Environment and Natural Resources Trust Fund

M.L. 2020 Approved Work Plan

General Information

ID Number: 2020-047

Staff Lead: Corrie Layfield

Date this document submitted to LCCMR: August 13, 2021

Project Title: Native Eastern Larch Beetle Decimating Minnesota's Tamarack Forests

Project Budget: $398,000

Project Manager Information

Name: Brian Aukema

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

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Project Reporting

Date Work Plan Approved by LCCMR: August 13, 2021

Reporting Schedule: April 1 / October 1 of each year.

Project Completion: June 30, 2025

Final Report Due Date: August 14, 2025

Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 08f

Appropriation Language: $398,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to understand conditions triggering eastern larch beetle outbreaks and develop management techniques to protect tamarack forests from this native insect. This appropriation is available until June 30, 2025, by which time the project must be completed and final products delivered.

Appropriation End Date: June 30, 2025

Narrative

Project 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.

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

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.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

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.

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.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

Delineating the scope of the challenge will help understand management options and prioritize restoration efforts for tamarack on the landscape. For example, the US Forest Service publishes FIDL (Forest Insect and Disease Leaflet) guides for various insect challenges nationally. Currently, in the eastern larch beetle FIDL handbook, there is no section on management other than a note that management has not been required historically. This project will give us options to present to foresters and other natural resource managers throughout the upper Midwest.

Project Location

What is the best scale for describing where your work will take place?

Region(s): NE, NW, Central,

What is the best scale to describe the area impacted by your work?

Region(s): Central, NW, NE,

When will the work impact occur?

During the Project and In the Future

Activities and Milestones

Activity 1: Characterize the natural enemies and lures to attract them

Activity Budget: $194,630

Activity 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.

Activity Milestones:

Description	Completion Date
Identification of accessible field sites with active populations	June 30, 2022
Characterization of tree volatile chemicals as part of lure	September 30, 2022
List of predators and competitors associated with eastern larch beetle	June 30, 2025
Determination of optimal lure choice for trapping pest or augmenting natural enemies	June 30, 2025

Activity 2: Find the temperature threshold that governs generational development

Activity Budget: $203,370

Activity 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.

Activity Milestones:

Description	Completion Date
Determination of diapause conditions and life stage	June 30, 2024
Determination of seasonal conditions that may trigger or maintain outbreaks	June 30, 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Forest Health Team	MN Department of Natural Resources	Field and logistical support	No
Dr. Brian Sullivan	US Forest Service	International expert who will help with pheromone identification	No

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.
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, Entomological Society of America, IUFRO, 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. We will also send out notable achievements on social media. We will acknowledge the support of the ENRTF in all dissemination efforts.

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this be funded?
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.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Biosurveillance and Biocontrol of Emerald Ash Borer - Phase 2	M.L. 2014, Chp. 226, Sec. 2, Subd. 04d	$447,000
Mountain Pine Beetle Invasive Threat to Minnesota's Pines	M.L. 2014, Chp. 226, Sec. 2, Subd. 04e1	$175,000
MITPPC #2: Mountain Pine Beetle, Phase II: Protecting Minnesota	M.L. 2015, Chp. 76, Sec. 2, Subd. 06a	-
MITPPC #5: Optimizing Tree Injections Against Emerald Ash Borer	M.L. 2015, Chp. 76, Sec. 2, Subd. 06a	-
MITPPC #9: Dispersal Characteristics of Gypsy Moth Larvae to Improve the Effectiveness of Quarantines	M.L. 2015, Chp. 76, Sec. 2, Subd. 06a	-
Emerald Ash Borer Biocontrol - Phase III	M.L. 2017, Chp. 96, Sec. 2, Subd. 06b	$729,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Graduate student		Conduct research work in Activities 1 and 2			19.9%	2		$183,793
Faculty summer support		Advise and mentor research conducted by graduate student			36.5%	0.6		$54,367
Undergraduate		Undergraduate student worker during summers			0%	1		$37,485
Temporary student worker (recent university grad)		Summer research help			8%	0.75		$29,910
							Sub Total	**$305,555**
Contracts and Services								
							Sub Total	**-**
Equipment, Tools, and Supplies								
	Tools and Supplies	$1,905 each of four years for research supplies such as funnel trap repair, pheromone lures for baiting traps, twine, and miscellaneous gear	Lindgren funnel traps specialized to catch larch beetles, pheromones attract them to traps, twine is used for period repairs (vs. buying new trap at $80 each) and hanging traps					$7,620
	Equipment	Computer	Data collection, storage, analysis, and writing over life of project (4 years)	X				$1,300
							Sub Total	**$8,920**
Capital Expenditures								
		Insect rearing chambers (2)	Hold insects at constant temperatures for proposed research work	X				$25,000
							Sub Total	**$25,000**

Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Spread over 48 months life of project, primarily in summers; total of 13 months x fleet truck rental $1250/mo (ins/admin/park), 48 sampling trips x 1000 miles @ 40c/mile, 4 hotel nights x 2 people @ $125/night x 13 months	Trips for sampling eastern larch beetle and natural enemy complex, testing pheromone responses. Travel estimates derived from previous projects on larch beetle in northern Minnesota.					$47,150
							Sub Total	**$47,150**
Travel Outside Minnesota								
	Conference Registration Miles/ Meals/ Lodging	Estimate for four day conference (1/yr): $500 travel, $500 hotel, $200 food, $200 registration (student rate). Cost may be reduced by competitive student travel grants	Annual conference or workshop(s) to disseminate project results & confer with other experts	X				$5,600
	Other	Trip to Pineville, LA, 1 month duration. Student and project manager would drive to Pineville with tree sections and insects (2 days), student would stay for 3 weeks before driving back (2 days) while project manager rtn by air after 2 days. Est. $1250 fleet truck rental, $1000 mileage (2500 miles x 40c/mile), $1920 camp lodging next to research station (24 nights x $80), $350 per diems ($50/day; 4 travel days student, 3 project manager), $375 hotel en route ($125/night; 2 nights student, 1 night project manager), flight ($480, project manager return)	Expert Dr. Brian Sullivan recently offered a month of his time, expertise, and specialized equipment, to train the student to identify pheromone directly from eastern larch beetle.	X				$5,375
							Sub Total	**$10,975**
Printing and Publication								
	Printing	Printing of research posters (4), fact sheets (200). Approx. $100/year	Research posters for conferences, fact sheets or informational handouts for extension gatherings					$400
							Sub Total	**$400**

Other Expenses								
							Sub Total	**-**
							Grand Total	**$398,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Capital Expenditures		Insect rearing chambers (2)	**Additional Explanation :** Requesting permission for two rearing chambers for lab assays in Activities 1 and 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).
Equipment, Tools, and Supplies		Computer	Requesting permission for a desktop computer $1300 for graduate student to store data, conduct analyses, and write results over life of project (4 years)
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	Estimate for four day conference (1/yr): $500 travel, $500 hotel, $200 food, $200 registration (student rate). Cost may be reduced by competitive student travel grants	Special request of $1400/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 Outside Minnesota	Other	Trip to Pineville, LA, 1 month duration. Student and project manager would drive to Pineville with tree sections and insects (2 days), student would stay for 3 weeks before driving back (2 days) while project manager rtn by air after 2 days. Est. $1250 fleet truck rental, $1000 mileage (2500 miles x 40c/mile), $1920 camp lodging next to research station (24 nights x $80), $350 per diems ($50/day; 4 travel days student, 3 project manager), $375 hotel en route ($125/night; 2 nights student, 1 night project manager), flight ($480, project manager return)	Dr. Sullivan has offered to conduct pheromone identification and electroantennogram studies in his lab at no cost other than our expense sending the graduate student with beetles and clean tamarack for a month. We are thrilled with this unexpected opportunity as Dr. Sullivan is the expert in this field. While we have good guesses on attractive chemicals the beetles produce, this opportunity would pay for itself by eliminating the first few iterations of field experiments in initial proposal (testing best guesses) and moving to immediate identification and testing of the most behaviorally-active compounds identified by Dr. Sullivan and the student on this project.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	**-**
Non-State				
In-Kind	US Forest Service MacIntire Stennis MN17-095 "Challenges to tamarack from native and invasive insects in Minnesota"	Augmenting travel funding, publication costs, vehicle repairs	Secured	$50,000
			Non State Sub Total	**$50,000**
			Funds Total	**$50,000**

Attachments

Required Attachments

Visual Component

File: 26bb7af9-f44.pdf

Alternate Text for Visual Component

Picture of tamarack forest and eastern larch beetle...

Optional Attachments

Support Letter or Other

Title	File
LCCMR 2019 Letters of support re-loaded (DNR, SFEC)	6e15188b-788.pdf
Background check waiver	c5701ebc-36f.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

We have made two changes:

1. Updated salary & benefits rates within personnel category to current.

2. Reallocated a portion of research travel from Minnesota to travel out of state, with accompanying permission request. Activity 1 originally proposed a series of iterative field experiments to develop a "better" lure for insect monitoring. Recently, Dr. Brian Sullivan of the US Forest Service (Pineville, Louisiana) offered to conduct pheromone identification and electroantennogram studies in his lab at no cost. He is an expert in this area. We propose to seize this opportunity and bring insects and tree material to Pineville shortly after the project begins. While we have good guesses on attractive chemicals the beetles produce, this opportunity would pay for itself by eliminating the first few iterations of field experiments (testing good guesses) and permit rapid field testing of the most active compounds (i.e., “best” lure) identified by Dr. Sullivan.

Neither change affects the scope, overall budget, expected outcomes or timeline of the project.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

Yes

Do you agree travel expenses must follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I agree to the UMN Policy.

Does your project have potential for royalties, copyrights, patents, or sale of products and assets?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

Project 219-F

Eastern Larch

A NATIVE BARK BEETLE

Please note: This 2020 project was recommended for funding at $398K and is simply resubmitted pending outcome of current legislative session.

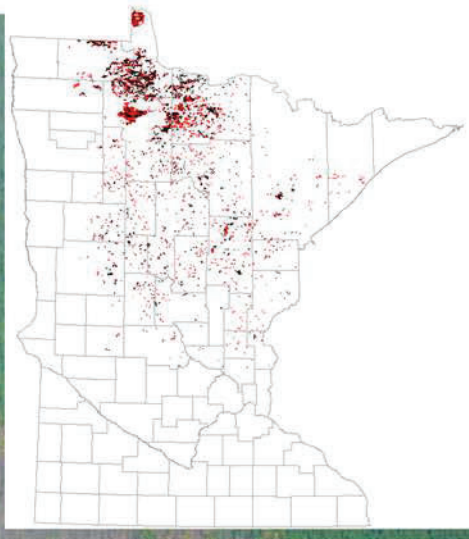
Tamaracks in Trouble

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 popultion trajectory)



Four years, $398 K