

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

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**LCCMR ID: 080-C1**

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**Project Title:** Prevention and Early Detection of Invasive Earthworms

**Total Project Budget:** \$ \$182,135

**Proposed Project Time Period for the Funding Requested:** 3 years, Jul 2009-Dec. 31 2011

**Other Non-State Funds:** \$ \$0.00

**Priority:** C1. Aquatic and Terrestrial Invasive Species

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**First Name:** Cindy

**Last Name:** Hale

**Sponsoring Organization:** U of M, NRRI

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**Region:**

**County Name:**

**City / Township:**

Statewide

**Summary:** Invasive earthworm impacts on hardwood forests will be curtailed through risk-assessment of the vectors of spread, testing of Management Recommendations, and identification of key areas for action in the state.

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**Main Proposal:** 1008-2-050-proposal-617371 Hale LCCMR 2009\_main\_proposal\_submitREV.doc

**Project Budget:** 1008-2-050-budget-617371 Hale LCCMR RFP\_2009\_Project Budget-submit-final-1.

**Qualifications:** 1008-2-050-qualifications-617371 Hale LCCMR ProjectManagerQualifications.do

**Map:**

**Letter of Resolution:**

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## MAIN PROPOSAL

### PROJECT TITLE: Prevention and Early Detection of Asian Earthworms and Reducing the Spread of European Earthworms.

#### I. PROJECT STATEMENT

Invasive earthworms have been shown to have large and potentially irreversible impacts on hardwood forest biodiversity and regeneration which threaten the sustainability of this important resource. Unlike many invasive species, human mediated dispersal is the primary means of introduction and spread of invasive earthworms. Therefore, great potential exists to arrest the current spread of European earthworms that are already present in the state and prevent the introduction of even more destructive Asian species that are present to the east but are not yet established in Minnesota and the western Great Lakes region. The multi-pronged approach of this project will greatly reduce the introduction and spread of invasive earthworms through rigorous quantification of the relative importance of different vectors of introduction for earthworm species, development and testing the effectiveness of Management Recommendations for resource managers to limit the spread and introduction of earthworms, and through a comprehensive effort involving research and educational institutions, governmental agencies, non-governmental organizations and citizen science to inform and actively engage diverse stakeholders in efforts to identify and protect earthworm-free and minimally impacted areas of the state (estimated to be ~50%). Key to all aspects of the project is a focus on early detection and suppression of incipient invasions of new invasive earthworm species that have begun to appear in adjacent states but are not yet detected or established in the state. Reasonable and cost effective action now to control the important vectors of earthworm invasion will lead to protection of our hardwood forest resources for generations to come.

#### II. DESCRIPTION OF PROJECT RESULTS

##### **Result 1: Risk-Assessment of Vectors of Earthworm Introduction      Budget: \$ 52,726**

In contrast to the traditional approach to risk assessments based on species, we propose to identify, describe and quantify the potential vectors of in-state spread of established earthworm species and of interstate transport and introduction of non-established earthworm species (i.e. intentional and unintentional transport of compost, mulch, and soils; fishing bait), including field-based measures of earthworm species and relative abundance present in each vector.

##### **Deliverable**

##### **Completion Date**

- |  |               |
|--|---------------|
| 1. Risk Assessment of in-state vectors of earthworm spread                       | June 30, 2010 |
| 2. Risk Assessment of interstate vectors of earthworm introductions              | June 30, 2010 |
| 3. Peer-reviewed publication in professional journal (i.e. Biological Invasions) | Aug 30, 2010  |

##### **Result 2: Testing Effectiveness of Management Recommendations      Budget: \$ 59,698**

Management Recommendations resulting from previous work in 2008 and further developed by Result 1 of this project (i.e. equipment hygiene, public land-use restrictions, bait labeling or restrictions, etc.) will be field tested to determine the cost-benefit and relative effectiveness of different recommendations to actually limit the spread/introduction of different earthworm species.

