

ML 2015, Ch. 76. Art. 2, Sec. 6a Project Abstract

For the Period Ending June 30, 2021

Amended December 8, 2022

PROJECT TITLE: MITPPC #1: Garlic Mustard Biocontrol: Ecological Host Range of Biocontrol Agents.
Subproject-01. Start date 4/1/2017, End date 6/30/2021.
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: ML 2015, Ch. 76. Art. 2, Sec. 6a

APPROPRIATION AMOUNT: \$600,000

AMOUNT SPENT: \$600,000

AMOUNT REMAINING: \$0

Sound bite of Project Outcomes and Results

We were integral in the release of *Ceutorhynchus scrobicollis* in Canada, the first biological control agent for garlic mustard in North America. We moved closer to federal regulatory approval to release *C. scrobicollis* and *C. constrictus* in the United States. When achieved, these will offer the first viable control of garlic mustard in Minnesota woodlands.

Overall Project Outcome and Results

Garlic mustard poses significant threats to our forest ecosystem. Research supported by this grant develops effective biological control of garlic mustard in Minnesota, the United States, and Canada, offering the first viable control option for this troublesome invasive plant. We gained a recommendation that *Ceutorhynchus scrobicollis* be considered for a release in the U.S. from the APHIS PPQ Technical Advisory Group. In follow-up consultation between USDA-APHIS-PPQ and USFWS, questions were generated that were intended to expedite writing the Biological Assessment for *C. scrobicollis*. Funding from this grant enabled us to address those questions with specific research on three federally listed species. COVID-19 altered our timeline, yet we will be submitting the third edition of the response in August 2021. This funding supported Entomology PhD candidate Mary Marek-Spartz analyze predictive tools used to determine the expected range of biological control insects introduced to a new region, define specific biological thresholds of *C. scrobicollis*, and develop a novel biennial stage-structured plant-herbivore population model. She improved the accuracy of this model through data generated in our monitoring efforts funded from this grant. Also supported on this grant, Project Scientist Dr. Katovich further defined the vernalization requirements for a garlic mustard which will greatly improve the accuracy of the projected range of garlic mustard in the US, a key factor in determining the risk of introducing specific biological control insects to North America. Additionally, she completed host specificity testing for *C. scrobicollis* and made significant progress towards completing the registration package for *C. constrictus*. We have a draft of the petition for the release of *C. constrictus* for biological control of garlic mustard. Due to technical difficulties in rearing threatened and endangered species out of their normal habitats, we will complete the few species needed at CABI, Delémont CH.

Project Results Use and Dissemination Knowledge gains have been distributed widely through professional and land manager meetings. Additionally, we presented our findings to our colleagues at the triennial International Symposium on the Biological Control of Weeds, hosted in 2018 by our cooperators from CABI, CH.

Generations.py is a software program publicly available with a novel biennial component enabling modelers to improve predictions of the dynamics and biology of biennial organisms. We played a key role in the first release

of a biological control insect for garlic mustard in North America. Additionally, four to six papers will be published in professional journals. A petition for the release of *C. constrictus* will be submitted to USDA APHIS PPQ TAG this fall or early next spring.

Appendix 1. Publications, Proceedings, Bulletins etc. supported by this grant. Items in red are pending.

Refereed Journal Articles

1. Katovich EJ, Becker RL, Gerber E, Hinz HL, Cortat G, Reardon, RC. 2019. Lessons learned: rearing the crown-boring weevil, *Ceutorhynchus scrobicollis* (Coleoptera: Curculionidae), in containment for biological control of garlic mustard (*Alliaria petiolata*). J. Great Lakes Entomologist. 52 (3-4):78-93.

