



Environment and Natural Resources Trust Fund (ENRTF)

M.L. 2020 ENRTF Work Plan (Main Document)

Today's Date: January 29, 2020

Date of Next Status Update Report: November 30, 2020

Date of Work Plan Approval:

Project Completion Date: June 30, 2024

Does this submission include an amendment request? __

PROJECT TITLE: Native eastern larch beetle is decimating Minnesota's tamarack forests

Project Manager: Brian Aukema

Organization: University of Minnesota

College, Department, or Division: Department of Entomology

Mailing Address: 1980 Folwell Avenue

City, State, Zip Code: St. Paul, MN 55118

Project Manager Direct Telephone Number: (612) 624-1847

Email Address: BrianAukema@umn.edu

Web Address:

Location: The extensive tamarack coverytype of central to the northern regions of Minnesota

Total Project Budget: \$398,000

Amount Spent: \$0

Balance: \$398,000

Legal Citation: M.L. 2020, Chp. xx, Sec. xx, Subd. xx

Appropriation Language:

PROJECT STATEMENT:

Summary: Eastern larch beetle is decimating Minnesota's tamarack forests. This is unprecedented behavior for a normally benign native insect. UMN research recently determined that a proportion of insects lack the physiological "stop" switch to overwinter – instead producing a second generation of insects into each fall (!). More insects = more dead trees. This proposal focuses on devising insect management techniques and determining how bad this problem may remain in the future.

Tamarack (*Larix laricina*) is the fifth most abundant tree in Minnesota. Tamarack forests serve as habitat to several birds and mammals, including several on the DNR's list of Greatest Conservation Need, and provide critical ecosystem services such as water filtration. **A key component of Minnesota's northern wetland ecosystems, tamarack's importance is increasing with the impending loss of black ash to emerald ash borer.**

Eastern larch beetle is a native insect has killed trees over 40% of Minnesota's 1.26 million acres of tamarack forests since 2001. This insect is closely related to mountain pine beetle and has been studied for more than 100 years. Outbreaks occasionally flare after other insects weaken the trees by eating their needles. In tamarack forests across North America over the past century, outbreaks have always subsided within three or four years. Hence, **Minnesota's ongoing outbreak of 18 years and counting** – spreading across almost half of the state's remaining tamarack – is **HIGHLY unusual behavior for this insect.**

Recent (non-LCCMR) work at the University of Minnesota:

From 2012-2016, collaborative non-LCCMR research (UMN, DNR, US Forest Service) determined that **extended growing seasons are responsible for this unprecedented outbreak.** Previous research elsewhere in North America had shown that larch beetles can only reproduce once per year, because they putatively required a cold period (i.e., winter) before they become physiologically mature and reproduce in the spring. We discovered and published evidence that **a proportion of insects in Minnesota can reproduce without a required cold phase (!).** As such, we believe that **the outbreak in Minnesota is occurring because a proportion of insects can develop a second generation each summer/fall as a consequence of slowly expanding growing seasons.**

Critical Need:

Because the insect has rarely been a problem historically, **there is a paucity of management information for eastern larch beetle.** In Minnesota, it remains critical to develop a better understanding of the insect for management plans (sampling, natural enemies, etc.

- Activity 1: Characterize natural enemy complex, including what lures work best to attract them (e.g., foundational knowledge for biological control)
- Activity 2: Determine what proportion of the insects can reproduce without overwintering and what cues affect those levels. Delineating the scope of the challenge will help prioritize restoration efforts for tamarack on the landscape.

II. OVERALL PROJECT STATUS UPDATES:

First Update April 1, 2021

Second Update October 1, 2021

Third Update April 1, 2022

Fourth Update October 1, 2022

Fifth Update April 1, 2023

Sixth Update October 1, 2023

Seventh Update April 1, 2024

Final Report between project end (June 30) and August 15, 2024

III. PROJECT ACTIVITIES AND OUTCOMES:

This project is proposed for **four years** to train a PhD student & summer undergraduates, whose times are split between the two activities. The work involves extensive travel to tamarack bogs in northern part of state.

ACTIVITY 1 Title: *Characterize the natural enemies and lures to attract them*

Description: Bark beetles release airborne chemicals known as pheromones when they attack a tree in order to attract mates. The pheromone for eastern larch beetle has been discovered and is commercially available, but it is based on populations in western North America (think: different accent). The lure works well, but we hypothesize that further refinements will boost attraction (helpful for trapping pests) and/or selectively attract insects that feed on eastern larch beetle, such as checkered beetles and hister beetles. Preliminary surveys have shown that a variety of natural enemies are attracted to eastern larch beetle pheromones and could be useful in biological control, but a full survey has never been conducted.

