

**Environment and Natural Resources Trust Fund
2017 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 107-D

Implementing Biological Control of Garlic Mustard

Category: D. Aquatic and Terrestrial Invasive Species

Total Project Budget: \$ 421,987

Proposed Project Time Period for the Funding Requested: 3 years, July 2017 - June 2020

Summary:

Gain approval and implement release of a crown-mining weevil for biological control of garlic mustard in Minnesota; complete testing of a seed-feeding weevil for additional control of garlic mustard.

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Sponsoring Organization: U of MN

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Image of biological control insects for garlic mustard biocontrol and garlic mustard distribution in Minnesota.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____ %



PROJECT TITLE: Implementing Biological Control of Garlic Mustard

I. PROJECT STATEMENT

Federal regulatory reviews to release the crown-mining weevil *Ceutorhynchus scrobicollis*, considered most damaging to garlic mustard, will be completed and if approved release will occur in late 2019 or 2020. Biological control of garlic mustard will provide long-term, sustainable, affordable management of this non-native invasive plant that threatens native plant communities, limits regeneration of our woodlands, and degrades wildlife habitat in forest and riparian zones in Minnesota. To achieve this, we will 1.) complete APHIS-PPQ documentation and reviews towards approval to release *C. scrobicollis*; 2.) complete host-range testing of the seed-feeding weevil, *C. constrictus* as the second priority garlic mustard biological control insect and petition USDA APHIS for release; 3.) characterize environmental variables critical to *C. scrobicollis* and *C. constrictus* to improve establishment success and spread when released; and 4.) monitor landscape-scale population dynamics of garlic mustard and non-target natives to determine impacts of release of these biocontrol agents. We anticipate release of the second priority insect, *C. constrictus* would occur in future funding cycles due to the length of navigating the regulatory process. The garlic mustard biological control program was initiated in 1998, and has been funded since 2003 by LCCMR and the USDA-Forest Service. This project was not selected for continued support through 2016 -2017 biennium through the new MITPPC U of M, and a follow-up grant to US Forest Service with 100% real \$ match from MITPPC was not funded. If not funded, we have no choice but to terminate the effort just as we are on the cusp of reaching the goal of achieving biological control of garlic mustard in Minnesota, and will fail to reap the benefits of past support by LCCMR.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Release the crown-boring weevil, *C. scrobicollis* for biological Control of garlic mustard in Minnesota. Budget: \$ 150,000

After scientific panel approval, biological weed biological control agents must be reviewed for compliance with the National Environmental Policy Act (NEPA) and Endangered Species Act. This process takes two to four years to complete. We will assist in writing these reviews, conduct any required tests and provide any additional information if requested by USDA-APHIS or USFWS to meet any compliance targets during this process. Once through the process, we will implement biological control of garlic mustard and establish *C. scrobicollis* in Minnesota. *C. scrobicollis* is thought to be the most impactful of the agents being considered, and is our highest priority insect.

Outcome	Completion Date
1. Release of the crown-mining weevil <i>C. scrobicollis</i> to mitigate the impacts of the destructive invasive plant, garlic mustard	June 2020

Activity 2: Complete required testing of the seed-feeding weevil, *C. constrictus* Budget: \$ 80,000

We will complete oviposition and larval development tests on federally listed Threatened and Endangered plants, their surrogate species, or representatives from newly created Brassicaceae tribes. Over 75% of the work is already completed with only approx. 30 species that remain to be tested. All studies will be completed in the BL2 containment facility on the St. Paul campus or at CABI, Delémont, Switzerland.

Outcome	Completion Date
1. Completed all specificity testing for the second priority weevil, <i>C. constrictus</i> and petitioned to APHIS for release	June, 2020

Activity 3: Determine factors that enhance effective biocontrol in Minnesota. Budget: \$ 105,000

These weevils are not currently in North America. To improve implementation of biological control of garlic mustard in Minnesota, we will determine how these weevils native to northern Germany will respond to the climate in Minnesota. We will determine the effects of climate variables such on weevil egg laying and insect life-cycles. With this data, can improve model predictions and mapping the potential range of these weevils in North



America. All experiments will be conducted under controlled conditions in the BL2 High Security Containment facility on the U of M St. Paul campus with potential for field validation for *C. scrobicollis* if released.

