

Environment and Natural Resources Trust Fund 2019 Request for Proposals (RFP)

Project Title:**ENRTF ID: 199-F**

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: \$** 382,000**Proposed Project Time Period for the Funding Requested:** June 30, 2023 (4 yrs)**Summary:**

Eastern larch beetle is decimating Minnesota's tamarack forests. This proposal focuses on devising insect management techniques and determining how bad this problem may remain in the future.

Name: Brian Aukema**Sponsoring Organization:** U of MN**Title:** Faculty member**Department:** Department of Entomology**Address:** 1980 Folwell Avenue

St. Paul MN 55108

Telephone Number: (612) 624-1847**Email** BrianAukema@umn.edu**Web Address****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, Mahnommen, 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.

<input type="checkbox"/>	Funding Priorities	<input type="checkbox"/>	Multiple Benefits	<input type="checkbox"/>	Outcomes	<input type="checkbox"/>	Knowledge Base
<input type="checkbox"/>	Extent of Impact	<input type="checkbox"/>	Innovation	<input type="checkbox"/>	Scientific/Tech Basis	<input type="checkbox"/>	Urgency
<input type="checkbox"/>	Capacity	<input type="checkbox"/>	Readiness	<input type="checkbox"/>	Leverage	<input type="checkbox"/>	TOTAL <input type="checkbox"/> %
<input type="checkbox"/> If under \$200,000, waive presentation?							



PROJECT TITLE: Tamarack in trouble: diagnosing the insect behind the outbreak

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.

Tamarack (*Larix laricina*) is the fifth most abundant tree in Minnesota, with almost 750 million trees over one inch in diameter. A critical component of Minnesota's northwoods, 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.**

The problem of eastern larch beetle

This native insect has killed trees over 35% of Minnesota's 1.26 million acres of tamarack forests since 2001. Eastern larch beetle 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 17 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 is now critical to develop:

- 1) Better understanding of the insect for management plans (sampling, natural enemies, etc.) [*this proposal*]
 - 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.
- 2) Mitigation and restoration responses to larch beetle-damaged forests [*complementary DNR proposal*]

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.



Environment and Natural Resources Trust Fund (ENRTF)
2019 Main Proposal Template

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: \$189,700

Outcome	Completion Date
1. List of predators and competitors associated with eastern larch beetle	June 2023
2. Determination of optimal lure choice for trapping pest or augmenting natural enemies	June 2023

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: \$192,300

Outcome	Completion Date
1. Determination of diapause conditions and life stage	June 2022
2. Determination of seasonal conditions that may trigger or maintain outbreaks	June 2023

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role
Brian Aukema	Associate Professor	University of Minnesota	Project Lead

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
Forest Health Team		DNR	Logistical support

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

This is the first request for LCCMR investment on eastern larch beetle. 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 (2018-2023) to complement these two projects.

2019 Proposal Budget Spreadsheet

Project Title: Tamarack in trouble: diagnosing the insect behind the outbreak

IV. TOTAL ENRTF REQUEST BUDGET 4 years July 1 2019 - June 30 2023

BUDGET ITEM (See "Guidance on Allowable Expenses")	AMOUNT
Personnel: PhD student for 4 years \$181,681 (\$28K salary/year includes 17% 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 \$60,717 (one in yr 1, two in yrs 2 and 3; one in yr 4; summer salary \$8960 indexed at 3%/yr; budgeting 8% benefits for one of the students in years two and three as UMN charges fringe for recent graduates or undergrads attending non-UMN schools such as Macalester or Bethel); partial faculty summer salary \$37,331 over four yrs + 33.7% fringe.	\$ 289,310
Professional/Technical/Service Contracts:	\$ -
Equipment/Tools/Supplies: \$2,000 each of four years for research supplies such as funnel trap repair, chemicals for baiting traps, twine, and miscellaneous gear. Requesting two permissions: 1) desktop computer \$1300 for graduate student to store data, conduct analyses, write results over life of project 2) two rearing chambers for lab assays in Activity 2 \$20,000. 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).	\$ 29,300
Acquisition (Fee Title or Permanent Easements):	\$ -
Travel: 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 + \$1200 / yr 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
Additional Budget Items: Printing charges \$400 (\$100x4 yr)	\$ 400
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 382,000

