SCOPE OF WORK

The RESTORE project at the University of Toledo Stranahan Arboretum

Revitalizing
Ecosystems
Scientifically
Through
Organized
Research and
Education

Henry M. Streby, PI
Associate Professor of Ecology
Department of Environmental Sciences
Research and Teaching Coordinator
Stranahan Arboretum
University of Toledo

Jeanine M. Refsnider, Co-I
Associate Professor of Ecology
Department of Environmental Sciences
Stranahan Arboretum
University of Toledo

David Krants, Advisory Personnel
Associate Professor
Department of Environmental Sciences
University of Toledo

"The [Stranahan} Arboretum provides an environment that cannot be duplicated in any other environment, not the MetroParks, city parks or even private properties in this area. There have been several PhD dissertations that have come out of the Arboretum, none of which would have been possible in another environment. It is a living, natural laboratory that cannot be duplicated elsewhere on campus." Associate Vice President, University of Toledo, 1994.

Background

The University of Toledo's Stranahan Arboretum is a Board-Certified University Center with a mission of research, education, and community engagement. The Arboretum historically had a strong positive impact on recruitment, retention, student well-being, research funding, experiential learning opportunities, and community donor support. Unfortunately, the Arboretum was hanging on by a thread after having no formal budget for decades and then the COVID-19 Pandemic. For a more detailed history, see Henry Streby's sabbatical research report available on request. In recent years, a team of dedicated volunteers, including University faculty, staff, students, neighbors, and other community members worked to bring the Arboretum back for the sake of our institution and the community we serve. In this time, the Arboretum has seen a massive increase in use by UT undergraduate and graduate

courses from several UT Colleges, the procurement of more than $1,000,000 in funding for research infrastructure and research activity, and completion of nearly $100,000 (almost all from donor support) in Arboretum improvements and community engagement.

The University of Toledo has subsequently instated a prohibition on all volunteering and public access, restricting the use of the Arboretum solely to research and formal UT courses.

In 2024, we were supported by UT Facilities leadership and the Department of Environmental Sciences and installed a new gravel access road for two main purposes, 1) to provide safe access to central research sites (vehicles were getting stuck), and 2) to provide access for students and faculty to replace large areas of turf grass with native prairie plants to create an experimental savanna for research and teaching opportunities. UT Facilities and Construction provided funding for the access road specifically because the RESTORE project would save them money, time, and maintenance from reduced mowing. Of course, it also improves water infiltration (reduced runoff) and water quality, pollinator and wildlife habitat, increased carbon sequestration, and most importantly to us, opportunities for students to participate in experiential learning through field-based experimental scientific research.

A fall 2025 survey of the entire UT undergraduate student body found that 83% would like to attend classes and events at the Arboretum, 82% are interested in volunteering at the Arboretum, and 78% would support a student fee to fund the Arboretum. It would be foolish to ignore these numbers and deny students what they want and need. The Arboretum has a full head of steam and is positioned to be a major, long-term resource to increase enrollment, research funding, and community goodwill, all of which are stated priorities of every UT Administration. In recognition of this pivotal moment, we have initiated a research and education project to use the Arboretum for its original intent, to increase research and education opportunities for University of Toledo students while increasing the natural and ecological integrity of the facility.

The RESTORE Project aims to take advantage of the growing enthusiasm and historical neglect of the Arboretum grounds to provide a multi-disciplinary opportunity for research and education around the restoration of an ecologically degraded landscape. Specifically, this project involves experimental ecology research within the context of the ecological restoration of a savanna from its current state of neglected trees and mowed but otherwise neglected turfgrass (lawn). One place where we have a headstart is in the abundance of dead trees and dead branches thanks to many years without an arborist being employed; although aesthetically undesirable to lawn and park manicurists, these snags and wolf trees are an essential and difficult-to-establish part of a healthy savanna landscape. Any such restoration project takes at least a decade to fully establish and requires active management throughout the process and to maintain the dynamics of the system after restoration.

Students can learn the process of restoring a prairie from Google and they can participate in that process by volunteering with any number of conservation organizations in the region. This is not that. This project will teach students scientific study design, application of experimental treatments, collection of scientifically valid data, application of appropriate statistical analysis, and writing and publication of peer-reviewed scientific articles. These are the skills and products that make a degree in Environmental Science more valuable than general work experience. These are the experiential learning opportunities that make the University of Toledo different from all the universities conducting feel-good conservation by planting conspicuous pocket prairies along roadsides that serve as ecological traps for pollinators and other wildlife to be killed by cars. And if completed under the direction of experts in

habitat ecology and scientific study design, such a project becomes an invaluable asset for producing uniquely qualified environmental science graduates.

The opportunities are nearly endless for UT students to participate in every stage of a large scale ecosystem restoration project, including preliminary background research and landscape design, monitoring of soil composition and changes in hydrogeophysics, experimental studies of habitat manipulation effects on pollinators and other animals in different stages of habitat succession, comparisons of vegetation communities with an without mammal herbivory, assessing plant growth patterns in different amounts of sunlight, assessing human aesthetic perceptions of various stages of restoration, and much more. In addition to the environmental science opportunities, this project will provide opportunities for students in 2-D and 3-D art courses, writing courses, science education courses, and environmental engineering courses.

Every aspect of this project will be conducted as coursework, research, and formal education and training to maximize the benefits to our students' education, training, and research experience. Students will not only learn to plan, propose, and implement the work, but they will also be involved in the paperwork, training, and permitting processes. For example, students will work with professors through the process of IACUC approval when work involves vertebrate animals or IRB if work involves human research subjects.

