

**Environment and Natural Resources Trust Fund  
2018 Request for Proposals (RFP)**

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**Project Title:**

**ENRTF ID: 008-A**

Safeguarding Red Pine Forest Health and Productivity

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**Category:** A. Foundational Natural Resource Data and Information

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**Total Project Budget: \$** 420,000

**Proposed Project Time Period for the Funding Requested:** 3 years, July 2018 to June 2021

**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.

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**Sponsoring Organization:** U of MN

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St. Paul MN 55108

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**Location**

**Region:** Northwest, Northeast

**County Name:** Aitkin, Beltrami, Carlton, Cass, Chippewa, Cook, Jackson, Koochiching, Lake, Mille Lacs, Pine, St. Louis

**City / Township:**

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**Alternate Text for Visual:**

Images of thinned and unthinned forest; image of tree rings from low and high growth years; image of shelter to reduce rainfall received by juvenile trees

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

## PROJECT TITLE: Safeguarding Red Pine Forest Health and Productivity

### I. PROJECT STATEMENT

Pine forests cover nearly 825,000 acres of forest land 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 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. In dry years, growth declines precipitously and stressed trees become more susceptible to insect and disease pests, threatening the diverse ecological benefits pine forests provide. Moderate to severe growing season droughts that reduce growth and impact health occur every 5 to 10 years in northern Minnesota. To maintain forest health, increased thinning in red pine forests (harvesting some of the trees to increase the survival and growth of the trees left behind) could maintain red pine growth during periods of prolonged drought. At the same time, creating openings in the canopy can increase tree diversity and create low competition sites for new trees to establish and thrive, better ensuring the future of red pine forests. Thinning will help sustain the diverse ecological benefits provided by pine forests, while at the same time providing wood to pulp and timber mills from the harvested trees.

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

1. *Maximize pine tree health and growth by determining the best ways to thin red pine forests.* 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.
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.
3. *Determine when and how much thinning foresters should do in their red pine forests to better maintain tree health and growth.* We will generate thinning guidelines that maintain habitat, optimize growth of timber, and maintain tree growth during more stressful growing seasons.

Overall, the project results will aid in determining appropriate levels of thinning to ensure continued health of Minnesota's pine forests and maintain the multiple benefits they provide.

### II. PROJECT ACTIVITIES AND OUTCOMES

**Activity 1: Determine soil moisture and plant water status in 30 forest sites thinned to different levels and in forest openings.** Budget: \$ 163,294

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.

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

**Budget: \$ 148,654**

We will examine past growth by measuring tree ring widths and examining inventory records from before and after thinning occurred. Growth will be related to the amount of thinning 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. This experiment will simulate drought and examine growth and survival of juvenile trees. Results will be broadly communicated to managers through activities, such as workshops, webinars, field tours and informational pamphlets.

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 conducted on thinning red pine to maintain health and growth	September 2020

**Activity 3: Estimate red pine health and growth during stressful environmental conditions across 700,000 acres of forest**

**Budget: \$ 108,051**

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.

Outcome	Completion Date
1. Incorporate findings from forest plots into computer models	May 2020
2. Analyze how thinning maintains health and growth of red pine during drought on 700,000 acres of Minnesota's forests	March 2021

### III. PROJECT STRATEGY

#### A. Project Team/Partners

*Funded:* Drs. Rebecca Montgomery (overall project manager) and Marcella Windmuller-Campione (lead Activity 3) from the U of Minnesota. *Unfunded:* Dr. Brian Palik from the USDA Forest Service (lead Activity 2), and Dr. Rob Slesak with the MN Forest Resources Council (lead Activity 1). Cooperators will include the MN Department of Natural Resources, several MN Counties, and the USFS.

#### B. Project Impact and Long-Term Strategy

This work will directly ensure sustainability of pine forests for diverse public benefits and support Minnesota forest industry's ability to maintain the states valuable pine resource. Our long-term goal is enhance the health of pine forests by providing information to forest managers on where and how much thinning will be most effective. We will meet this goal by communicating findings broadly through workshops, presentations, tours, reports, and publications.