V. OTHER FUNDS (This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ To Be Applied To Project During Project Period: 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: The project lead has received a federal USDA award of \$50K (2018-2023) to work in tamarack forests investigating potential 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).	\$ 25,000	ongoing
Past and Current ENRTF Appropriation: N/A	\$ -	
Other Funding History: UMN McKnight Professorship funds to project leader (\$142K, 2011-2013) started work on eastern larch beetle, continued by US Forest Service (\$176K, 2011-2016).	\$ 318,000	spent

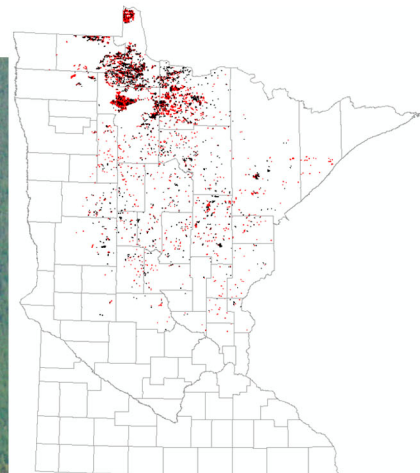
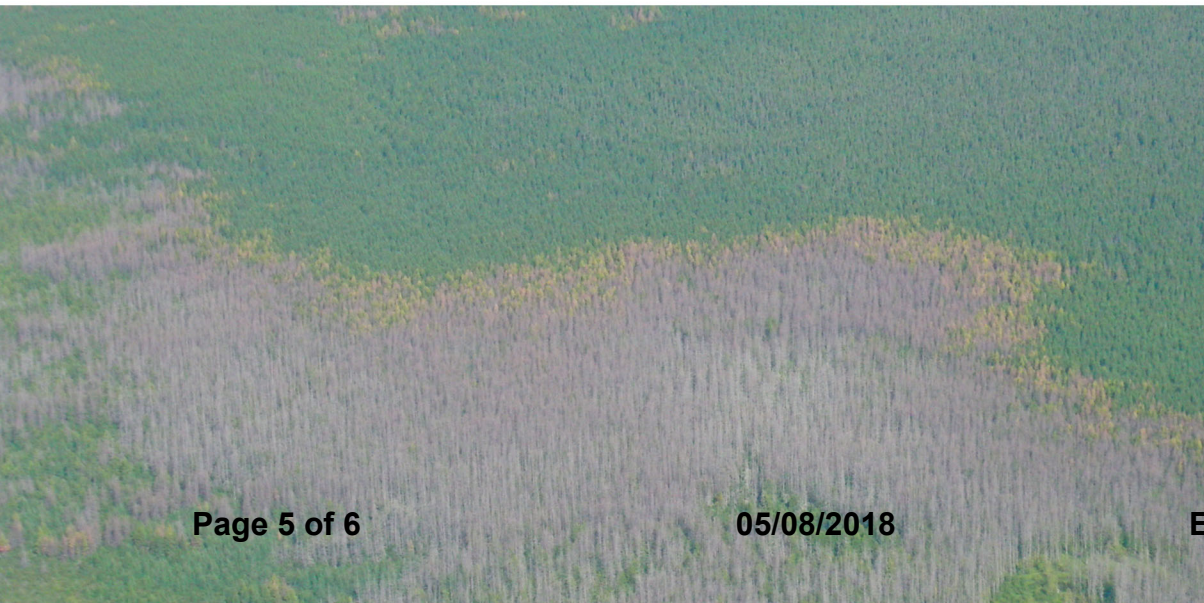
Eastern Larch Beetle

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

Dr. Brian Aukema directs the Forest Insect Laboratory in the Department of Entomology at the University of Minnesota. 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, 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.