

**Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 139-E

Managing for "Climate-Smart" Trees and Forests

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

Total Project Budget: \$ 380,026

Proposed Project Time Period for the Funding Requested: 2 years, July 2016 to 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.

Name: Peter Reich

Sponsoring Organization: U of MN

Address: 1530 Cleveland Avenue North
St. Paul MN 55108

Telephone Number: (612) 624-4270

Email preich@umn.edu

Web Address _____

Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Map shows location of study sites, and preliminary 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 growth of a species in cooler parts of the state, but reduce its growth in warmer areas because soils become drier. 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) detailed 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 two types of information 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: \$324,926.

Tree rings and bud scars provide a permanent record of diameter and height growth; recording these data for individual, harvested young trees provides detailed information on their year-by-year growth. Temperature and rainfall vary 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 in similar soil and light conditions at numerous sites. Detailed measures of soils, light, and deer browse pressure



Environment and Natural Resources Trust Fund (ENRTF)

2016 Main Proposal

Project Title: "Climate-Smart" Trees and Forests

will enable us to assess response to climate standardized for these effects, and as well provide information on how response to climate varies with soil, light, and deer browse pressure. 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 areas such as 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 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 extend our prior work (restricted to 5 species studied at 7 sites), to more trees (~4,500) and species (25 including 9 native conifers, 14 native hardwoods, and 2 invasive hardwoods), across more of Minnesota (30 sites). As the amount of rainfall also controls tree growth, assessing growth sensitivities to both rain and temperature is necessary to develop 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.

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

Activity 2: Develop forest management tool and user interface. Budget: \$55,100.

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.

Outcome	Completion Date
1. Documented climate – growth relations generalized for simple management tools	6/30/2018
2. Online "Forest Adaptation Management" tool	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, C Swanston, and Division of Ecological and Water Resources, MN DNR, Ann Pierce.

B. Project Impact and Long-Term Strategy. Results will enable "smarter" forest management because it will allow managers to choose 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, Minnesota Forestry Extension, etc.).

C. Timeline Requirements. The project requests funding for two years (July 1 2016-June 30, 2018). Given the time needed for each, work on the research (Activity 1) and outreach efforts (Activity 2) will overlap.

2016 Detailed Project Budget

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

IV. TOTAL TRUST FUND REQUEST BUDGET 2 years funding

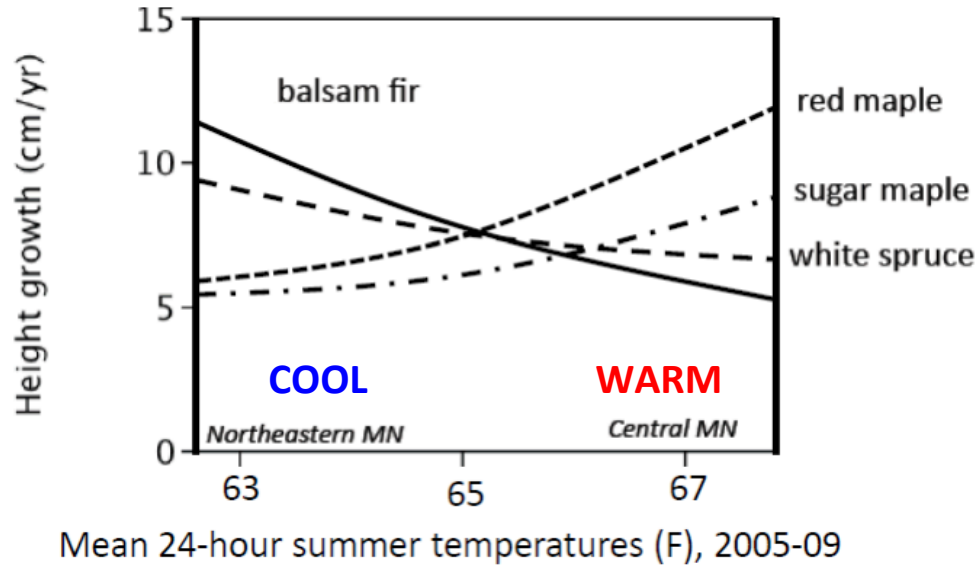
BUDGET ITEM	AMOUNT
Personnel:	\$ 308,978
1 Research associate- 100% time of \$53,000 annual + 33.8% fringe for 2 years	143,246
1 Technician-50% time of \$47,150 annual + 26.3% fringe for 2 years	60,146
1 Research Fellow- at 30% of \$46,927 annual + 33.8% fringe for 2 years	38,050
3 Interns- for 4 months/year for 2 years, \$15/hr for approximately 520 hours each per yr + 7.70% fringe	50,652
5 student workers - part time each academic year (1200 hours total)	16,884
Equipment/Tools/Supplies:	\$ 8,200
Supplies/equipment: labels, sample bags, chainsaw maintenance and part replacement, plot tags, data sheets, data storage, light sensors, sandpaper, misc supplies	8,200
Travel: 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)	\$ 34,848
Additional Budget Items:	\$ 28,000
Web site, computer server, software licenses	21,200
Hosting the workshops (room rentals, refreshments, printing materials, meeting supplies, etc.)	6,800
TOTAL ENVIRONMENT & NATURAL RESOURCES TRUST FUND \$ REQUEST	\$ 380,026

