

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

Project Title:

ENRTF ID: 201-F

Sustaining One Million Acres of Minnesota Pine Forest

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

Sub-Category:

Total Project Budget: \$ 420,000

Proposed Project Time Period for the Funding Requested: June 30, 2022 (3 yrs)

Summary:

We will produce guidelines to maintain and maximize healthy and diverse pine forests with sustained growth and productivity of our state tree, the red pine, during seasonal and periodic drought.

Name: Rebecca Montgomery

Sponsoring Organization: U of MN

Title: Associate professor

Department: Forest Resources

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St. Paul MN 55108

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Email rebeccam@umn.edu

Web Address

Location

Region: Northwest, Northeast

County Name: Aitkin, Carlton, Cass, Chippewa, Cook, Hubbard, Isanti, Itasca, Koochiching, Lake of the Woods, Pine, Red Lake

City / Township:

Alternate Text for Visual:

Map of pine forest in Minnesota; image of thinned forest; image of tree rings from low and high growth years; image of shelter to reduce rainfall received by juvenile trees

<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: Sustaining One Million Acres of Minnesota Pine Forest

I. PROJECT STATEMENT

Pine forests cover nearly one million acres of forestland in Minnesota. Red pine, the state tree of Minnesota, is the most abundant species in most of these forests. Red pine forests provide many benefits.

Wildlife: Habitat for songbirds like chestnut-sided warbler and American redstart

Forest Products: The majority of softwood sawtimber (\$13 million in stumpage) and significant portion of pulpwood harvested (\$700,000 in stumpage) annually, providing valuable direct and indirect resources in Minnesota's rural forest-based economy

Biodiversity: Diverse understory herbs and shrubs as well as co-occurring northern red oak, jack and white pine, ecologically important species for maintaining healthy forests

Red pine forests are **highly susceptible to drought** because they tend to occur on well-drained sandy soils. Moderate to severe growing season droughts that reduce growth and impact health occur every 5 to 10 years in northern Minnesota. The frequency of drought is expected to increase with a changing climate. In dry years, growth declines significantly and stressed trees become more susceptible to insect and disease pests. Thus red pine forests are **highly susceptible to mountain pine beetle**, an emerging threat.

To maintain red pine forest, diversifying management of red pine is critical. Mountain pine beetles attack stressed trees and thrive in dense even aged stands. Thinning in red pine forests (harvesting some of the trees to increase the survival and growth of the trees left behind) can reduce competition for water and maintain red pine growth during periods of prolonged drought. Creating openings in the canopy can increase biodiversity, create sites for new trees to establish and thrive, and can increase resistance to beetle attacks. Diversifying management approaches in red pine will help sustain the diverse ecosystems services provided by pine forests.

Although thinning and creation of openings has potential to mitigate impacts of drought on red pine forests, the conditions where it will be effective are unclear, limiting the ability to make sustainable management decisions. In addition, we don't know the impacts on water availability during drought and its effect on the growth of juvenile trees. This project will address these unknowns, the goals are:

1. *Determine best management practices to maintain tree growth and health in more drought-prone climate.* We will use a network of sites with known histories of thinning and examining inventory records, tree rings, and modeling results that relate growth to thinning levels and seasonal weather. We will generate guidelines that maintain habitat and tree growth during more stressful growing seasons.
2. *Reduce moisture stress from drought on juvenile trees to ensure the future of red pine forests.* We will establish an experiment that reduces rainfall received by juvenile trees to assess effects on growth.

II. PROJECT ACTIVITIES AND OUTCOMES

ACTIVITY 1: Determine soil moisture and plant water status in 30 forest sites thinned to different levels.

Description: We will use existing red pine forests in northern MN that have been thinned within the last five years to create a network of 30 sites that span a range of thinning levels. Soil water dynamics will be assessed over two growing seasons using soil moisture sensors, estimates of soil physical properties, and precipitation measurements. Moisture stress of red pine and other vegetation will be measured in each forest using predawn estimates of plant water potential. Soil moisture dynamics and its influence on plant water stress will be evaluated to determine the level of thinning where impacts of drought on plant available water is minimized.