ENRTF BUDGET: \$195,085

Outcome	Completion Date
<i>1. Create list of predators and competitors associated with eastern larch beetle</i>	<i>June 2024</i>
<i>2. Determination of optimal lure choice for trapping pest or augmenting natural enemies</i>	<i>June 2024</i>

First Update April 1, 2021

Second Update October 1, 2021

Third Update April 1, 2022

Fourth Update October 1, 2022

Fifth Update April 1, 2023

Sixth Update October 1, 2023

Seventh Update April 1, 2024

Final Report between project end (June 30) and August 15, 2024

Activity 2: *Find the temperature threshold that permits two instead of one generation each year, and determine whether the proportion of the insect population sensitive to the threshold is fixed or not*

Description: We now know that warm and/or elongated summers can result in two generations of eastern larch beetle in Minnesota instead of one. This activity will test development of the insect in the laboratory at a range of different temperatures to determine what life stage is receiving the developmental “stop sign” before winter, and elucidate whether the proportion of insects responsible for two generations each year instead of one changes through time. Once determined, we will be able to forecast the seasonal conditions under which tamarack will be under the greatest threat from this insect in the future.

ENRTF BUDGET: \$202,915

Outcome	Completion Date
<i>1. Determination of diapause conditions and life stage</i>	<i>June 2023</i>
<i>2. Determination of seasonal conditions that may trigger or maintain outbreaks</i>	<i>June 2024</i>

First Update April 1, 2021

Second Update October 1, 2021

Third Update April 1, 2022

Fourth Update October 1, 2022

Fifth Update April 1, 2023

Sixth Update October 1, 2023

Seventh Update April 1, 2024

Final Report between project end (June 30) and August 15, 2024

IV. DISSEMINATION:

Description: We will share results at workshops, field days, and conferences as opportunities arise. Based on past research in the Aukema lab, example venues might be the annual Northern Silviculture Workshop in Walker, MN; the North Central Forest Pest Workshop; the January Cloquet Forestry

Research Review, Western Forest Insect Work Conference, university seminars, or others. This work will form the basis of a graduate thesis at the University of Minnesota, and we anticipate peer-reviewed publications for the scientific literature as well by or shortly after project completion.

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the [ENRTF Acknowledgement Guidelines](#).

First Update April 1, 2021

Second Update October 1, 2021

Third Update April 1, 2022

Fourth Update October 1, 2022

Fifth Update April 1, 2023

Sixth Update October 1, 2023

Seventh Update April 1, 2024

Final Report between project end (June 30) and August 15, 2024

V. ADDITIONAL BUDGET INFORMATION:

A. Personnel and Capital Expenditures

Explanation of Capital Expenditures Greater Than \$5,000: We will purchase two environmental chambers (\$25K) to accomplish the objectives in Activity 2. These capital assets will be used to hold forest insects for research purposes throughout their useful life. They will not be sold. This purchase restores the lab's research capacity to accomplish the objectives of this grant after other chambers reached the ends of their useful lives on previous LCCMR projects rearing biological control agents against emerald ash borer.

Explanation of Use of Classified Staff: N/A

Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:

Enter Total Estimated Personnel Hours for entire duration of project: 11,245	Divide total personnel hours by 2,080 hours in 1 yr = 5.4
--	---

Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

Enter Total Estimated Contract Personnel Hours for entire duration of project:	Divide total contract hours by 2,080 hours in 1 yr = TOTAL FTE:
--	---

VI. PROJECT PARTNERS:

A. Partners outside of project manager's organization receiving ENRTF funding: None.

- B. Partners outside of project manager's organization NOT receiving ENRTF funding: Minnesota DNR Forest Health Team (logistical support)

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

LCCMR has not invested in a project on eastern larch beetle before this project. Past non-LCCMR research on eastern larch beetle was supported by a UMN McKnight Professorship award to Dr. Aukema (\$142K; 2011-2013) and a US Forest Service Evaluation Monitoring grant (\$176K; 2011-2016). Dr. Aukema is currently conducting complementary, ongoing work on tamarack in Minnesota on the failure of biological control in the resurgence of an invasive needle-feeding moth, larch casebearer (US Forest Service \$101K; 2016-2020), and has secured an additional \$50K from USDA McIntire Stennis (2018-2023) to complement these two projects.