Outcome	Completion Date
1. Knowledge gained will improve the outcomes for biological control of garlic mustard in Minnesota.	June, 2020

Activity 4: Ensure biological control of garlic mustard is having the desired outcome. Budget: \$86,987

We need to ensure that biological control of garlic mustard with insects results in improve native profiles in Minnesota woodlands. Past LCCMR sponsored monitoring efforts provided invaluable insight on the biology of garlic mustard in Minnesota woodlands and provides the basis to accurately characterize impacts of biocontrol once insects are released. Based on findings of our past LCCMR work on monitoring that delineated the fluctuating nature of garlic mustard populations, we will reassess pre- and post-release monitoring strategies to accommodated garlic mustard population dynamics at a landscape scale. Site data of plant community species richness and abundance will be developed from the 10 historical sites and the capacity for landscape-scale analysis developed on this grant. This will involve sampling a larger area surrounding the original transect locations where possible and analyzed using ArcGIS tools. Results will ensure selecting the best release sites to enable characterizing post-release impacts, the lack thereof a persistent criticism of biological control in general.

Outcome	Completion Date
1. Upload GPS data and analyze garlic mustard population density using ArcGIS (ArcMap)	October 2018
2. Deliver a monitoring protocol that will determine impacts of insect mediated biological control of garlic mustard in Minnesota.	June 2020

III. PROJECT STRATEGY

A. Project Team/Partners

Receiving Funds: Drs. Roger Becker (PI) and Elizabeth Katovich, and Ms. Mary Marek-Spartz, U of M; Dr. Hariet Hinz and Ms. Ghislaine Cortat at CABI Delémont, Switzerland will conduct specificity testing, prepare USDA APHIS and USFWS documents in the permitting process. All have extensive experience on previous and current LCCMR sponsored studies for garlic mustard biological control.

Not Receiving Funds: Dr. Van Ripper has a long history of biocontrol collaboration, will assist in preparing reports and documentation and conduct of monitoring efforts, and is our liaison with USDA TAG. Dr. Richard Reardon, USDA-Forest Service, is a key advisor on USDA APHIS, USFWS processes to successfully release agents and will aid in navigating the federal permitting process.

B. Project Impact and Long-Term Strategy

This will begin the first biological control program for sustainable management of garlic mustard in Minnesota, and in North American forested ecosystems. This project will reduce negative impacts of garlic mustard on native woodland species, reduce long-term costs for garlic mustard control and free labor to conduct other management needs in woodlands and parks, and remove one of the impediments preventing regeneration of species such as oak in our Minnesota woodlands. Development and implementation of a biocontrol program is a long-term commitment, and the majority of the costs have been incurred upfront to get to this point. We anticipate up to 80% control of garlic mustard with the crown-mining weevil, *C. scrobicollis*. Most of the testing required for *C. constrictus*, the insect estimated to provide the remaining 20% control of garlic mustard, has been completed. Following the work to gain approval for *C. scrobicollis*, we are in the final phase of submitting for approval to release the second insect *C. constrictus*. We feel that if these two weevils are released, we will have all the tools needed to control garlic mustard in Minnesota.

C. Timeline Requirements. This project will run for three years from July 1, 2017 to June 30, 2020.

2017 Detailed Project Budget

Project Title: Implementation of Biological Control of Garlic Mustard

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel:	
Salary - Civil Service Bargaining Unit. Project Scientist(s) total FTE @ approx.1 .25 FTE/yr + 27.4% fringe to conduct the research. 3.75 FTE total for 3 years of funding.	\$295,336
Salary - Undergrad Student. Student Labor approx. 8.75 wks/yr to assist Scientists. 0% fringe. 0.17 student FTE, 0.50 FTE total for 3 years of funding.	\$29,858
Total Salary and Fringe	\$325,194
Contracts:	N/A
Equipment/Tools/Supplies: Temperature probes, field supplies: flags, netting, stakes, pots, potting medium, cages, insect purchases, etc.	\$941
Acquisition (Fee Title or Permanent Easements):	N/A
Travel: Travel to monitoring site research plots @ \$0.54/ mile, 10 sites twice a year for first two years with increase to possible 15 sites in year 3 if releasing <i>C. scrobicollis</i> at an avg. 100 miles per site trip to monitor possible release sites pre-release and facilitate release of insects in year 3 if approved. \$750 or to present or report findings at professional meetings, and may need to attend, present, discuss findings at an APHIS Technical Advisory Group mtg. in suburban Washington, D.C.. est. \$1500 travel.	\$5,692
Additional Budget Items:	
General Operating Services: Watering charges and other service charges for greenhouse and field space (\$600/yr). Costs for insect APHIS permitted shipment (5 shipments at \$1500/per shipment) from CABI Delémont Switzerland. 2 <i>scrobicollis</i> and 3 <i>constrictus</i> over course of the grant. \$300 ArcGIS annual license. Together, plus \$300 incidentals is \$3700/yr.	\$11,436
Short Term Rents & Lease: Greenhouse, biosecurity BSL 2 containment facility and field space rental fees an est. \$1200 per month. Yr 3 decreases to \$667 per month as <i>C. scrobicollis</i> need for quarantine	\$32,360
Professional/Technical/Service Contracts:: \$15,000 per year for CABI, Delémont, Switzerland to conduct specificity testing we can not do in a quarantine facility such as choice tests outdoors, travel and labor to collect insects for shipment to quarantine in Minnesota. CABI has conducts work that can not be conducted in Minnesota as we must be in a quarantine facility. CABI at Delémont has been involved from the beginning of this project and are capable, knowledgeable, experienced in biological control of garlic mustard.	\$46,364
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$421,987

