

**Environment and Natural Resources Trust Fund  
2015 Request for Proposals (RFP)**

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**Project Title:**

**ENRTF ID: 099-E**

Managing for "Climate-Smart" Trees and Forests

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

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**Total Project Budget:** \$ 457,953

**Proposed Project Time Period for the Funding Requested:** 3 years, July 2015 - June 2018

**Summary:**

Measure tree growth responses to climate throughout Minnesota to identify climate-resilient species for each region to promote through management; and develop an on-line forest management tool for climate change adaptation

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**Name:** Peter Reich

**Sponsoring Organization:** U of MN

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St. Paul MN 55108

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**Web Address** \_\_\_\_\_

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**Location**

**Region:** Central, Metro, NW, NE, SE

**County Name:** Statewide

**City / Township:**

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**Alternate Text for Visual:**

Map shows location of study sites throughout forested region of Minnesota and example of data showing how different species may grow faster or slower with climate change

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



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

**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 likely increase by ~7-9 degrees F by 2100, it would be smart to learn how tree species growth varies with temperature, and to use that information to manage forests to favor species likely to grow well under warmer 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 information 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 height growth of a species in cooler parts of the state, but reduce its growth in warmer areas. 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 new field measurements to identify tree species likely to grow well in each region of the state under anticipated future temperatures and rainfall. We will focus on young trees, as they are destined to become tomorrow's forests, and 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 (i) new measurements of growth of young trees of important Minnesota tree species across carefully selected climate gradients, along with (ii) analyses of existing inventory data available from the U.S. Forest Service that tell us where currently dominant species are replacing themselves and where they are being replaced by species better suited to today's climate. Together these results will identify climate-resilient species to promote through management.

**(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 growth responses of 25 tree species to climate.** Budget: \$366,989.

Tree rings and bud scars provide a permanent record of diameter and height growth. Temperature and rainfall vary from year to year, and also across MN; hence by comparing growth responses to regional differences in climate as well as to year-to-year variation we can characterize how growth of each species varies with temperature and rainfall. We will compare young trees (~8-12 feet tall) of different species growing side-by-side



**Environment and Natural Resources Trust Fund (ENRTF)**  
**2015 Main Proposal**  
**Project Title: "Climate-Smart" Trees and Forests**

in similar soil and light conditions at numerous sites across Minnesota. Our team has developed proven techniques that allow systematic documentation of climate change responsiveness from such data.

In prior work we found that spruce and fir grow faster in cooler northeastern MN than in warmer north central MN. In contrast, sugar maple, red maple, and red oak respond in an opposite fashion, growing faster under warmer conditions. Moreover in northeastern MN, spruce and fir grew faster than young maples and oaks in the 1970s, grow at about the same rate now, and will grow more slowly than maples and oaks in 20-30 years if climate keeps warming at the current pace. Activity 1 will greatly extend prior work (restricted to 5 species studied at 7-14 sites), to more trees ( $\approx 4,500$ ) and species (25 including 9 native conifers, 14 native hardwoods, and 2 invasive hardwoods), across more of Minnesota (25 new sites). As the amount of rainfall, not surprisingly, also controls tree growth, assessing growth sensitivities to both rain and temperature is necessary to develop the most useful recommendations of species to promote through management. Further, by combining these growth data with forest inventory data that measures the current abundance of all species in sapling, pole, and mature tree size classes, we will also project future forest composition across most Minnesota forests.

<b>Outcome</b>	<b>Completion Date</b>
<b>1. Estimates (by region and ecological province) of how much better or worse 25 tree species will grow under anticipated future climate.</b>	6/30/2018
<b>2. Maps (by region and ecological province) of projected forest composition under anticipated future climate.</b>	6/30/2018
<b>3. List of regions and site types where invasive buckthorn or black locust are projected to outcompete native tree species.</b>	6/30/2018

**Activity 2: Develop forest management tool and user interface.** Budget: \$90,964.

We will use knowledge from Activity 1 to build a tool that projects individual species growth, as well as forest composition, under anticipated future climate; and identifies good candidates for 'climate smart' management. This tool will project (at a regional scale) whether each species 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 or survive well or poorly under future climate. The online "Climate-Smart Management" tool will also identify adaptive management strategies (e.g., whether to plant or use silvicultural treatments) given specific forecasts region by region. Four workshops held around the state will introduce the tool to managers and train them in its use.

