

**Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 219-F

Native Eastern Larch Beetle is Decimating Minnesotas Tamarack Forests

Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Sub-Category:

Total Project Budget: \$ 398,180

Proposed Project Time Period for the Funding Requested: June 30, 2024 (4 yrs)

Summary:

Eastern larch beetle, native to Minnesota, is suddenly decimating Minnesota's tamarack forests. This proposal develops insect management techniques and determines how bad this problem may remain in the future.

Name: Brian Aukema

Sponsoring Organization: U of MN

Job Title: Faculty member

Department: Department of Entomology

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Location:

Region: Central, Metro, Northwest, Northeast

County Name: Aitkin, Anoka, Becker, Beltrami, Benton, Carlton, Cass, Chisago, Clearwater, Cook, Crow Wing, Dakota, Douglas, Hennepin, Hubbard, Isanti, Itasca, Kanabec, Kittson, Koochiching, Lake, Lake of the Woods, Mahnomen, Marshall, Meeker, Mille Lacs, Morrison, Ott

City / Township:

Alternate Text for Visual:

Picture shows insets of eastern larch beetles over aerial photos of larch beetle-damaged tamarack forests.

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



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

I. 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.

Please note: *This proposal ranked #2 in section F in the last competition. While we appreciated the strong support, the work was not funded with encouragement to apply to MITPPC. MITPPC has clarified that it cannot fund work on native insects, so this proposal is returned to LCCMR for renewed consideration.*

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. 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: 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: \$195,300

Outcome	Completion Date
1. List of predators and competitors associated with eastern larch beetle	June 2024
2. Determination of optimal lure choice for trapping pest or augmenting natural enemies	June 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: \$202,880

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

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding - Brian Aukema, Associate Professor, Univ. of Minnesota (project lead)

B. Partners NOT receiving ENRTF funding - Minnesota DNR Forest Health Team (logistical support)

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

LCCMR has not invested in a project on eastern larch beetle to date. 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.

V. TIME LINE REQUIREMENTS:

We are proposing **four years** of support for a PhD student to work on this project (7/1/20-6/30/24). [Aside: we have a strong track record of successful student training. The PhD graduate on previous non-LCCMR work on eastern larch beetle, Dr. Fraser McKee, was hired in Canada to monitor and slow the spread of mountain pine beetle].

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: \$398,180

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

Today's Date: April 10, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	\$ 300,490	\$ -	\$ 300,490
PhD student for 4 years \$180,539 (\$28K salary/year includes 16.1% fringe, tuition starting at \$17.5K/year indexed 3% each year x 3 years and reduced to \$10K in 4th year)			
Undergraduate summer research help \$67,450 (two students in years 1-3, one student in year 4; summer salary \$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 + 36% fringe			
Professional/Technical/Service Contracts			
	\$ -	\$ -	\$ -
Equipment/Tools/Supplies			
\$2,000 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	\$ 9,300	\$ -	\$ 9,300
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	\$ 398,180	\$ -	\$ 398,180

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
		\$ -	\$ -	\$ -

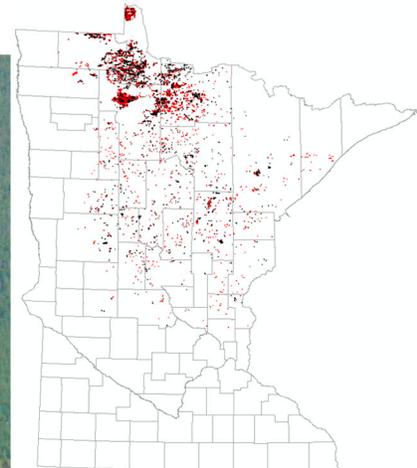
Eastern Larch Beetle

A NATIVE BARK BEETLE



Tamaracks in Trouble

Eastern larch beetle has devastated
115,144 acres (180 sq. miles) of mature forests
since outbreak began in 2001



Project Director Qualifications and Organization Description

Dr. Brian Aukema directs the Forest Insect Laboratory in the Department of Entomology at the University of Minnesota. The University of Minnesota-Twin Cities, founded in 1951, is the largest campus within the University of Minnesota system with an enrolment of just over 50,000 students.

Prof. Aukema and his students work on both native and invasive species threatening the state of Minnesota and region (e.g., mountain pine beetle on pines, emerald ash borer on ash, gypsy moth on oak and aspen, thousand cankers disease on walnut, eastern larch beetle and larch casebearer on tamarack, and more).

Students he has taught can be found in a wide variety of resource professional positions, from city arborists to industry to state and federal government. For example, the most recent PhD student graduate from a prior (non-LCCMR) eastern larch beetle project, Dr. Fraser McKee, is now working to delineate and manage the mountain pine beetle threat in Canada.

Prof. Aukema joined the Department of Entomology as their Forest Insect specialist in the fall of 2010. Prior to this, he was a research scientist for five years with the government of Canada responsible for a program managing large-area insect outbreaks.

Prof. Aukema has successfully administered more than \$2 million in research project funding from a wide variety of state, federal and industrial sources in his career. He has received early career awards for Creativity and Innovation (Government of Canada) and a McKnight Land-Grant award from the University of Minnesota.