ENRTF BUDGET: \$ 161,594

Outcome	Completion Date
1. Red pine stands identified and selected to create network of 30 research sites	July 2018



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2. Measure soil moisture and tree water stress	September 2020
3. Develop thinning guidelines to mitigate negative impacts of drought	June 2021

ACTIVITY 2: *Determine red pine growth and survival in 30 thinned stands and in 60 shelters that reduce rain received by juvenile trees*

Description: We will examine past growth by measuring tree ring widths and inventory records. Growth will be related to management strategy and a drought index based on temperature and precipitation. To examine seedling response to drought, we will construct shelters that reduce rainfall to juvenile red, white and jack pine grown in thinned forest and forest openings. Results will be broadly communicated to managers through activities, such as workshops, webinars, field tours and informational pamphlets.

ENRTF BUDGET: \$ 146,953

Outcome	Completion Date
1. Analyze tree ring and inventory growth data from thinned stands	May 2020
2. Juvenile tree stress from drought assessed using 60 rainout shelters (20/species)	June 2021
3. Workshops, webinars and field tours on thinning red pine to maintain health and growth	September 2020

ACTIVITY 3: *Estimate red pine growth during drought on up to a million acres of forest*

Description: We will integrate findings from Activities 1 and 2 into a well-validated, commonly used computer model (Forest Vegetation Simulator) to simulate how red pine growth responds to different thinning levels and a range of growing season environmental conditions. Results will be summarized in public project reports and conveyed to managers through outreach activities.

ENRTF BUDGET: \$ 111,453

Outcome	Completion Date
1. Findings from forest plots incorporated into computer models and publicly available	May 2020
2. Analysis and report on growth of red pine during drought on up to a million acres of forest	March 2021

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Rebecca Montgomery, Associate Professor, University of Minnesota, overview of entire project
Marcella Windmuller-Campione, Assistant professor, University of Minnesota will lead activity 3.
Student field technicians will be hired by the USDA Forest Service to conduct field work.

B. Partners NOT receiving ENRTF funding

Rob Slesak, program manager, MN Forest Resources Council will lead activity 1.

IV. LONG-TERM- IMPLEMENTATION AND FUNDING: Field sites are maintained by cooperators such as USDA Forest Service, MN Department of Natural Resources and several MN counties.

V. TIME LINE REQUIREMENTS: The duration of the project is three years to identify sites, conduct fieldwork, analyze tree-ring data, and determine optimal management approaches that promote long-term productivity, health, sustainability and multiple uses of Minnesota's pine forests.

2018 Detailed Project Budget

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IV. TOTAL ENRTF REQUEST BUDGET 3 years

<u>BUDGET ITEM</u>	<u>AMOUNT</u>	
	Breakdown	Totals
Personnel		\$ 321,411
0.5 months of faculty summer salary and fringe (33.5%) for three years for Rebecca A. Montgomery PI and Marcella Windmuller-Campione; 0.04 FTE each	\$ 38,448	
Salary and fringe (21.4%) for a research associate for 2 years (1.0 FTE)	\$ 120,163	
Salary and fringe (45.9%) for 2 graduate students for 2 years (0.5 FTE each)	\$ 162,800	
Professional/Technical/Service Contracts: USDA Forest Service Northern Research Station contract includes: 1) funds for salary and fringe for two undergraduate summer employees for two years (\$30,000). The summer students will be employed through the USDA Forest Service because that is the most cost-effective approach and our need to have personnel dedicated to this research study who are located close to the field sites. 2) Dedicated field vehicle for 2 years (\$12,000); 3) misc. field supplies needed on site (\$3000).		\$ 45,000
Equipment/Tools/Supplies:		\$ 40,640
Soil temperature and moisture sensors (90 totalling \$14,220), dataloggers (20 totalling \$8,920), and precipitation gauges (10 totalling \$4,500)	\$ 27,640	
Forest inventory equipment (increment borers 2 @ \$250.00 each, dendrochronology suppliers (sand paper, safety equipment, tree core mounts) @ \$500)	\$ 1,000	
Rainout shelters for seedling experimental work (200/shelter * 60 shelters)	\$ 12,000	
Travel: Travel for natural resource manager workshops: 2 year * 2 workshops * 1 d * (mileage [250 mi/workshop*0.535 cents/mile*2yr * 2 workshops] + per diem [4 person * \$82 lodging + \$56 meals and incidentals* 2 year * 2 workshops]) and graduate student, PI and staff travel for field work: 12 trips/year * 300 mi/trip * 0.535/mi = 1926\$; 60d * \$56 meals and incidentals = 3360\$; 60d * \$82 lodging = \$4920		\$ 12,949
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$	420,000

