Environment and Natural Resources Trust Fund
2009 Phase 2 Request for Proposals (RFP)

LCCMR ID: 083-C1

Project Title: Simulating Predation of Invasive Earthworms for Woodland Restoration

Total Project Budget: $ $112,500

Proposed Project Time Period for the Funding Requested: 3 years; July 2009 to June 2012

Other Non-State Funds: $ $20,000.00

Priority: C1. Aquatic and Terrestrial Invasive Species

First Name: Lonnie **Last Name:** Brokke

Sponsoring Organization: Harriet Alexander Nature Center (Roseville)

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Region:	County Name:	City / Township:
Metro	Ramsey	Roseville

Summary: This cooperative research and educational outreach project with the University of Minnesota investigates the potential for woodland habitat recovery and restoration following an earthworm invasion using a (simulated) flatworm predator.

Main Proposal: 1008-2-015-proposal-LCCMR 2009 - Earthworm Predation Simulation Project - M

Project Budget: 1008-2-015-budget-Earthworm Predation Simulation - 2009 Project Budget.xls

Qualifications: 1008-2-015-qualifications-Earthworm Predation Simulation - Prj Mgr Quals an

Map: 1008-2-015-maps-Earthworm Predation Simulation - Test Site Location Map.PDF

Letter of Resolution:

1. PROJECT STATEMENT

The incursion of exotic earthworms into North American hardwood forests has adversely disrupted this ecosystem. Regionally and across Minnesota's hardwood forests, exotic, invasive earthworms feed on and remove the leaf litter (soil mulch) layer, and relocate much of the leaf-derived carbon and other elements deeper into the soil profile beyond the shallow-rooting zone of many native woodland wildflowers and grasses. This transfer reduces the concentration and availability of necessary plant nutrients and causes a loss in vigor and sustainable growth. The loss of the leaf-litter cover exposes the underlying mineral soil and creates drier and warmer soil conditions during the growing season. This additional stress further contributes to the loss of native plant and animal (e.g., salamander) woodland species. The bare soil also promotes the germination of exotic Eurasian buckthorn, and causes increased soil erosion and runoff to nearby lakes and streams. Increased erosion of soil-bound phosphorus to surface water adversely affects water quality through accelerated rates of eutrophication. In Wisconsin, an exotic flatworm (*Bipalium adventitium*) an earthworm predator that originated from Asia has recently been identified in the Green Bay and Milwaukee areas (Watermolen and Fojut, 2008), but its affect on the native ecosystem is not known.

The 52-acre Harriet Alexander Nature Center contains a woodland habitat that has been invaded and significantly degraded by earthworms. By late summer the leaf-litter cover is largely absent from the forest floor due to earthworm activity. Non-native, predatory flatworms have the potential to control and reduce earthworm populations in woodland soils, but federal law prohibits their release in a field setting without years of prior extensive study. This LCCMR-funded investigation will simulate the introduction of predatory flatworms for earthworm control and woodland recovery by applying small electrical shocks to the soil using buried electrodes. Because earthworms are highly sensitive to even a few volts of electricity, this action will expel the earthworms from a test plot so that comparisons can be made with an adjacent control plot where earthworm activity will be unhindered. Field monitoring parameters for the two plots include assessing differences in native-plant establishment, leaf-litter accumulation, buckthorn germination, soil moisture/temperature/chemistry, soil-erosion rates, and water runoff-volume and quality.

Educational Outreach - With more than 13,000 visitors passing through its interpretive center annually, the Harriet Alexander Nature Center provides important natural resource and outdoor environmental education programs for school groups from several districts. LCCMR-funding and a separate U.S. EPA Environmental Education grant will be used to help support year-round part-time instruction, as well as develop educational curriculum and materials for this project. The LCCMR funds will be applied as a match to the requested federal dollars. Collectively, this hands-on, interdisciplinary field-research project will provide students with a direct understanding of the adverse effects that invasive species pose to the environment and demonstrate that science can be a lot of fun! With this project students (K-12) will have the opportunity to:

- Collect earthworms as they emerge from the soil and identify the species.
- Simulate earthworm control by flatworm predators (electrodes) in a terrarium model.
- Observe leaf-type food preferences for earthworms (terrarium model).
- Determine the leaf-litter cover at the two plots (using the tape-line method).
- Plant and monitor native-plant seedling germination/establishment/mortality rates.
- Count the number of buckthorn seedlings that emerge annually from each plot.
- Measure the weight of eroded sediment (collected on filter paper) from each plot.
- Examine differences in soil temperature, moisture, and chemistry between the plots.

NSF Grant - Project field methods and exploratory research results will provide the University of Minnesota with enough preliminary information to pursue a subsequent National Science Foundation (NSF) grant as part of a much more extensive investigation involving multiple test sites.