VIII. REPORTING REQUIREMENTS:

- Project status update reports will be submitted April 1 and October 1 each year of the project
- A final report and associated products will be submitted between June 30 and August 15, 2024

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

A. Budget Spreadsheet

B. Visual Component or Map

C. Parcel List Spreadsheet

D. Acquisition, Easements, and Restoration Requirements

E. Research Addendum

Attachment A: Project Budget Spreadsheet
 Environment and Natural Resources Trust Fund
 M.L. 2020 Budget Spreadsheet



Legal Citation:

Project Manager: Brian Aukema

Project Title: Native eastern larch beetle is decimating Minnesota's tamarack forests

Organization: University of Minnesota

Project Budget: \$398,000

Project Length and Completion Date: 4 years, July 1 2020 - June 20 2024

Today's Date: January 29, 2020

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	\$ 300,690	\$ -	\$ 300,690
Graduate student for 4 years \$181,680 (\$28K salary/year includes 16.1% fringe, plus tuition starting at \$17.5K/year indexed 3% each year x 3 years and reduced to \$10K in 4th year)			
Undergraduate summer research help \$67,395 (two students in years 1-3, one student in year 4; summer salary for each student is \$8,960 indexed at 3%/year; budgeting 8.2% benefits for one of the undergraduate students in years 1-3 at UMN charges fringe for recent graduates or undergraduates attending non-UMN schools such as Hamline, Macalester, or Bethel)			
Partial faculty summer salary \$38,605 over four years + 33.7% fringe \$13,010			
Professional/Technical/Service Contracts			
	\$ -	\$ -	\$ -
Equipment/Tools/Supplies			
\$1,905 each of four years for research supplies such as funnel trap repair, pheromone lures for bating traps, twine, and miscellaneous gear. Requesting permission for a desktop computer \$1300 for graduate student to store data, conduct analyses, and write results over life of project	\$ 8,920	\$ -	\$ 8,920
Capital Expenditures Over \$5,000			
Requesting permission for two rearing chambers for lab assays in Activity 2. We currently have 5 old chambers; one wore out on previous LCCMR work (rearing biological control agents for EAB) and has been repaired without success and the other similarly needs replacement soon. Replacement chambers will last beyond life of project, but will continue to be used for forest insect work of benefit to the state (such as EAB).	\$ 25,000	\$ -	\$ 25,000
Fee Title Acquisition			
	\$ -	\$ -	\$ -
Easement Acquisition			
	\$ -	\$ -	\$ -
Professional Services for Acquisition			
	\$ -	\$ -	\$ -
Printing			
\$100 each of four years	\$ 400	\$ -	\$ 400
Travel expenses in Minnesota			
Estimates are based on previous (non-LCCMR) project and work in northern part of the state (Baudette area). Travel estimated at \$19,100 each of first three years: (6 mo. Fleet truck rental \$850, 1K miles at 40c/mile x 20 sampling trips to capture seasonal flight of natural enemies, 4 hotel nights x 2 people at \$100/night each month = \$17,900 + special request of \$1200 / year to share results/ receive advice at forest insect conference, which may be out of state (most experts are in other places with tamarack such as western North America and Canada). Travel reduced to \$5690 in final year. Request permission to reduce travel costs as possible by using lab truck when available.	\$ 62,990	\$ -	\$ 62,990
Other			
	\$ -	\$ -	\$ -
COLUMN TOTAL	\$ 398,000	\$ -	\$ 398,000

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		\$ -	\$ -	\$ -
State:		\$ -	\$ -	\$ -
In kind: The project lead has received a federal USDA McIntire-Stennis award of \$50K (2018-2023) to work in tamarack forests investigating links between mortality due to eastern larch beetle and feeding behavior of an invasive moth, larch casebearer. Investigating the resurgence of that moth (and apparent unexpected failure in biological control) is the subject of a separate (non-LCCMR) award (US Forest Service, \$101K, 2016-2020). For the proposed work, the DNR Forest Health Team will continue to provide logistical support (e.g., aerial survey maps and interpretation).	Secured	\$ 25,000	\$ -	\$ 25,000
Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		\$ -	\$ -	\$ -

Project 219-F

Eastern Larch

A NATIVE BARK BEETLE



Tamaracks in Trouble

Tamarack is the 5th most abundant tree in Minnesota (8% of forest land, or 1.4M acres). Eastern larch beetle has affected 535K acres (40% of resource) since an outbreak began in 2001

Project Lead: Dr. Brian Aukema
(Forest Insect Lab, University of Minnesota)

Activity 1: Characterize natural enemy complex

Activity 2: Determine what proportion of insects can reproduce without overwintering (i.e., future population trajectory)