V. OTHER FUNDS

<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
Other Non-State \$ To Be Applied To Project During Project Period: These are operating funds for experimental forests, thinning, gap creation and research on those in the USDA Forest Service Northern Research Station budget.	\$ 120,000	Secured
Other State \$ To Be Applied To Project During Project Period	N/A	N/A
In-kind Services To Be Applied To Project During Project Period: In-kind salaries provided by USDA Forest Service Researcher (0.3 FTE; B. Palik), USDA Forest Service technician (0.3 FTE), as well as in-kind use of Forest Service ATV and trailer, office and laboratory space (\$98,000). In-kind salaries provided by UMN Researchers (R. Montgomery, 0.04 FTE, \$15,171; M. Windmuller-Campione, 0.04 FTE, \$13,759)	\$ 148,930	Secured
Past and Current ENRTF Appropriation:	N/A	N/A
Other Funding History:	N/A	N/A

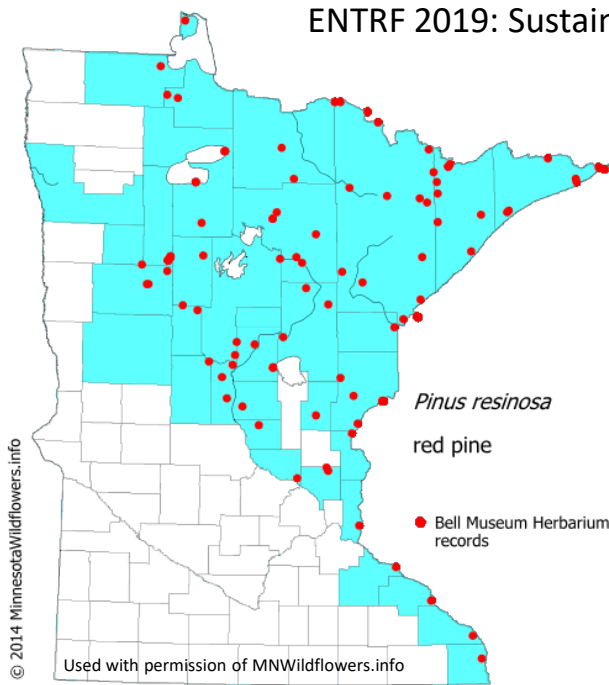


Figure 1: Range map



Figure 2: Forest thinned to increase tree growth and biodiversity

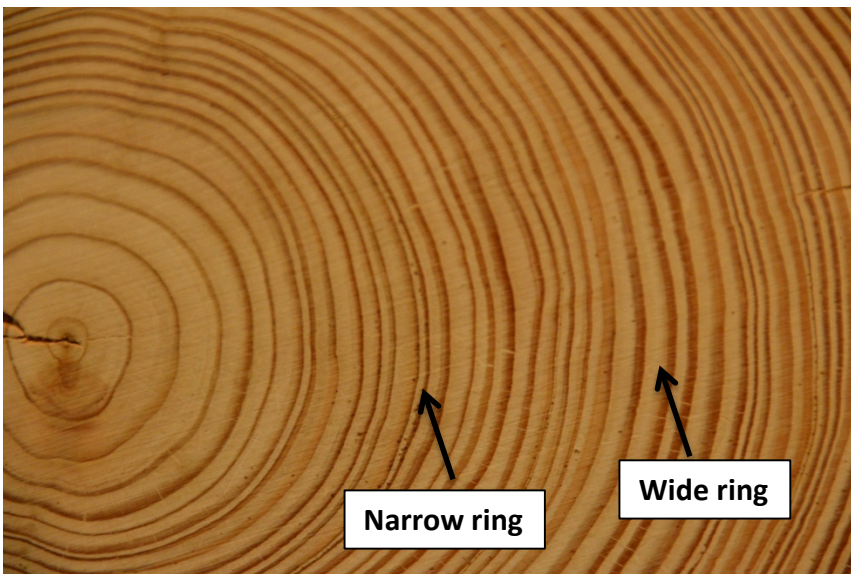
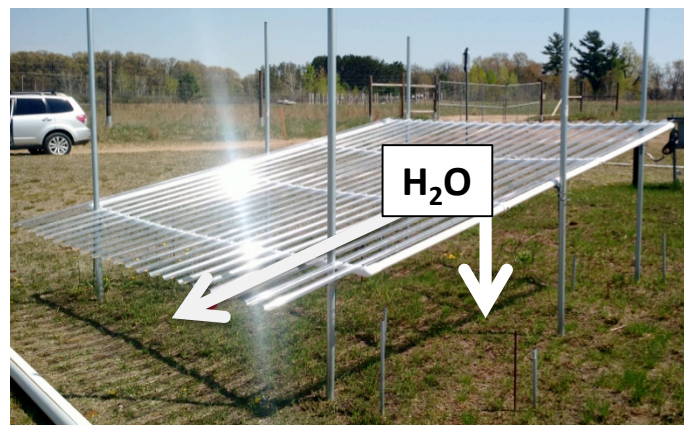


Figure 3: Tree cross section showing narrow rings (low growth, dry growing season) and wide rings (high growth, wet growing season).

Figure 4: Example of a shelter to reduce rainfall made of clear plastic slats that funnels some water off the plot and allows some through between slats.



Project Manager Qualifications and Organization Description

Project Manager: Rebecca A. Montgomery

Associate Professor, Dept. of Forest Resources, University of Minnesota, St. Paul, MN 55108.

Professional Appointments and Preparation

Associate Professor, Forest Resources, University of Minnesota, 2011-present
Assistant Professor, Forest Resources, University of Minnesota, 2004-2011
Research Associate, Forest Resources, University of Minnesota, 2003-2004
Instructor, Forest Resources, University of Minnesota, 2003-2004
Ph.D., Ecology and Evolutionary Biology, University Connecticut, 1999.
B.A., Biology, *magna cu laude*, Occidental College, 1994.

Honors, Professional Recognition and Service (Selected)