2. DESCRIPTION OF PROJECT RESULTS

Result 1: Test Plot Selection and Initial Site Characterization **Budget: $** 33,000

Deliverable	Completion Date
1. Site selection, monitoring equipment installation and testing.	November 2009
2. Baseline site characterization (plant species composition, leaf-litter cover, soil chemistry, plot runoff).	November 2009

Result 2: Earthworm Control Simulation and Assessment **Budget: $** 38,500

Deliverable	Completion Date
1. Simulate flatworm predation for earthworm control through electrode activation (starting in spring 2010).	May 2012
2. Plant native woodland species (seeds and seedlings) in two test plots.	June 2010
3. Monitor for two years from the two plots (test and control) differences in: • Exotic earthworm population density (electrode plot only - upon expulsion) and composition of invasive worm species. • Leaf-litter accumulation. • Native plant establishment or mortality (for woodland restoration). • Exotic buckthorn-seedling germination rates. • Soil moisture, temperature, and chemistry at different depths. • Distribution, concentration and partitioning of soil, leaf litter, and plant (foliar) nutrients and chemistry. • Runoff rates, volume, water chemistry and associated soil erosion and sediment transport parameters (e.g., phosphorus loading).	May 2012

Result 3: Educational Outreach **Budget: $** 41,000

Deliverable	Completion Date
1. Provide funds for part-time instruction and course development at the Harriet Alexander Nature Center.	June 2012

3. PROJECT STRATEGY AND TIMELINE

A. Project Partners

Lee Frelich, Ph.D. - Forest Ecologist and Director of the University of Minnesota Center for Hardwood Ecology, Department of Forest Resources, University of Minnesota. Dr. Frelich has conducted extensive field studies on the effects of earthworms on hardwood-forest ecology and is one of the leading authorities on this subject with several published research papers. For this project Dr. Frelich will assist with test-plot selection at the Harriet Alexander Nature Center in Roseville, serve as an educational resource, guide ecological field-data collection, assist with its interpretation, and help prepare reports.

Robert Guthrie, Ph.D. - Research Scientist. Dr. Guthrie has prepared and implemented grants for the Stearns County SWCD (LCMR and 319 Water Quality) and the University of Minnesota (USDA and MDA). He has extensive experience with field-instrument installation, sample collection, data acquisition, interpretation, and reporting. For this project Dr. Guthrie will provide technical support (equipment acquisition, installation, testing, sample collection, data compilation and interpretation, and report preparation) to the Harriet Alexander Nature Center (City of Roseville - Parks and Recreation Department) for this project.

B. Project Impact

C. Time

This project is scheduled to last for three years. The first few months of the project will be used for select the test sites and install the needed equipment. The remainder of the project will be used to collect field data, samples, and assess the effects of such a control strategy, as well as implement a companion educational curriculum. This project is budgeted to meet the specified deliverables.

D. Long-Term Strategy (if applicable)

This project is unique in that it will attempt to simulate the effects of flatworm predation for earthworm control and quantify these outcomes as a long-term strategy for woodland restoration.

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET

BUDGET ITEM	AMOUNT	% FTE
Personnel:	$ -	%
Year-round part-time instructor(s) at Harriet Alexander Nature Center for project-related curriculum development/outdoor environmental education	$ 40,000	25%
Contracts:	$ -	
U of M - Research Analytical Laboratory - Sample analyses for water, soil, and plant tissue	$ 9,100	
Lee Frelich, Ph.D. - Forest Ecologist - Site selection, ecological field-data collection, data interpretation, report preparation	$ 14,000	
Robert Guthrie, Ph.D. - System installation/testing, sampling, technical support, data acquisition/interpretation, report preparation.	$ 28,000	
Muska Electric - provide electrical service to test site for equipment	$ 5,100	
Equipment/Tools: Sensors and monitoring equipment to quantify differences between two test plots (soil properties and water runoff).	$ 14,700	
Restoration: <1 acre - System decommissioning	$ 1,000	
Other: Native Plant Species (seeds and plants) for Site (Test Plot) Restoration (using local ecotypes)	$ 600	
	$ -	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 112,500	

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Remaining $ From Previous Trust Fund Appropriation (if applicable):	$ -	
Other Non-State $ Being Leveraged During Project Period: Roseville is applying separately for a U.S. EPA Environmental Education grant to help develop a companion educational curriculum and materials for this project, and to fund a part-time instructor at the Harriet Alexander Nature Center. The LCCMR funds will be applied as a match to the requested federal dollars.	$ 20,000	Pending
Other State $ Being Spent During Project Period: *What additional state cash $ (e.g. bonding, other grants) will be spent on the project during the funding period? For each individual sum, list out the source of the funds, the amount, and indicate whether the funds are secured or pending approval.*	$ -	
In-kind Services During Project Period: Community-volunteer hours for project	$ 6,000	
Past Spending:	$ -	
Past Spending:	$ -	