Non-refereed Journal Articles, Essays, or Book Chapters

1. Becker RL, ES Katovich, H Hinz, G Cortat, L Van Riper, and M Marek-Spartz. Response to USFSW re: An APHIS authored document derived from "A Petition for the Introduction, Experimental Release and Open-Field Release of the Root-Mining Weevil *Ceutorhynchus scrobicollis* (Coleoptera: Curculionidae) for the Biological Control of *Alliaria petiolata* (Garlic Mustard) in North America." Updated February 7 2020 informed by *Streptanthus glandulosus* subsp. *niger* work since the response submitted in August 2018, 16 pp. **Updated informed by *Streptanthus glandulosus* subsp. *niger* work and resubmitted Feb. 7, 2020, 56 pp. Updated after consultation with APHIS PPQ and resubmitted August XX, 2021, 62 pp.**

Proceedings of Conferences

1. Katovich, E., R. Becker, M. Marek-Spartz, G. Cortat, H. Hinz, and L. Van Riper. 2018. Biological Control of Garlic Mustard with *Ceutorhynchus scrobicollis*, an Update. Poster at the XV International Symposium on Biological Control of Weeds. Engelberg, Switzerland. Session 1-P22-Target and agent selection. Aug. 26-31, 2018.
2. Marek-Spartz, M., and K. Marek-Spartz, G. Heimpel, and R. Becker. 2018. Generations: understanding weed-herbivore interactions using Python. Poster at the XV International Symposium on Biological Control of Weeds. Engelberg, Switzerland. Session 4-P13-Novel methods to determine efficacy and environmental safety of agents. Aug. 26-31, 2018.
3. Becker, R., L. Van Riper, R. Montgomery, L. Knosalla, M. Marek-Spartz, J. Katovich, and B. Kinkaid. 2018. Monitoring Garlic Mustard in Minnesota - Now You See Them, Now You Don't. Presentation at the Upper Midwest Invasive Species Conference. Rochester Convention Center, Rochester MN. Oct. 15-18, 2018
4. Katovich, E, R. Becker, M. Marek-Spartz, G. Cortat, H. Hinz, and L. Van Riper. 2018. Biological Control of Garlic Mustard with *Ceutorhynchus scrobicollis*, an Update. Poster at the Upper Midwest Invasive Species Conference. Rochester Convention Center, Rochester MN. Oct. 15-18, 2018.
5. Marek-Spartz, M., G. Heimpel, R. Becker, and K. Marek-Spartz. 2018. Generations: Understanding Weed-Herbivore Interactions Using Python. Poster at the Upper Midwest Invasive Species Conference. Rochester Convention Center, Rochester MN. Oct. 15-18, 2018.
6. Becker, R., L. Van Riper, R. Montgomery, L. Knosalla, M. Marek-Spartz, J. Katovich, and B. Kinkaid. 2018. Monitoring Garlic Mustard in Minnesota - Now You See Them, Now You Don't. Presentation. North Central Weed Science Soc. Hyatt Regency, Milwaukee, WI. Dec. 3-6, 2018. (206)
7. Katovich, E., R. Becker, M. Marek-Spartz, L. Van Riper, G. Cortat, and H. Hinz. 2018. Biological Control of Garlic Mustard: No Impact of *Ceutorhynchus scrobicollis* on Two Endangered Brassicaceae. Poster: North Central Weed Science Soc. Hyatt Regency, Milwaukee, WI. Dec. 3-6, 2018. (36)
8. Marek-Spartz, M., K. Marek-Spartz, G. Heimpel, and R. Becker. 2018. *Generations*: Understanding Weed-Herbivore Interactions using Python. Poster. North Central Weed Science Soc. Hyatt Regency, Milwaukee, WI. Dec. 3-6, 2018. (34)
9. Marek-Spartz ME, GE Heimpel, and RL Becker. 2019. Climate match of two biological control agents (*Ceutorhynchus spp.*) prioritized for release to control garlic mustard (*Alliaria petiolata*) in North America. Proc Entomological Society of America Annual Conference. St. Louis, MO. Nov. 17-20, 2019. (Poster, non-refereed).
10. Marek-Spartz ME, Becker RL, Heimpel GE. 2020. Petition Process and Risk Assessment for a Weed Biocontrol Agent of *Alliaria petiolata* in the United States. Joint North Central Branch and Southwestern Branch of ESA Meeting. Symposium title: Biological control in agroecosystems and natural areas: highlighting the work of a new generation of biocontrol scientists. (Delivered virtually due to COVID-19). (Skirvin Hilton, Oklahoma City, OK March 15-20, 2020. (Presentation).
11. Marek-Spartz ME, RL Becker, and GE Heimpel. 2019. The strange loop making parasitic insects our friends. Strange Loop 2019. Symposium title: Software in strange places. Sept. 22-24. Hyatt Union Station., St. Louis, MO. (Presentation).