V. OTHER FUNDS

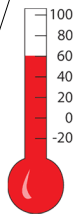
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ Being Applied to Project During Project Period:		
Wilderness Research Foundation & DOE award	\$ 75,000	Secured
Other State \$ Being Applied to Project During Project Period:	\$ -	
In-kind Services During Project Period:		
Project manager (Reich) will contribute 1% time to project; other University PIs (Montgomery, Frelich) will contribute 1% time to working with project employees and cooperators	\$ 10,276	Secured
Unrecovered indirect costs @ 52% of modified total direct cost base of \$457,953	\$ 197,614	Secured
Remaining \$ from Current ENTF Appropriation (if applicable):		
Project Title: Assessing species vulnerability to climate change using phenology, Project Manager: Rebecca Montgomery	\$ 175,000	In progress
Funding History:		
ENTF Project: Climate change and CO2 affect prairie/forest production, Project Manager Peter Reich, 2008-2011	\$ 330,000	Expired
ENTF Project: Healthy Forests to Resist Invasion, Project Manager Peter Reich, 2010-2013	\$ 359,000	Expired
US Department of Energy, Boreal Forest Experimental Warming, P Reich and R Montgomery, 2011-15	\$ 2,420,000	In progress
Wilderness Research Foundation, Composition and Health of Northern Minnesota Forests, P Reich, 2012-2016	\$ 310,000	In progress

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

Large shifts in performance across regional climate gradient (from preliminary data)



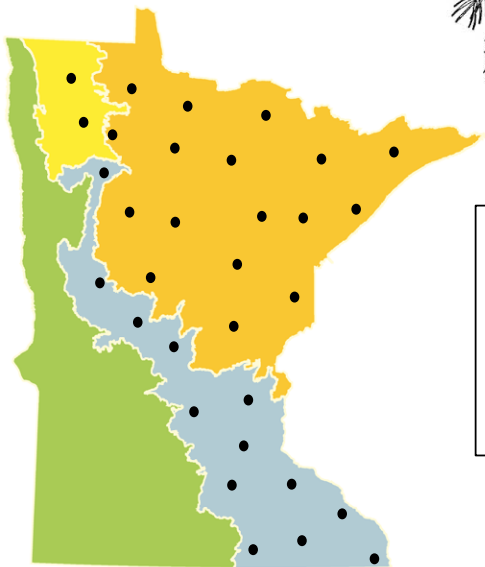
As temperatures rise...



Maple growth increases



Spruce & fir growth declines



Map of proposed study sites

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

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)

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 CO₂; 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:

> 500 scientific articles and book chapters, including > 30 in high profile general
journals (Nature, Science, etc.) as well as >450 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