

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

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**Project Title:**

**ENRTF ID: 175-E**

"Climate-Smart" Trees and Forests for Minnesota

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

**Sub-Category:**

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**Total Project Budget: \$** 494,000

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

**Summary:**

We will fill a key knowledge gap by identifying tree species likely to be 'winners' under future climate, helping establish a strategy to make our trees and forests "Climate-Smart"

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**Name:** Peter Reich

**Sponsoring Organization:** U of MN

**Job Title:** Professor

**Department:** Sponsored Projects Administration

**Address:** 450 McNamara Alumni Center, 200 Oak St SE

Minneapolis MN 55455

**Telephone Number:** (612) 624-5599

**Email** preich@umn.edu

**Web Address:**

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**Location:**

**Region:** Statewide, Northeast

**County Name:** Statewide

**City / Township:**

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**Alternate Text for Visual:**

Preliminary results from prior related research, plus maps of potential Field sites around Minnesota and a photo with accompanying illustrations of the open-air climate change experimental facility

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



**PROJECT TITLE: "Climate-Smart" Trees and Forests for Minnesota**

**I. PROJECT STATEMENT**

Minnesota's forests face unprecedented challenges from climate change and other pressures. Given the ~17 million acres of forestland and their value to the forest products and recreation/tourism industries, and to the environment more broadly, maintaining forest growth and health is vitally important to our state. As temperatures will almost certainly increase, and rainfall patterns will likely vary, in the decades ahead, it would be smart to learn how different tree species growth varies with temperature and moisture supply, and to use that information to manage forests to favor species likely to grow well under future conditions. We will thus fill a key knowledge gap by identifying tree species likely to be 'winners' and 'losers' under future climate in each region of Minnesota. By using this evidence-based strategy, rather than opinion, to manage for those likely to be winners, we can make our trees and forests "Climate-Smart".

This project will:

- Better inform public and private land managers about likely changes to trees and forests that can help them adopt resilient management strategies.
- Directly enhance management of Minnesota forests by helping managers choose species to promote in their region that will grow well under projected future climate.
- Contribute to sustained economic yield and forest health for forest-based industries, as well as enhanced forest and wildlife health, biodiversity and habitat, and carbon sequestration.

Responses to climate change are not simple; for example, the same degree of warming might increase growth of a species in cooler or moister regions of the state or in cooler, wetter years, but reduce its growth in warmer and/or drier times and places. Moreover, different species will respond to our changing climate in different ways. Thus, understanding when and where climate change will be negative, neutral, or positive for tree growth is critical to developing flexible region-specific plans given anticipated climate. This project will use field measurements and complementary experiments to identify tree species likely to grow well under anticipated future temperatures and rainfall. We will focus on young trees, as they are destined to become tomorrow's forests; moreover, early growth is also a good indicator of future growth. Our project will use this critical knowledge to develop a tool for 'climate smart' management. The project goals are to:

**(1) Identify tree growth responses to climate.** This will be done with measurements of growth of young trees of 15 important Minnesota tree species (i) across carefully selected climate gradients, and (ii) within a unique world-class facility that allows experimental tests in the field of responses to future climate. Together these results will identify climate-resilient species to promote through management. Direct measurement of young trees is essential to assessing Minnesota's future tree growth, as the inventory data from agencies does not allow assessment of growth of individual young trees in relation to a changing climate.

**(2) Develop an on-line forest management tool for climate change adaptation.** This will include a user-friendly interface to a web-based, information system that will provide land managers and the public guidelines and strategies for 'climate-smart' management (e.g. what to plant or manage for, depending on the region of the state, type of site, past land use history, etc.).