#### C. Timeline Requirements

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

## 2018 Detailed Project Budget

**Project Title: Safeguarding Red Pine Forest Health and Productivity**

### IV. TOTAL ENRTF REQUEST BUDGET 3 years

<b>BUDGET ITEM</b>	<b>AMOUNT</b>
<b>Personnel:</b> 0.5 months of faculty summer salary and fringe (0.335) for three years for Rebecca A. Montgomery PI and Marcella Windmuller-Campione; 0.04 FTE each	\$ 38,448
<b>Personnel:</b> Salary and fringe (0.214) for a research associate for 2 years (1.0 FTE)	\$ 120,163
<b>Personnel:</b> Salary and fringe (0.459) for 2 graduate students for 2 years (0.5 FTE each)	\$ 162,800
<b>Professional/Technical/Service Contracts:</b> 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
<b>Equipment/Tools/Supplies:</b> Soil temperature and moisture sensors (90 totalling \$14,220), dataloggers (20 totalling \$8,920), and precipitation gauges (10 totalling \$4,500)	\$ 27,640
<b>Equipment/Tools/Supplies:</b> Forest inventory equipment (increment borers 2 @ \$250.00 each, dendrochronology supplies (sand paper, safety equipment, tree core mounts) @ \$500)	\$ 1,000
<b>Equipment/Tools/Supplies:</b> Rainout shelters for seedling experimental work (200/shelter * 60 shelters)	\$ 12,000
<b>Travel:</b> 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])	\$ 2,743
<b>Travel:</b> 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	\$ 10,206
<b>TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =</b>	<b>\$ 420,000</b>

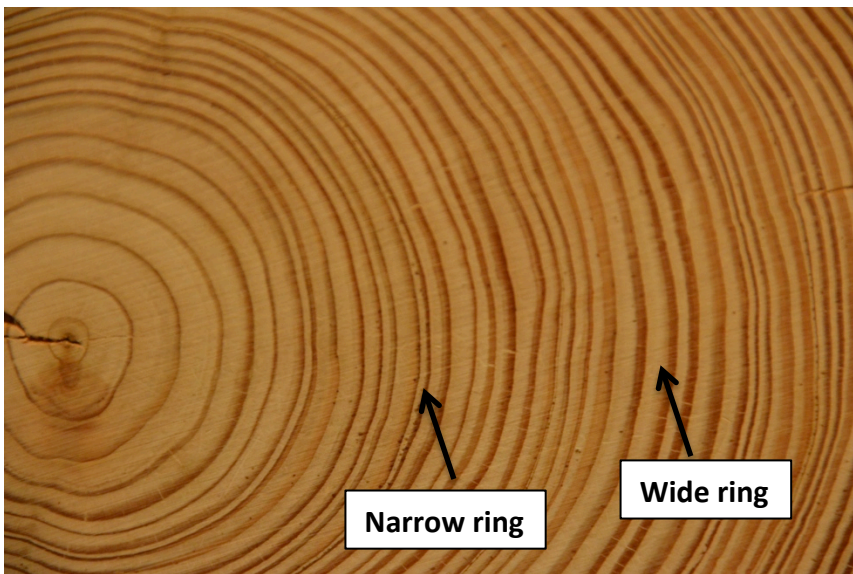
### V. OTHER FUNDS

<b>SOURCE OF FUNDS</b>	<b>AMOUNT</b>	<b>Status</b>
<b>Other Non-State \$ To Be Applied To Project During Project Period:</b> 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	<i>Secured</i>
<b>Other State \$ To Be Applied To Project During Project Period</b>	N/A	N/A
<b>In-kind Services To Be Applied To Project During Project Period:</b> 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).	\$ 148,930	<i>Secured</i>
<b>Past and Current ENRTF Appropriation:</b>	N/A	N/A
<b>Other Funding History:</b>	N/A	N/A



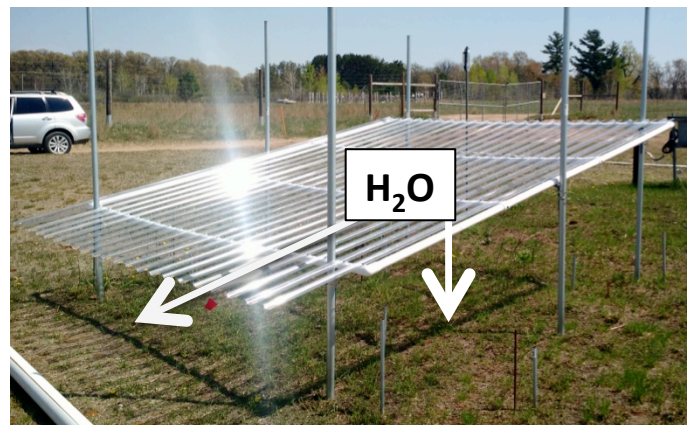


**Figure 1:** A) Unthinned forest    B) Forest thinned to increase tree growth and biodiversity



**Figure 2:** Tree cross section showing narrow rings (low growth, dry growing season) and wide rings (high growth, wet growing season).

**Figure 3:** 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 >15 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-five publications, including articles, book chapters, and reports. Forty 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.