Project Manager Qualifications and Organization Description

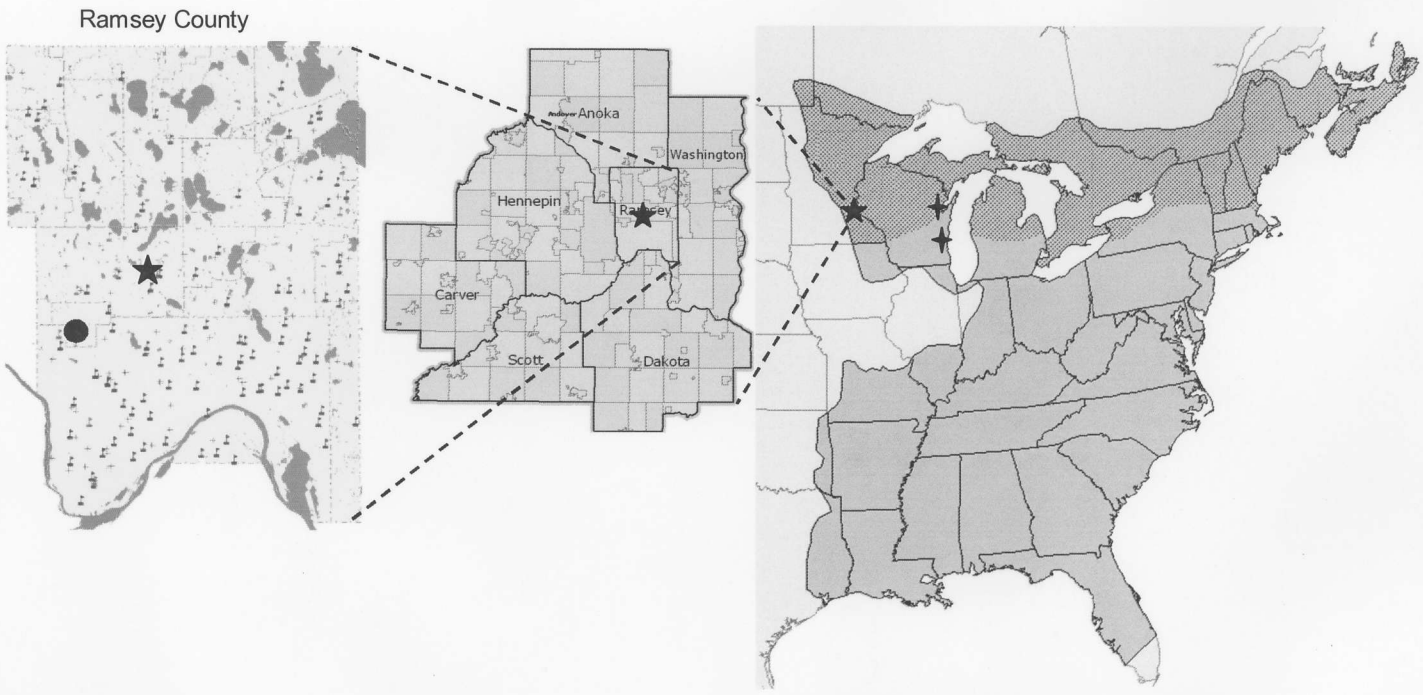
Lonnie Brokke, CPRP, Director of Parks and Recreation, Roseville, Minnesota

Mr. Brokke has served as the director of Roseville's Parks and Recreation Department since 2002 and served as assistant director from 1990 to 2002. He supervises a staff of 100+ seasonal and full-time employees and has budgetary responsibility for the entire department. Mr. Brokke has administered numerous grants with a monetary value of more than $1,000,000.

The Harriet Alexander Nature Center, contains 52 acres of marsh, prairie, and deciduous/pine forest. Earthworm activity at the nature center is responsible for the annual loss of the leaf-litter cover in the woodlands and causing extensive degradation to this habitat. With its erodible hillsides and proximity to a marsh, the nature center provides an excellent setting to monitor the effects of invasive earthworms on the environment as well as investigate a potential long-term control strategy for woodland-habitat recovery and restoration. The Harriet Alexander Nature Center is located just a few miles away from the University of Minnesota Forestry Department making it a convenient stopping point for students interested in forest ecology and natural resources. The nature center adjoins an elementary school and is frequented by K-12 students from several schools and districts. The Harriet Alexander Nature Center has a full-time naturalist (Debbie Cash) who manages various educational programs and events, directs volunteers, and coordinates the numerous activities. In 2007, the Harriet Alexander Nature Center received more than 13,000 visitors to its interpretive center including school field trips, day camps, and citizens from the surrounding communities. The nature center provides protection for hundreds of animal and plant species.

Roseville's Parks and Recreation Department is a progressive, environmentally-sensitive, department that is fully accredited by the National Recreation and Park Association (NRPA's) Commission for Accreditation of Park and Recreation Agencies (CAPRA). In Roseville there are 30 parks encompassing 632 acres with 64 miles of trails throughout the city. The park system includes the Guidant John Rose Minnesota OVAL and Skating Center, Cedarholm Golf Course, Muriel Sahlin Arboretum, and the Harriet Alexander Nature Center.

Simulating Predation of Invasive Earthworms for Woodland Restoration



(Modified from Hendrix and Bohlen, 2002)

EXPLANATION

- Reported Asian Flatworm (Earthworm Predator) Populations in Wisconsin
- Earthworm-Free Zone Prior to European Settlement
- Temperate Deciduous Forest
- **Harriet Alexander Nature Center** (Cooperative Educational Research Site for Earthworm Control)
- Ramsey County Schools (K-12 public and private)
- University of Minnesota – St. Paul Campus