**II. DESCRIPTION OF PROJECT ACTIVITIES**

**Activity 1: Assess responses of native tree species to past and future climate.**

In addition to longer-term trends associated with a changing climate, temperature and rainfall vary from year to year, and also across MN; hence by comparing juvenile tree growth responses to recent regional and year-to-year differences in climate, as well as experimental future climates, we can characterize sensitivity of growth of



important tree species to potential future climate variation. First, we will use tree rings and bud scars as a record of recent growth in relation to both spatial (statewide) and temporal (past decade) conditions and gradients. We will compare young trees ( $\approx 8$ -12 feet tall) of 15 different species (including aspen, birch, cedar, larch, maple, oak, pine, and spruce species), accounting for variation in soil and light conditions at numerous sites across Minnesota. Radial and leader/branch growth data associated with the past  $\approx 10$  years will be correlated to local weather station data from those same years, and growth patterns across the state will be related to spatial gradients in climate. Second, we will use state-of-the-art open-air climate change facilities, called B4WarmED, located at two sites in northern MN to directly test responses of the same 15 tree species to future climates over two growing seasons (2021 and 2022). We will test responses of juvenile trees to both elevated temperature (raised by 1.5 and 3 °C) and reduced summer rainfall (by 40%), using 72 7-m<sup>2</sup> plots at sites near Cloquet and Ely, MN. In both studies we will focus on young trees, which are destined to become tomorrow's forests; moreover, early growth is a good indicator of future growth. We have proven that both our observational and experimental approaches are effective tools for such research; thus, the project will build on a strong preliminary foundation and has a high likelihood of success.

**ENRTF BUDGET: \$438,000**

Outcome	Completion Date
<b>1. Characterize sensitivity of juveniles of native tree species to recent spatial and temporal variation in climate</b>	6/30/2023
<b>2. Assess capacity of native tree species to grow and survive under potential future climate in northern Minnesota</b>	6/30/2023

**Activity 2: Develop forest management tool and user interface.**

We will use knowledge from Activity 1 to build a tool that projects tree growth under anticipated future climate; and identifies good candidates for 'climate smart' management. This tool will project (at a regional scale) for each species whether it is likely to grow better or worse in a given future time frame given projected climate change, and thus identify tree species likely to regenerate, grow and survive well or poorly under future climate. The online "Climate-Smart Management" tool will provide region-specific information useful in developing adaptive management strategies (e.g., whether and what to plant, what silvicultural treatments to use). Three workshops held around MN will introduce the tool to managers and train them in its use.

**ENRTF BUDGET: \$56,000**

Outcome	Completion Date
<b>1. Documented climate – growth relations generalized for simple management tools</b>	6/30/2023
<b>2. Online "Forest Adaptation Management" tool</b>	6/30/2023

**III. PROJECT PARTNERS AND COLLABORATORS**

Receiving funds: P Reich (U. of Minnesota). Not receiving funds: R Montgomery, L Frelich (U. of Minnesota), S Handler (U.S. Forest Service), A Pierce (Division of Ecological and Water Resources, MN DNR).

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:** Field sites are maintained by a long-running research team at the University of Minnesota in collaboration with University field stations at Cloquet and Ely.

Attachment A: Project Budget Spreadsheet  
 Environment and Natural Resources Trust Fund  
 M.L. 2020 Budget Spreadsheet

Legal Citation:

