**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 insectis 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

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| **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

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| **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].