##### **Deliverable**

##### **Completion Date**

- |  |              |
|--|--------------|
| 4. General Technical Report: regional management recommendations | Oct 30, 2011 |
|--|--------------|

##### **Result 3: Regulatory Responses to Early Detection of Asian Earthworms      Budget: \$ 3,191**

In cooperation with governmental agencies (including but not limited to DNR, and USFS), a plan for regulatory responses will be developed to respond to early detection of earthworm species not already established in the state (i.e. *Amyntas* species) including possible control or eradication measures and monitoring for incipient invasions of new species.

##### **Deliverable**

##### **Completion Date**

- |   |              |
|---|--------------|
| 5. Technical Report: cooperative regulatory response procedures | Oct 30, 2011 |
| 6. National Conference presentation of Results 1-3              | Aug 30, 2011 |

**Result 4: Identify Priority Areas for Protection****Budget: \$ 66,520**

A comprehensive and coordinated effort involving research and educational institutions, governmental agencies, non-governmental organizations and citizen science will inform and involve diverse stakeholders to identify earthworm-free and minimally invaded areas of the state/region in order to prioritize protection efforts and provide rapid detection and response for new species introductions. This component is critical for agencies and project partners to effectively move forward with actions recommended in Results 1-3.

**Deliverable****Completion Date**

7. Updates of Great Lakes Worm Watch and National Institute for Invasive Species Science earthworm survey protocols and online data collection system customized for various potential users/stakeholders Nov 30, 2009
8. GIS data layer indicating earthworm-free, minimally invaded, moderately invaded and heavily invaded areas of the state Dec 30, 2011
9. GIS data layer of the known/estimated distributions of all earthworm species documented in the state Dec 30, 2011

**III. PROJECT STRATEGY AND TIMELINE****A. Project Partners**

**Cooperators in Results 1-3: MN Department of Natural Resources** – Andy Holdsworth, Science Policy and Ann Pierce, Terrestrial invasive species coordinator; **Chippewa National Forest** – Jim Barrott, Soil Ecologist; **Leech Lake Band of Ojibwe Division of Resource Management** – Rebecca Knowles, Plant Ecologist

**Cooperators in Result 4: The National Institute of Invasive Species Science, U.S.G.S. & Colorado State University, Fort Collins Colorado** – Jim Graham, Research Scientist; Catherine Jarnevich, programmer; **The Natural Resources Research Institute, University of Minnesota Duluth GIS lab** – George Host, Senior Research Scientist – GIS lab coordinator

**B. Project Impact**

The results of this project will fill large gaps in knowledge about 1) the risks associated with different vectors of spread for invasive earthworms such as fishing bait and the movement of soils, mulch and compost; 2) what management practices and regulatory responses can prevent further spread, 3) and what areas of the state should have the highest priority for protection. With the risk assessments in hand we can readily move towards developing highly effective strategies for limiting the spread of established earthworms and preventing introductions of species not yet present in the state, thereby protecting native forests resources from future aesthetic, biologic and economic impacts. Specifically, native plant populations, tree seedling regeneration, habitat for forest birds, amphibians and small mammals will be protected. We also expect to help limit the spread of many of the most destructive invasive plant species such as buckthorn and garlic mustard which appear to be facilitated by earthworm invasions. The results will be applicable to the state as a whole, since earthworm invasions are occurring statewide, and specifically to the forested ecosystems where large impacts have already been documented. Further, these results will be broadly applicable to the Eastern Deciduous Forest Biome of North America, where invasive earthworm invasions are occurring. The technology and information infrastructure created with the National Institute for Invasive Species Science (NISS) will be available for use by others continent-wide and lays the foundation for the development of an accessible and comprehensive system to involve citizens in long-term monitoring and rapid response to invasive species invasions (see [www.citsci.org](http://www.citsci.org)).

**C. Time**

Funding is requested for Dr. Cindy Hale, the project manager, who will oversee all project activities and work closely with project partners in implementation of our results through policy and education. A graduate student will be supported through 3 full field seasons, requiring extensive travel throughout the state, to allow the risk assessment of vectors to be completed before field testing of management recommendations. Three NRRI staff and NISS staff will be involved in GIS analysis, website and database infrastructure development, and education and citizen science research efforts with project partners and other stakeholders throughout the grant period.

