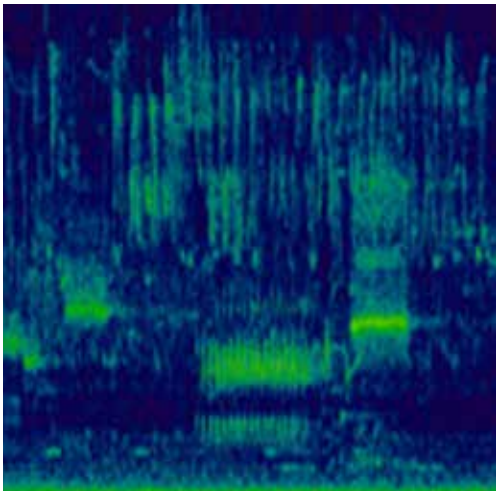
Casey W. Hoy, Entomology

## INTRODUCTION

Conserving biodiversity is one of the greater global environmental challenges of our time. Protecting the planet's wide variety of living things ensures that ecosystems function smoothly to provide energy, renewable materials, clean water and air, and food. In agriculture, biodiversity is evident in the many varieties of plants and animals used as food throughout the world. More importantly, it includes the many and varied organisms that allow carbon, water, and nitrogen cycles to operate. However, biodiversity is difficult to measure because of the scope needed to include every living thing in a particular place, from the smallest microbes to the largest animals.

## OBJECTIVES

This project was based on the idea that when there is high biodiversity, one should be able to hear it, because animals make a wide variety of sounds. The purpose of this project was to evaluate equipment for recording sounds in agricultural ecosystems over time and test how researchers can use those recordings to measure biodiversity efficiently and continuously. Most previous examples of this kind of work were from oceans, where the assumption was that human sounds are evidence of a disturbed ecosystem. But in a healthy agricultural ecosystem, farming sounds should coexist with sounds of the natural world. If only tractors and machines are heard, then the farming system may be too intensive to maintain biodiversity. But if one can hear a symphony of farm machinery, birds, insects, amphibians, and other animals, then the farming system may be more in harmony with nature. Investigators were looking for both human and natural sounds in the recordings, but the challenge was how to measure biodiversity on the farm based on a recording.



## OBJECTIVES CONT.

Using the Song Meter recording equipment from Wildlife Acoustics, investigators produced a large collection of recorded sounds from the initial test sites. Researchers used these recordings to develop and test software to analyze the audio recordings. The programs generate the Acoustic Entropy and Dissimilarity Indices. The Acoustic Entropy Index describes the biodiversity at a particular location based on the variation in natural sounds in the recording. The Dissimilarity Index estimates the difference between two recordings, allowing us to compare two or more ecosystems or habitats.

Scientists ran an experiment that compared more traditional measures of biodiversity, such as one-time samples of insects from traps or bird sightings within a specified time period, and the sound-based measures. They also placed the microphones in areas in which, based on previous research, they expected to have relatively high or low levels of agroecosystem health, of which biodiversity is a key component. The study found that the diversity of natural sounds in the recordings matched the expected amount of biodiversity based on the previous work — i.e., there was higher biodiversity in the recordings from areas with higher agroecosystem health. This confirmed that the sound recordings can detect differences in biodiversity from place to place.

## IMPACTS

The acoustic biodiversity monitoring methods are new, and researchers will continue to develop them. So far, the techniques have been included in two grant proposals, and will be part of at least two more that are currently under development. Furthermore, the recording equipment will be part of a long-term monitoring project at the Ohio State University, OARDC Mellinger Farm, which will monitor changes in biodiversity as a result of changing the farm's practices. As researchers further develop the technology, scientists expect to be able to monitor biodiversity in agriculture more widely and consistently and gain much better insight into how it can be increased through farming practices, and critically, how this technology may potentially enhance Ohio's $100+ billion agriculture industry.

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