# Environment and Natural Resources Trust Fund
# 2020 Request for Proposals (RFP)

**Project Title:** **ENRTF ID: 174-E**

Making Red Pine Forest Resilient to Climate Change

**Category:** E. Air Quality, Climate Change, and Renewable Energy

**Sub-Category:**

**Total Project Budget: $** 628,737

**Proposed Project Time Period for the Funding Requested:** June 30, 2023 (3 yrs)

**Summary:**

To increase resilience of red pine forests to climate change, we will conduct a statewide vulnerability assessment, develop approaches to adapt forest management, and create a Forest Adaptation Learning Network.

**Name:** Rebecca Montgomery

**Sponsoring Organization:** U of MN

**Job Title:** Dr.

**Department:** Department of Forest Resources

**Address:** 1530 Cleveland Ave N

St. Paul MN 55108

**Telephone Number:** (612) 624-7249

**Email** rebeccam@umn.edu

**Web Address:**

**Location:**

**Region:** Statewide

**County Name:** Statewide

**City / Township:** St. Paul

**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

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

**PROJECT TITLE: Making Red Pine Forest Resilient to Climate Change**

**I. PROJECT STATEMENT**

Climate change and changing disturbance events are predicted to threaten the ecology and economic resilience of Minnesota's forests. The overarching goal of this project is to increase the resistance and resilience of red pine forests to climate change. Specific outcomes include:

(1) A statewide assessment of red pine forest vulnerability to stress that will highlight hot spots for future forest health issues such as mountain pine beetle
(2) Forest management approaches to adapt red pine forests to expected changes,
(3) A learning network for climate change adaptation in red pine forests.

Red pine forests provide enormous benefits to both the economy ($13 million in stumpage not to mention the indirect economic benefit) and ecology (recreation, wildlife habitat for bird species like the chestnut-sided warbler, and cultural significant species including blueberries). Climate change, especially more severe and frequent droughts during the summer, can reduce productivity, increase mortality, and increase susceptibility to other insects and diseases.

While moderate to severe growing season droughts occur every five to ten years, the frequency and severity of drought is expected to increase with a changing climate. The susceptibility of red pine forests to drought and associated health stressors is higher when the forests are overly dense (too many trees per acre), a condition that may be common in red pine forests due to a lack of management and fire.

Models suggest that habitat suitable for current tree species in Minnesota may change. If this happens, we'll need to know which species can replace the old. Thus, our project helps to ensure that red pine forests remain forests even if other tree species become more common than red pine in the future.

To accomplish our objectives we will use existing data from forest inventories as well as an existing experiment that was developed through start-up investments from the USDA Forest Service and partners.

**II. PROJECT ACTIVITIES AND OUTCOMES**

**Activity 1:** Evaluate the vulnerability of red pine forests to drought and other stressors and develop guidelines to adapt forest management to climate change and future conditions

**Description:** We will assess current vulnerability of red pine in MN to reduced growth and mortality during drought. We will use statewide data on tree density compiled from forest inventory, LIDAR and remote sensing. We will create maps of tree vulnerability to different environmental stresses. These maps will highlight critical regions that could have high tree mortality due to drought and high risk for mountain pine beetle and other forest health problems. Maps will provide guidance to private and public landowners about opportunities to mitigate impacts of future conditions on their lands. Additionally, to develop guidelines to adapt management for climate change we will use an established operational-scale experiment, Adaptive Silviculture for Climate Change (ASCC). ASCC began in 2014 and implemented new approaches to managing red pine forests for climate change adaptation. Climate adaptation treatments included: thinning to reduce tree density and creating gaps to encourage regeneration of diverse species. We will test the effectiveness of these approaches by measuring soil moisture, tree growth and tree water stress.