Project Manager: Peter Reich

Project Title: 'Climate-Ready' Trees and Forests for Minnesota

Organization: Regents of the University of Minnesota

Project Budget: 494,000

Project Length and Completion Date: 3 years 6/30/2023

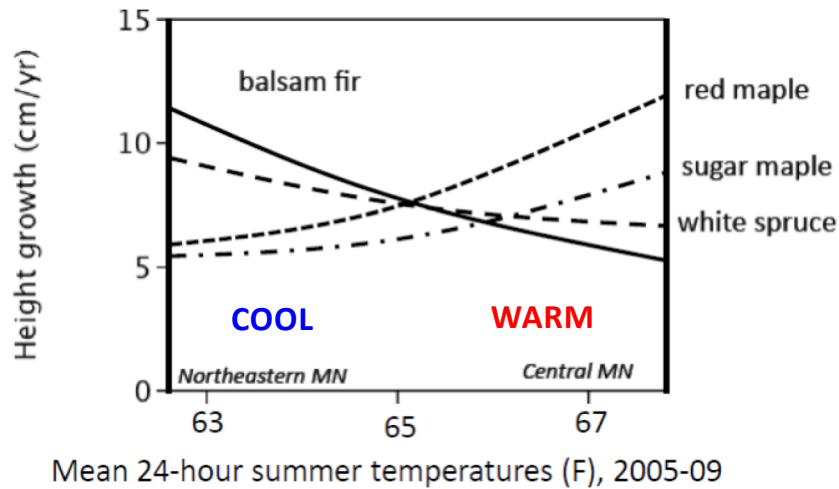
Today's Date: 4/11/2019



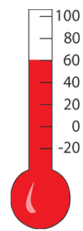
ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET		Budget	Amount Spent	Balance
<b>BUDGET ITEM</b>				
<b>Personnel (Wages and Benefits)</b>		\$ 356,217	\$ -	\$ 356,217
<i>Post Doc for 3 Years (201,496) 81% salary, 19% fringe 1 FTE</i>				
<i>Post Doc for 2 years(134,321) 81% salary, 19% fringe 1 FTE</i>				
<i>Undergraduate students (20,400) 100% salary</i>				
<b>Professional/Technical/Service Contracts</b>				
		\$ -	\$ -	\$ -
<b>Equipment/Tools/Supplies</b>		\$ 129,293		\$ 129,293
Refreshments for 3 workshops (300)				
Supplies for 3 Workshops (1800)				
Lab supplies: Labels, sample bags, increment borers, plat tags, data sheetss, data storage, light sensors, infrared warming lamps, sandpaper (18,000)				
Room Rental charges for 3 Workshops (1,000)				
Electrical power for warming treatments (108,193)				
		\$ -	\$ -	\$ -
<b>Capital Expenditures Over \$5,000</b>				
		\$ -	\$ -	\$ -
<b>Fee Title Acquisition</b>				
		\$ -	\$ -	\$ -
<b>Easement Acquisition</b>				
		\$ -	\$ -	\$ -
<b>Professional Services for Acquisition</b>				
		\$ -	\$ -	\$ -
<b>Printing</b>				
<i>Printing for 3 workshops(3,700)</i>		\$ 3,700	\$ -	\$ 3,700
<b>Travel expenses in Minnesota - in accordance with UMN Travel Policy</b>				
<i>From UMN Twin Cities campus to research sites in greater Minnesota; 2 3-week trips over two field seasons, each trip ≈800 miles in total (0.58/mile) and 40-person days for food and lodging, at \$40 per day. Plus 6 round-trips to experimental field sites in Cloquet and Ely (each ≈500 miles). Plus 3 roundtrips mileage for the workshops (total of 900 miles @ 0.58/mile). \$3190 mileage, food and lodging \$1600.</i>		\$ 4,790	\$ -	\$ 4,790
<b>Other</b>				
		\$ -	\$ -	\$ -
<b>COLUMN TOTAL</b>		\$ 494,000	\$ -	\$ 494,000
<b>SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT</b>				
	Status (secured or pending)	Budget	Spent	Balance
<b>Non-State:</b>		\$ -	\$ -	\$ -
<b>State:</b>		\$ -	\$ -	\$ -
<b>In kind:</b>		\$ -	\$ -	\$ -
University of Minnesota Unrecovered Facilities and Administration costs 54%		266,760		
<b>Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS</b>				
	Amount legally obligated but not yet spent	Budget	Spent	Balance
		\$ -	\$ -	\$ -

## Who will be the "winners" and "losers" in a warmer climate?

Results of earlier, smaller study (Fisichelli, Frelich, Reich 2012) of native forests showed maples winning over fir and spruce in warmer conditions