<b>Outcome</b>	<b>Completion Date</b>
<b>1. Documented climate – growth relations generalized for simple management tools</b>	6/30/2018
<b>2. Online "Forest Adaptation Management" tool</b>	6/30/2018

**III. PROJECT STRATEGY**

**A. Project Team/Partners.** The project is a collaboration among P Reich (Project Manager), R Montgomery, L Frelich, K Wythers, A Stefanski, and a postdoctoral researcher (to be determined) at U. of Minnesota. The latter three people will receive ENRTF funds. Partners (no ENRTF funds) include U.S. Forest Service, S Handler.

**B. Project Impact and Long-Term Strategy.** Results from our project will enable "smarter" forest management because it will allow managers to choose the species likely to perform the best in their region of Minnesota, given anticipated future climate conditions. This information will be disseminated through existing and expanded partnerships (e.g., USFS Climate Change Resource Center, Extension at Cloquet Forestry Center, Minnesota Forest Resources Council, and others).

**C. Timeline Requirements.** The project requests funding for three years (July 1 2015-June 30, 2018). Given the time needed for each, work on the research (Activity 1) and outreach efforts (Activity 2) will overlap.

## 2015 Detailed Project Budget

Project Title: 'Climate-Ready' Trees and Forests

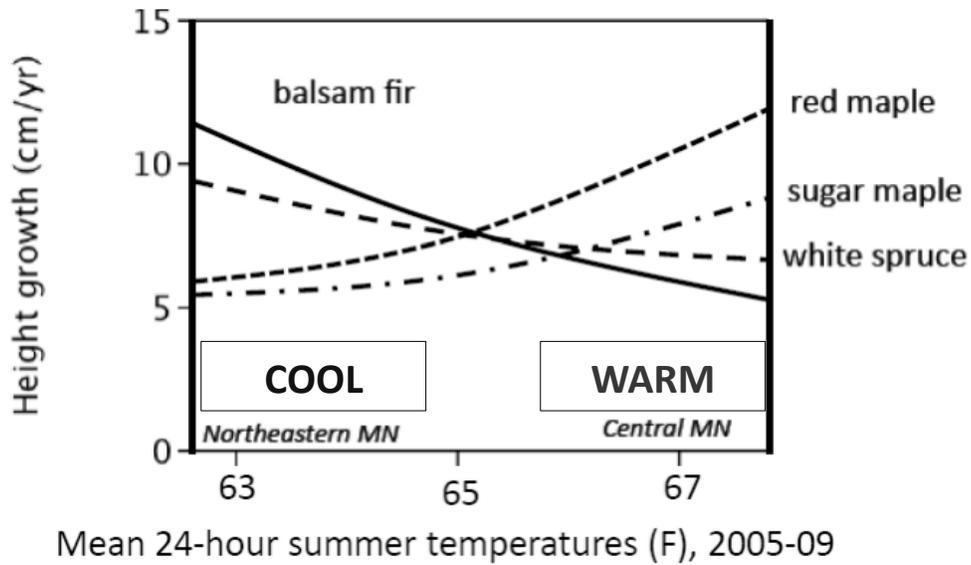
### IV. TOTAL TRUST FUND REQUEST BUDGET 3 years funding