**ENRTF BUDGET: $295,171**

| Outcome | Completion Date |
|---|---|
| *1. Statewide database of red pine stand vulnerability* | *July 2022* |

| | |
|---|---|
| *2. Statewide map of risk of tree stress and forest health issues* | *July 2022* |
| *3. Guidelines to adapt forest management for maintenance of red pine* | *June 2023* |

**Activity 2:** Evaluate the potential for red pine forests to adapt to climate change through natural and artificial regeneration of tree species suited to a warmer, drier climate

**Description:** To ensure that red pine forests remain forests even if other tree species become more common than red pine in the future, we will evaluate 4 future climate-adapted tree species planted in the ASCC project: ponderosa pine, white pine, bur oak, and northern red oak. We will assess survival and growth of planted seedings of these tree species. To study response to drought, we will construct shelters that reduce or eliminate rainfall to seedlings. These data will be used to generate guidelines for selecting species for regeneration efforts in red pine forests. Finally, we will evaluate natural regeneration potential of native species that are future climate adapted using data on natural regeneration in ASCC, on FIA plots and in the DNRs monitoring network.

**ENRTF BUDGET: $281,597**

| Outcome | Completion Date |
|---|---|
| *1. Growth and survival of juvenile trees assessed in climate change adaptation treatments* | *June 2023* |
| *2. Juvenile tree stress from drought assessed using 60 rainout shelters (20/species)* | *June 2023* |
| *3. Statewide assessment of natural regeneration potential in red pine forests* | *June 2023* |

**Activity 3:** Create a Forest Adaptation Learning Network to develop a climate adaptation toolbox for red pine

**Description:** We will create a Forest Adaptation Learning Network to promote climate adaptation approaches for red pine. We will survey organizations that manage red pine forests (e.g., Resource Management Divisions of MN Ojibwe bands, Chippewa and Superior National Forests, MN DNR, various county land agencies, Potlatch, Blandin, University of Minnesota) about current approaches, resources, concerns and challenges. We will host workshops and field tours aimed at facilitating knowledge sharing about adaptation approaches among diverse groups including private landowners. We will develop a set of case studies for the online Great Lakes Silviculture Library that managers query for new approaches. This Forest Adaptation Learning Network will promote landowner-landowner learning and information sharing about climate change adaptation.

**ENRTF BUDGET: $51,969**

| Outcome | Completion Date |
|---|---|
| *1. Survey of current approaches, resources, challenges in red pine forests* | *June 2021* |
| *2. 3 workshops and 5 demonstration tours* | *June 2023* |
| *3. 5 case studies for the Great Lakes Silviculture Library* | *June 2023* |

**III. PROJECT PARTNERS AND COLLABORATORS:**

Receiving funds: Rebecca Montgomery, Marcella Windmuller-Campione and Matthew Russell, University of Minnesota; Brian J. Palik, USDA Forest Service (ASCC project lead for MN). Not receiving funds: Rob Slesak, MN Forest Resources Council; MN DNR; USDA Forest Service FIA program.

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:** Field sites are maintained by cooperators such as USDA Forest Service. Great Lake Silviculture Library maintained by University of Minnesota.

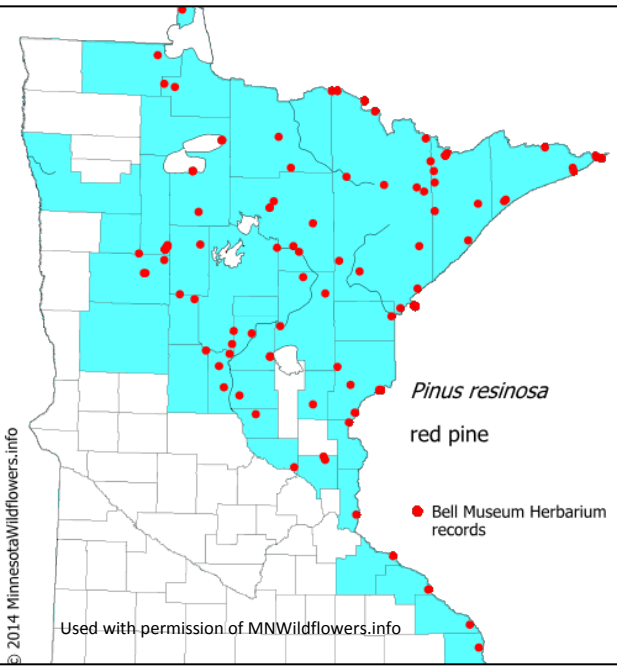
**Attachment A: Project Budget Spreadsheet**
**Environment and Natural Resources Trust Fund**
**M.L. 2020 Budget Spreadsheet**
**Legal Citation:**
**Project Manager:** Rebecca Montgomery
**Project Title:** Making Red Pine Forest Resilient to Climate Change
**Organization:** Univesrity of Minnesota
**Project Budget:** $628,737
**Project Length and Completion Date:** Three years; June 30, 2023
**Today's Date:** April 15, 2019

| ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET | | Budget | Amount Spent | Balance |
|---|---|---|---|---|
| **BUDGET ITEM** | | | | |
| **Personnel (Wages and Benefits)** | | $ 445,741 | $ - | $ 445,741 |
| Rebecca A. Montgomery PI 0.04 FTE 0.5 months of faculty summer salary and fringe (36%) for three years ($23, 090) | | | | |
| Marcella Windmuller-Campione 0.04 FTE 0.5 months of faculty summer salary and fringe (36%) for three years ($19,719) | | | | |
| Matt Russell 0.04 FTE 0.5 months of faculty summer salary and fringe (36%) for three years ($21,998) | | | | |
| Salary and fringe (36%) for a 1.0 FTE post-doctoral research associate for 2 years ($135,279 ) | | | | |
| Salary and fringe (45.9%) for 1 graduate student for 2 years (0.5 FTE; $98,154) | | | | |
| Salary and fringe (21.4%) for field research technician (Josh Kragethorpe) for 3 years (0.75 FTE; $147,501) | | | | |
| | | | | |
| **Professional/Technical/Service Contracts** | | | | |
| USDA Forest Service Northern Research Station contract includes: USDA Forest Service Northern Research Station contract includes: 1) funds for salary and fringe for two undergraduate summer employees for three years ($45,000). 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 field staff 3 years ($18,000-FOR +mileage); 3) Per UMN Policy Travel: in State travel for natural resource manager workshops/demonstrations-per diem [2 person * $82 lodging *8 workshops/demonstrations ($1312), $56 meals and incidentals* 8 workhops/demonstrations) ($896). 4) Misc. field supplies needed on site ($5000). | | $ 70,208 | | $ 70,208 |
| | | $ - | $ - | $ - |
| **Equipment/Tools/Supplies** | | | | |
| Soil temperature and moisture sensors (90 totalling $14,220), dataloggers (20 totalling $8,920), and precipitation gauges (10 totalling $4,500) | | $ 27,640 | | $ 27,640 |
| Field supplies (notebooks, flags, flagging tape, write-in-rain paper, deer fencing) | | $ 1,000 | | $ 1,000 |
| Stable isotope analysis (500 samples * $15/sample) | | $ 7,500 | | $ 7,500 |
| Rainout shelters for seedling experimental work (200/shelter * 40 shelters) | | $ 8,000 | | $ 8,000 |
| | | | | |
| **Capital Expenditures Over $5,000** | | | | |
| Licor 6800F Portable Photosynthesis System, 1 unit, this is a speciality piece of equipment used to measure photosynthesis, respiration and water loss of plants as well as other physiological measures of plant stress. It will be used in Activity 1 and 2. After this project ends, this instrument will be dedicated to the Montgomery lab program to better understand the impacts of climate change of trees and other plants in Minnesota, including continued use over the lifetime of the larger ASCC | | $ 50,950 | $ - | $ 50,950 |
| | | | | |
| **Travel expenses in Minnesota - in accordance with UMN Travel Policy** | | $ 17,698 | | $ 17,698 |
| Workshops & demonstrations: 3 workshops + 5 demonstrations * (mileage [250 mi/workshop*0.58 cents/mile] * 2 persons = *$2320* ; PI travel for field work: 5 trips/year * 300 mi/trip * 0.58/mi = *$870* ; rental of fleet field vehicle for graduate student summer field work, $1300/month * 3 months * 2 years = *$7800* | | | | |
| Lodging, 3 workshops + 5 demostrations * 2 persons * 82$/night per diem = *$1312* ; summer field housing, 500$/month * 3 months * 3 years = *$4500* | | | | |
| Meals, 3 workshops + 5 demonstrations * 2 persons * $56 = $896 | | | | |
| | | $ - | $ - | $ - |
| **Other** | | | | |
| | | $ - | $ - | $ - |
| **COLUMN TOTAL** | | $ 628,737 | $ - | $ 628,737 |

| SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT | Status (secured or pending) | Budget | Spent | Balance |
|---|---|---|---|---|
| **Non-State:** | | $ - | $ - | $ - |
| **State:** | | $ - | $ - | $ - |
| **In kind:**UMN unrecovered ICR @ 54% (MTDC- 561,627.00, total- $303,278.58), in-kind salary for Montgomery, Windmuller-Campione, Russell (0.04 FTE each; $64,807), In-kind salaries provided by USDA Forest Service Researcher (0.1 FTE; B. Palik $55,000), field research technician (0.25 FTE; $72,819), as well as in-kind use of Forest Service ATV and trailer, office and laboratory space. | Pending | $ 505,905 | $ - | $ 505,905 |

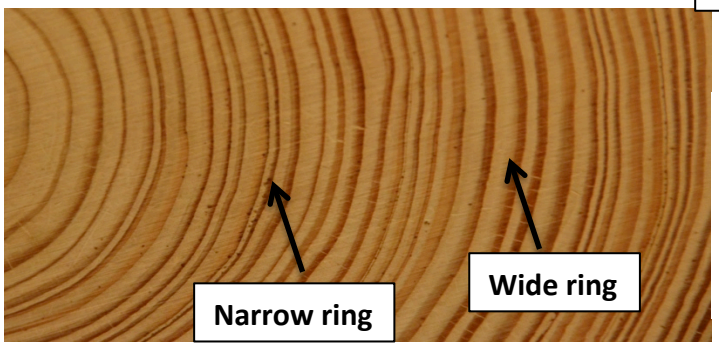
| Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS | Amount legally obligated but not yet spent | Budget | Spent | Balance |
|---|---|---|---|---|
| | | $ - | $ - | $ - |

**Goal:** to increase the resistance and resilience of red pine forests to climate change

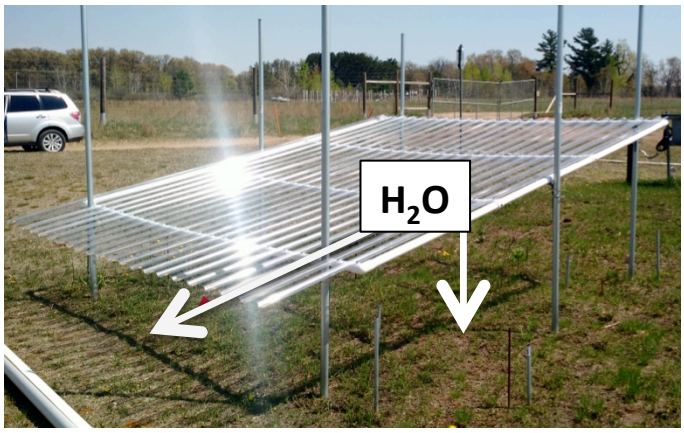



**Outcome:** statewide vulnerability assessment of red pine forests to drought and other stressors

**Outcome:** science-based guidelines to adapt forest management to climate change and future conditions and a Forest Adaptation Learning Network to share knowledge




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




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

**Professional Appointments and Preparation**

Professor, Forest Resources, University of Minnesota, 2018-present
Associate Professor, Forest Resources, University of Minnesota, 2011-2018
Assistant Professor, Forest Resources, University of Minnesota, 2004-2011
Research Associate, 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 fifeteen 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 post-doc and both oversee and participate in all project activities.

**Peer-reviewed publications**
Fifty publications, including articles, book chapters, and reports. Forty-five publications in the peer-reviewed literature.

**Organization Description**
The University of Minnesota has a strong tradition of education and public service through it 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.