Invited speaker at regional, national and international symposia, seminars, and workshops, e.g. MN Sustainable Forest Education Cooperative, Michigan State, UW-Madison, University of Toronto, US-Japan Workshop on Photosynthetic Plasticity and Global Change. Received Richard C. Newman Art of Teaching award (2010) and College of Food, Agricultural and Natural Resources Sciences Distinguished Teaching Award (2010). I serve as chair of the Physiology Working Group of the Society of American Foresters and subject editor of *Plant Ecology*. I served on the Science Team for the Minnesota Climate Change Vulnerability Assessment and on the Falcon Heights Environment Commission.

Areas of Expertise

Plant ecophysiology, forest ecology, forest regeneration and dynamics, shrub ecology, herbivory, competition, invasive species, rare and endangered species biology. Research spans temperate and tropical forests, managed and unmanaged ecosystems.

Project Management Experience and Responsibilities for this Project

More than ten years of research experience in prairies, oak savanna, deciduous and boreal forest of Minnesota. Principal investigator or co-principal investigator on >20 research grants from National Science Foundation, Minnesota Department of Natural Resources, US Department of Energy, US National Park Service and USDA Forest Service projects. Montgomery will provide scientific leadership, supervise funded staff, mentor the graduate student and both oversee and participate in all project activities.

Peer-reviewed publications

Forty-nine publications, including articles, book chapters, and reports. Forty-four publications in the peer-reviewed literature.

Organization Description

The University of Minnesota has a strong tradition of education and public service through its role as both the state land-grant university, and the state's primary research university. The Department of Forest Resources is the leading research and educational institution on forest related issues in Minnesota. For over 100 years the department has played a key role in discovering and fostering sustainable forest resource management activities in Minnesota.