Description of Work

We are establishing an experimental research and teaching terrestrial ecosystem restoration project on approximately 5.1 ha of the Stranahan Arboretum, none of which has been used for research, or been meaningfully maintained other than mowing, for at least 10 years. The delineation of study plots, as is currently and has always been the case for research at the Arboretum, should formally limit other activities in the plots that could compromise the research and coursework of faculty and students. Having control of activity in the area is exactly why the Arboretum is the only place such work could be completed. All of the plots have randomly dispersed mature trees with variable canopy openness from partially to completely open, and patchy ground cover of turfgrass, exotic weeds, leaf litter, course woody debris, seedlings and saplings of invasive trees and shrubs, invasive ornamental vines, and a few native prairie plants. In stages, the foundational design of the project involves the replacement of all ground vegetation with native prairie grasses, sedges, and forbs, as well as some native shrubs and understory trees, to gradually establish a pseudo-native savanna, with the primary difference being the retention of the mature Arboretum trees that represent temperate regions from around the world.

The establishment of the project involves specific study design considerations including replication for statistical comparison, staggered treatment implementation to differentiate effects of time and successional stage, and patch-size variation to allow study of core-area and edge-effects, all while maximizing opportunities for later studies to come and go within the larger design. Specifically, we are using three areas of 3.5 ha, 1.1 ha and 0.5 ha that have not been involved in any research for at least 10 years. Killing of existing ground vegetation occurred for the 3.5-ha plot (Plot 1) in multiple rounds in 2025. Removal of the ground vegetation in the 1.1-ha plot (Plot 2) and the 0.5-ha plot (Plot 3) will be completed using a silage tarping method in 2026 and 2027, respectively. Sowing of prairie seeds will be done in winter of 2025-26 (Plot 1), 2026-27 (Plot 2), and 2027-28 (Plot 3) by the Terrestrial Ecosystem Restoration class and students registered for Directed Research and Environmental Internship. The sequential initiation of each plot over 3 years, provides a critical, but often overlooked, advantage to the study design; it allows the differentiation of year effects (drought, flood, long winter) and successional

stage effects (observations potentially unique to vegetation age) in all of our studies because the plots will be different ages in any given year.

Except where excluded intentionally for research purposes, regionally typical prairie management methods will be used, including one or two high-cuts (mowing with the deck at 8 inches to reduce competition from persistent non-natives) in each of the first 2-3 summers of each plot, spot treatment of noxious weeds, mechanical removal of noxious weeds and invasive woody plants, and supplemental planting of head-started native plants. However, all of these methods will be applied intentionally and experimentally to study the impacts of different rates of these treatments on aspects of the ecosystem. The goal is not simply to install and maintain patches of prairie. Although, that will be a wonderful biproduct of this project, the goal is to establish a living scientific laboratory to test ecological hypotheses. There may be small patches that are mowed repeatedly or at different heights, allowed to retain non-native plants or have them added to study their impact, have native plants added or removed to study the effects of high and low diversity, etc., and therefore careful coordination of all activities will be necessary.

Longterm studies

Savanna Vegetation Succession and Climate Variability: Establishing and monitoring replicate sampling quadrats within each RESTORE plot, will enable studies plant height, form, above and below-ground biomass, and plant community composition throughout the succession of the plots. This will allow for comparisons of these vegetation metrics across successional stages, variable amounts of sunlight and shade, with natural and experimental variation in water availability, with and without vertebrate herbivory (exclosure studies), and among other experimental treatments. The size and multi-year initiation of the project will allow students to conduct publishable scientific research on the effects of manipulations large and small, such as experimentally manipulating plant species diversity (removing and adding species to small replicate plots) and collecting data on the response of many aspects of the system.

Pollinator Response to Ecosystem Restoration: All of the monitoring and experimentation with vegetation above can be combined monitoring changes in invertebrate pollinator species richness and diversity. Additional monitoring of resource competition with non-native honey bees will be possible thanks to long-time neighbors, and Arboretum friends, who have hives with bees that forage throughout the Arboretum.

Avian Community Response to Ecosystem Restoration: In early June 2025, we conducted surveys to census and map the community of birds breeding throughout the Arboretum grounds. This survey was intended as a general inventory to inform our Avian Ecology Lab course. But with the opportunity to monitor changes in the avian community during the RESTORE project, we have developed an IACUC protocol to formalize this vertebrate research. We plan to monitor changes in the bird community over time in combination with educating and training students on common bird survey, capture, handling, and marking methods that will give them valuable experience for jobs. These methods will include point-count surveys, territory mapping, banding birds using passive and targeted mist-netting and hand capture to band nestlings from nest boxes and other nests. All of these activities are basic bird research methods that have been conducted by the PI and his colleagues for multiple decades and have extensive experience teaching and training avian research methods.

Reptile and Amphibian Response to Ecosystem Restoration: Turtle trapping techniques and salamander monitoring methods have been demonstrated at the Arboretum as part of research in the Dr. Jeanine

Refsnider Lab. The Arboretum hosts few amphibians and reptiles, likely due to the long history of mowing which can kill these animals directly and lead to increased mortality from predators by reducing cover. Anecdotally, salamanders are currently limited to a few small areas, turtles rarely leave the wetlands and are often depredated when they do, and snakes are exceedingly rare with only a few garter snakes and 1 hognose snake observed on the entire property in the past 3 years. We have developed an IACUC protocol to formalize monitoring these vertebrate populations moving forward, that will be submitted independently.