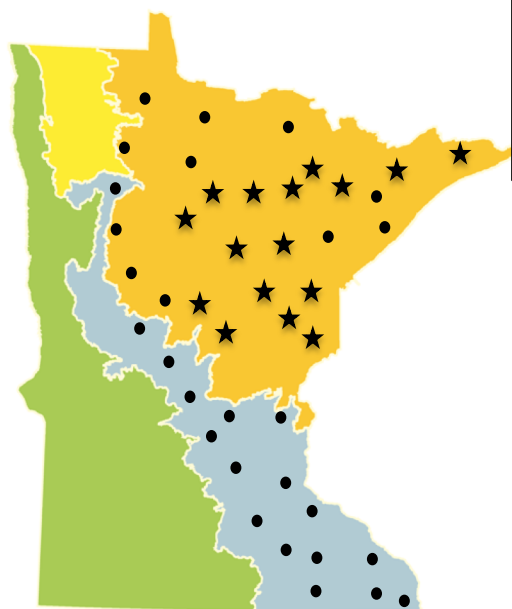


As temperatures rose...



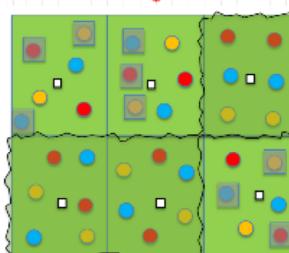
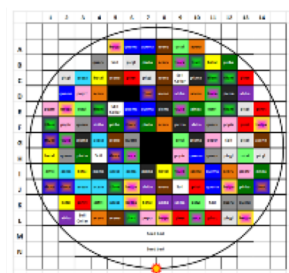
Maple growth increased

Spruce & fir growth declined



Map of existing (stars) and proposed new study sites (circles)

Growth responses of 15 tree species across climate gradients (left) and experimental warming (below right) will help us identify and manage for "climate smart" trees and forests



**B4WarmED Experimental Design:**  
 = 72 plots on 2 sites  
 x2 Canopy  
 x3 Blocks  
 x3 Heat trt  
 x2 replicates (open canopy split into rain ambient and rain excluded treatments)

## Project Manager Qualifications & Organization Description

### **Project Manager: Professor Peter B. Reich**

Regents Professor, Distinguished McKnight University Professor  
F.B. Hubachek Professor of Tree Physiology and Forest Ecology  
Department of Forest Resources, University of Minnesota, St. Paul, MN 55108  
E-mail: preich@umn.edu; Phone: 612-624-4270; FAX 612-625-5212

### **Professional Appointments and Preparation**

F.B. Hubachek, Sr., Professor, Dept of Forest Resources, U. Minnesota, 1991-  
Assistant/Associate Professor, Dept of Forestry, U. Wisconsin-Madison, 1985-1991  
Post-doc (1985) and Ph.D. (1983) Cornell University  
M.S. (1977) University of Missouri  
B.A. (1974) Goddard College

### **Honors, Professional Recognition and Service (Selected)**

Member, National Academy of Sciences  
Invited speaker > 200 symposium, conferences, and seminars; e.g., Harvard; Duke;  
Penn State; Princeton; Stanford; Cornell; Michigan State; Washington, U. Wisconsin.  
Institute for Scientific Information (ISI) Science Citation Index, List of Top 10  
Ecologists and Environmental Scientists in the World, 2002 – present  
Advisor to numerous Federal science and policy agencies  
Member of numerous editorial review boards and federal science agency panels

### **Areas of Expertise**

Forestry; forest productivity, ecology and management; impacts of climate change on  
forests; invasive species biology; biodiversity; wildfire, elevated CO<sub>2</sub>; carbon cycling.  
Systems studied: forests, woodlands, grasslands, agricultural crops.

### **Project Management Experience**

Lead PI or co-PI on forest and grassland science projects (total funding, >\$30 million  
2000- present, from federal [NSF, DOE, USDA, NASA], state, and private sources).

### **Peer-reviewed publications:**

> 610 scientific articles and book chapters, including > 40 in high profile  
journals (Nature, Science, etc.) as well as >460 in specialized technical journals

### **Project Management Qualifications for this Project**

Background in forest ecosystem ecology and management, including climate change studies.  
Extensive experience successfully leading science projects and managing large  
research teams.

### **Organization Description**

The University of Minnesota is both the state land-grant university, with a strong tradition of  
education and public service, and the state's primary research university