## Project Budget

### IV. TOTAL PROJECT REQUEST BUDGET - Funding period: 7/1/09-12/31/11 (2.5 years)

| <b>BUDGET ITEM</b>   | <b>AMOUNT</b>     | <b>% FTE</b> |
|--|-------------------|--------------|
| <b>Personnel:</b> Cindy Hale, NRRI Research Associate-project manager. Salary and benefits (rate 30.4%)  | \$ 24,789         | 14%          |
| George Host, NRRI Research Scientist - GIS lab coordinator. Salary and benefits (rate 30.4%)   | \$ 6,446          | 2%           |
| Gerry Sjerven, NRRI GIS Specialist. Salary and benefits (rate 30.4%)   | \$ 7,484          | 4%           |
| Jane Reed, NRRI junior scientist - website designer. Salary and benefits (rate 32.7%)  | \$ 2,359          | 2%           |
| NRRI junior scientist (to be named) - education & research outreach. Salary and benefits (rate 32.7%)  | \$ 28,539         | 30%          |
| UMD graduate student (to be named) - field research, 12 month appt. Salary and benefits (salary and fringe, varies according to percent appointment and number of credits).  | \$ 82,967         | 50%          |
| <b>Consultant:</b> The National Institute of Invasive Species Science, consultation and programming to build online data entry system as a module for their nationwide program. Primary contact Jim Graham, Research Scientist | \$ 2,250          |              |
| <b>Other:</b> Travel: 3 field seasons and support for stakeholder participation statewide  | \$ 22,001         |              |
| Supplies: field sampling supplies and project specific data storage  | \$ 3,200          |              |
| Publication Costs: 2 peer-reviewed publications  | \$ 1,000          |              |
| Lab fees   | \$ 800            |              |
| long distance phone and express mailing  | \$ 300            |              |
| <b>TOTAL PROJECT BUDGET REQUEST TO LCCMR</b>   | <b>\$ 182,135</b> |              |

### V. OTHER FUNDS

| <b>SOURCE OF FUNDS</b>  | <b>AMOUNT</b> | <b>Status</b>  |
|---|---------------|----------------|
| IMPLEMENTATION PROJECT: USING THE GODM CYBER-INFRASTRUCTURE TO INVOLVE CITIZEN SCIENTISTS IN MOVING FROM DATA ISOLATION TO DATA INTEGRATION, National Science Foundation award #OCI-0636210, 2006-2009, PI - M. Kalkhan, Jim Graham - project manager (total award \$900,000) (Separate but complimentary, not committed as match or cost-sharing for this proposal). | \$ 180,000    | <i>Secured</i> |
| <b>Other Non-State \$ Being Leveraged During Project Period:</b> "Exotic earthworm invasions: integrated research and education to achieve natural resource protection" Minnesota Coastal Program grant. PI - Cindy Hale (Separate but complimentary, not committed as match or cost-sharing for this proposal).  | \$ 94,220     | <i>Secured</i> |
| <b>Past Spending:</b> "Regional Assessment And Proposed Actions To Address Non-Native Earthworm Invasion Threats To Northern Forests of the Great Lakes Region", National Forest Foundation grant   | \$ 4,999      |                |
| <b>Past Spending:</b> "Predicting and managing invasive potential of exotic species: objective 2 - efficacy of educational efforts" MN Futures Project funded by the University of Minnesota Office of the Vice President for Research, David Andow, Lead Investigator (total award \$250,000)  | \$ 22,000     |                |

**Cindy M. Hale**, Research Associate – LCCMR project manager

**Organization Description:** University of Minnesota Duluth - The Natural Resources Research Institute, Center for Water and the Environment. Dedicated to basic and applied research and educational outreach to support the sustainability of Minnesota's natural resources.