<u>BUDGET ITEM</u>	<u>AMOUNT</u>
<b>Personnel:</b>	<b>\$ 386,905</b>
1 Research associate- 100% time of \$56,842 annual + 33.6% fringe for 3years	227,829
1 Lead Technician-20% time of \$43,311 annual + 36.8% fringe for 3 years	35,600
1 Research Fellow- at 50% of \$46,927 annual + 33.6% fringe for two years	62,694
3 Interns- for 4 months/year for 2 years, \$13/hr for 520 hours each per yr + 8.23% fringe	43,898
5 student workers - part time each academic year (1200 hours total) +8.23% fringe	16,884
<b>Equipment/Tools/Supplies:</b>	<b>\$ 8,200</b>
Supplies/equipment: labels, sample bags, chainsaw maintenance and part replacement, plot tags, data sheets, data storage, light sensors, sandpaper, misc supplies	8,200
<b>Travel:</b> From UMN Twin Cities campus to research sites in greater Minnesota; 12 3-week trips over two field seasons, each trip ≈800 miles in total (0.56/mile) and 60-person days for food and lodging, at \$40 per day. Plus 4 roundtrips mileage for the workshops (total of 1200 miles @ 0.56/mile)	<b>\$ 34,848</b>
<b>Additional Budget Items:</b>	<b>\$ 28,000</b>
Web site, computer server, software licenses	21,200
Hosting the workshops (room rentals, refreshments, printing materials, meeting supplies, etc.)	6800
<b>TOTAL ENVIRONMENT &amp; NATURAL RESOURCES TRUST FUND \$ REQUEST</b>	<b>\$ 457,953</b>

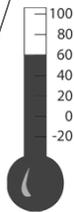
### V. OTHER FUNDS

<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
<b>Other Non-State \$ Being Applied to Project During Project Period:</b>		
Wilderness Research Foundation & DOE award	\$ 75,000	Secured
<b>Other State \$ Being Applied to Project During Project Period:</b>	\$ -	
<b>In-kind Services During Project Period:</b>		
Project manager (Reich) will contribute 1% time to project; other University PIs (Montgomery, Frelich) will contribute 1% time to working with project employees and cooperators.	\$ 14,106	Secured
Unrecovered indirect costs @ 52% of modified total direct cost base of \$457,953	\$ 238,136	Secured
<b>Remaining \$ from Current ENTF Appropriation (if applicable):</b>		
Project Title: Assessing species vulnerability to climate change using phenology, Project Manager: Rebecca Montgomery	\$ 175,000	Under consideration by legislature

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



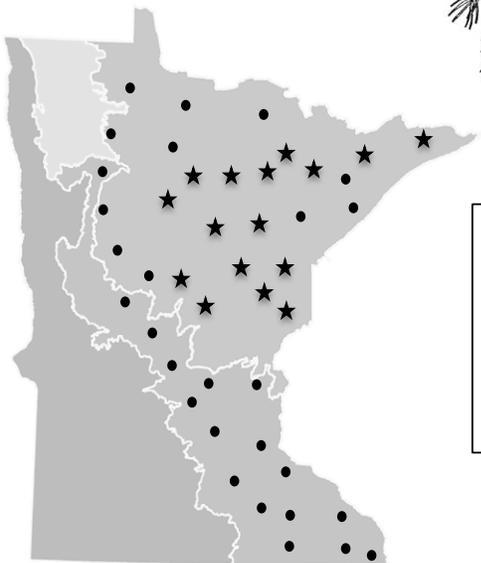
As temperatures rise...



Maple growth increases



Spruce & fir growth declines



Growth responses of 25 trees across climate gradients will provide a tool to identify and manage for "climate smart" trees and forests

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

## Project Managers Qualifications & Organization Description

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

Regents Professor, Distinguished McKnight University Professor, and F.B. Hubachek, Sr., 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)**

Invited speaker > 180 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 row crops.

### **Project Management Experience**

Lead PI or co-PI on forest and grassland science projects (total funding, >\$25 million 2000- present, from federal [NSF, DOE, USDA, NASA], state, and private sources.

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

> 440 scientific articles and book chapters, including > 25 in high profile general journals (Nature, Science, etc.) as well as >350 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