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ To Be Applied To Project During Project Period: No other grants will be available to cover costs on this effort	N/A	
Other State \$ To Be Applied To Project During Project Period:	N/A	
In-kind Services To Be Applied To Project During Project Period: University indirect costs not paid by the state at 52% = \$220,924. PI is not receiving any salary funding and is contributing 5% of time = \$22,455 paid for form state Experiment Station and Extension funds and federal CSREES Extension funds.	\$ 243,379	Secured
Funding History: This grant begins the final phase of this effort, implementation of biological control of garlic mustard. Previous funding to conduct required testing to be able to get to this point has totaled approx. \$614,645 from LCCMR and US Forest Service Funding \$614,680 - or approx. \$47,400 LCCMR funding per year since 2003. These values are somewhat confounded by common buckthorn work and monitoring of garlic mustard on the biology of the pest, but overall gives an estimate of the support to date.	N/A	
Remaining \$ From Current ENRTF Appropriation: Current LCCMR funding via MnDNR for Biological Control of Garlic Mustard \$140,000 ending June 30 2016. US Forest Service final FY16 amount of \$12,204 of three year grant of \$84,000 will also be spent by June 2016.	N/A	

Implementation of Biological Control of Garlic Mustard

Roger Becker
University of Minnesota



Wide-spread invasive in Minnesota

- Threatens native plant communities
- Limits regeneration of woodlands
- Degrades wildlife habitat
- Consumes resources to manage annually
- Is a Minnesota Restricted Noxious Weed

Garlic Mustard Has Invaded Much of Minnesota's Deciduous Forests and Oak Savannahs



garlic mustard (*Alliaria petiolata*)



Map generated on Jan 24, 2016

EDD MapS
Erik Strommen & Distribution Mapping System



Two European Insect Offer Biocontrol

- Crown-mining weevil *Ceutorhynchus scrobicollis*
- Seed-feeding weevil *C. constrictus*



Insects control garlic mustard

- severely damage / kill crowns
- reduce seed production

Outcome – Restored Minnesota Woodlands

- Sustainable, long-term control
- Regeneration of native trees
- Recovery of desirable native herbaceous plants
- Improved ecosystem services and wildlife habitat
- Reduces costs to managers



Qualifications

Dr. Roger Becker (PI) is an Extension Agronomist – Extension State Specialist in Weed Science in the department of Agronomy and Plant Genetics at the St. Paul campus of the University of Minnesota. He will lead the research team, coordinate and be the liaison among federal regulators, MnDNR, and LCCMR. He is the federal permit holder to import the weevils into quarantine in North America. He has over 30 years of experience in weed management strategies in annual and perennial systems in disturbed and undisturbed habitats. He was instrumental in development of biological control of purple loosestrife in wetlands; exploring biological control of and managing buckthorn and garlic mustard in woodlands; and leafy spurge, and spotted knapweed in native prairies, pastures and right-of-ways. He has worked with LCCMR on garlic mustard efforts since 2003, and is currently supported through LCCMR funding to determine the specificity of biological control insects for Canada thistle to protect Minnesota's native thistles. The University of Minnesota is Minnesota's flagship, land-grant university and has the laboratory, quarantine, and field research facilities and staff to conduct the research. Dr. Becker has a joint Agricultural Experiment Station / University of Minnesota Extension appointment. Extension's mission is to provide practical education and research-based solutions, to help Minnesota's people, businesses and communities solve problems, develop skills and build a better future.

CABI Swiss Centre in Delémont, Switzerland carries out applied scientific research and undertakes consultancy projects to support CABI's work on invasive species in many different regions around the world. Personnel at CABI Delémont were the first to identify and study the insects we are testing to use for biological control of garlic mustard, and have the expertise with Dr. Harriet Hinz and Ms. Ghislaine Cortat and the lab and field facilities to conduct tests we can not conduct because of the limitations of conducting research in quarantine in the U.S. The CABI Delémont group has been involved in most of the biological control of plants programs currently in use in Minnesota. CABI, Delémont, Switzerland, is part of the Center for Agriculture and Bioscience International, a not-for-profit inter-governmental development and information organization based in the United Kingdom with over 400 staff working from more than 21 locations throughout the world, including the United States.