**Project manager Qualifications:**

- Ph. D. 2004 - University of Minnesota, College of Natural Resources, Department of Forest Resources, St. Paul, MN, Major field: Forest ecology, Minor field: science education – Dept. of Curriculum and Instruction
- M.S. 1997 - Environmental Sciences, University of Minnesota - Duluth, Department of Biology
- B.S. 1988 - Ecology-Individually Designed Program, University of Minnesota, College of Biological Sciences

**Relevant Research and Educational Experience:**

1998 – present: Natural Resources Research Institute - An international recognized leader in research, education and collaborative activities related to the study of non-native earthworm invasions and their impacts to native ecosystems of the Great Lakes region. Train and supervise graduate students in field-based ecology research.

1999 – present: Great Lakes Worm Watch Program <<http://www.greatlakeswormwatch.org>>

Created and manage this web-based forest ecology curriculum and citizen science program to involve diverse stakeholders in conducting earthworm and habitat surveys. Organize and lead training workshops for citizen groups, formal and non-formal educators and natural resource professionals in collaboration with Environmental Learning Centers and other organizations across the Great Lakes Region. Train and supervise graduate students in environmental education. Author of the recently published book “Earthworms of the Great Lakes”

2007 – present: Graduate Fellows in K-12 Education - Program Manager of the National Science Foundation funded project to train and support 50 graduate fellows over 5 years in Biology, Geology, Chemistry & Mathematics to teach in K-12 settings under the mentorship of an experience teacher. The project manager oversees fellow & teacher recruitment, training and supervision throughout the project.

**Grants**

- 2008 “Exotic earthworm invasions: integrated research and education to achieve natural resource protection” Minnesota Coastal Program grant, total project budget \$94,220 – award amount \$46,935.
- 2007 “Regional Assessment And Proposed Actions To Address Non-Native Earthworm Invasion Threats To Northern Forests Of The Great Lakes Region.” The National Forest Foundation, award amount \$4,999.
- 2007 “GK-12: Interdisciplinary Science and Mathematics Graduate Fellow teams in K-12 Education” – 5 year program to support 10 graduate fellows annually from Biology, Geology & Mathematics to support the development of skills to effectively communicate STEM knowledge to non-technical audiences and to improve STEM teaching and learning in the K-12 environment, award \$2,931,797. DGE-0637027.
- 2006 Woodland Advisor Program, Minnesota Forest Stewardship Program - to host 19 workshops for private forest landowners on a range of natural resource management practices. Award amount \$5,968.
- 2005 “Minnesota Worm Watch: educational tools and training for non-formal educators in exotic earthworm invasion.” National Science Foundation, 2 year award amount \$74,982.
- 2003 Development of monitoring protocols to assess impacts of European earthworm invasions. Cooperative Ecosystems Studies Unit, Voyageurs and Pictured Rocks National Parks, 2 year award amount \$ 64, 597

**Relevant Publications:**

- Hale, CM. 2008. Evidence for Human-Mediated Dispersal of Exotic Earthworms: support for exploring strategies to limit further spread. *Molecular Ecology Perspectives* **17**: 1165-1169.
- Hale, C.M. 2007. *Earthworms of the Great Lakes Region*. Kollath & Stensaas Publishing. 36 pages.
- Hale, C. M., L.E. Frelich, P.B. Reich and J Pastor. 2007. Exotic earthworm effects on hardwood forest floor, nutrient availability and native plants: a mesocosm study. *Oecologia* **155**: 509-518.
- Hale, C. M., L. E. Frelich, P. B. Reich. 2006. Changes in cold-temperate hardwood forest understory plant communities in response to invasion by European earthworms. *Ecology* **87(7)**: 1637-1649.
- Hale, C. M., L. E. Frelich, P. B. Reich and J. Pastor. 2005. Effects of European earthworm invasion on soil characteristics in northern hardwood forests of Minnesota, U.S.A. *Ecosystems* **8(8)**: 911-927.
- Hale, CM and GE Host. 2005. Assessing the impacts of European earthworm invasions in beech-maple hardwood and aspen-fir boreal forests of the western Great Lakes region. National Park Service Great Lakes Inventory and Monitoring Network Report **GLKN/2005/11**.
- Hale, C. M., L. E. Frelich, P. B. Reich. 2005. Exotic European earthworm invasion dynamics in northern hardwood forests of Minnesota, U.S.A. *Ecological Applications* **15(3)**: 848-860.