12. Barth, K, R Becker, B Lockhart. 2020. Using Viruses as a Biocontrol on Garlic mustard (*Alliaria petiolata*). UROP Spring Symposium. University of Minnesota. (Poster).
13. Ghislaine Cortat, Harriet L. Hinz, Esther Gerber, Elizabeth Katovich, Roger Becker and Laura Van Riper. 2021. *Ceutorhynchus constrictus*, as a potential biocontrol agent of garlic mustard (*Alliaria petiolata*). Presentation to APHIS PPQ TAG April 20, 2021. Virtual due to CV 19.

Extension Product Development (Webcasts, Newsletters, Magazines, Mimeographs, Digital Content)

1. Marek-Spartz ME. (Heimpel and Becker Labs). 2020. Phenology of *Alliaria petiolata* (garlic mustard) and proposed biological control agents *Ceutorhynchus scrobicollis* and *Ceutorhynchus constrictus* (Curculionidae). News from the Minnesota Invasive Plant and Pests Center, November 2020. Retrieved from <<https://mailchi.mp/da2af6e93580/july2020-4582420?e=824f804246> > (Infographic Author)

Software Development

1. Marek-Spartz, ME. 2018. Generations (1.3.0) [Python package]. The Python Package Index <<https://pypi.org/project/generations/>>
2. Marek-Spartz, ME. Climate Match (1.0.0) [ShinyR Web Application]. ShinyApps.io <https://alfalimajuliett.shinyapps.io/climatematchapp/>

Undergraduate Student Activities

2019-2020 UROP student Kenzie Barth, in an undergraduate research effort: Potential of viruses as a biological control for garlic mustard (*Alliaria petiolata*)

Graduate Student Activities

Doctoral Dissertations Directed

2017- **Sept. 2021**. Mary Marek-Spartz, Ph.D. with George Heimpel, Roger Becker. Ecological host range modeling. **Expected paper from her dissertation.**

1. *Generations.py*: modeling weed-herbivore population dynamics for biological control in a biennial system.
2. Effects of temperature on *Ceutorhynchus scrobicollis* oviposition and development.
3. A potential distribution in North America for the garlic mustard seed weevil, *Ceutorhynchus constrictus*.

Project Scientist Activities

1. Vernalization Cooling Degree Requirements for Garlic Mustard (*Alliaria petiolata*) Differ by Ecotype.
2. Elizabeth Katovich, Esther Gerber, Harriet L. Hinz, Ghislaine Cortat Mary Marek-Spartz, Roger Becker. Anticipated 2022. The Sequel: host range of *Ceutorhynchus scrobicollis*, a potential biocontrol agent for garlic mustard (*Alliaria petiolata*). ISPM.
3. Knosalla, Becker, Montgomery, Van Riper, Katovich, Marek-Spartz. Anticipated 2022. The Sequel: Population Biology of Garlic Mustard (*Alliaria petiolata*) in Minnesota Hardwood Forests.
4. Cortat, G, Gerber, E. Katovich, E. J. S., Hinz, H. L. Becker, R. Biology and host range of a seed-feeding weevil, *Ceutorhynchus constrictus* for the biological control of garlic mustard.
5. ES Katovich, H Hinz, G Cortat, Becker RL, L Van Riper, and M Marek-Spartz. Anticipated Fall 2021. A Petition for the Introduction, Experimental Release and Open-Field Release of the Seed-feeding Weevil *Ceutorhynchus constrictus* (Coleoptera: Curculionidae) for the Biological Control of *Alliaria petiolata* (Garlic Mustard) in North America."
6. MIPN GM Position Paper: Garlic mustard in the Midwest: an Overview for Managers. Anticipated August 2021.
7. MN GM Position Paper: Status of garlic mustard in the Midwest. Anticipated August 2021.