

**Environment and Natural Resources Trust Fund
2017 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 127-E

Managing for "Climate Smart" Trees and Forests

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

Total Project Budget: \$ 385,000

Proposed Project Time Period for the Funding Requested: 2 years, July 2017 – June 2019

Summary:

We'll fill a knowledge gap by identifying trees likely to be 'winners' under future conditions; and use that knowledge to manage forests favoring trees likely to thrive in the future.

Name: Peter Reich

Sponsoring Organization: U of MN

Address: 1530 Cleveland Ave N
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:

graph of winners and losers in a warmer climate; and map of Minnesota with study site locations

| | | | |
|--------------------------|-------------------------|-----------------------------|----------------------|
| _____ 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 increase and rainfall patterns will vary, it would be smart to learn how 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 likely 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. 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. 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.

(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: \$329,000

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



Environment and Natural Resources Trust Fund (ENRTF)
2017 Main Proposal
Project Title: Managing for "Climate-Smart" Trees and Forests

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 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 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 (25 new 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. | 6/30/2019 |
| 2. Maps (by region and ecological province) of projected forest composition under anticipated future climate. | 6/30/2019 |
| 3. List of regions and site types where invasive buckthorn or black locust are projected to outcompete native tree species. | 6/30/2019 |

Activity 2: Develop forest management tool and user interface. Budget: \$56,000

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 | 6/30/2019 |
| 2. Online "Forest Adaptation Management" tool | 6/30/2019 |

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 near-future climate conditions. This information will be disseminated through existing and expanded partnerships (e.g., USFS Climate Change Resource Center, Forestry Extension, Minnesota Forest Resources Council, etc.).

C. Timeline Requirements. The project requests funding for two years (July 1 2017-June 30, 2019). Given the time needed for each, work on the research (Activity 1) and outreach efforts (Activity 2) will overlap.

2017 Detailed Project Budget

Project Title: Managing for 'Climate Smart' Trees and Forests

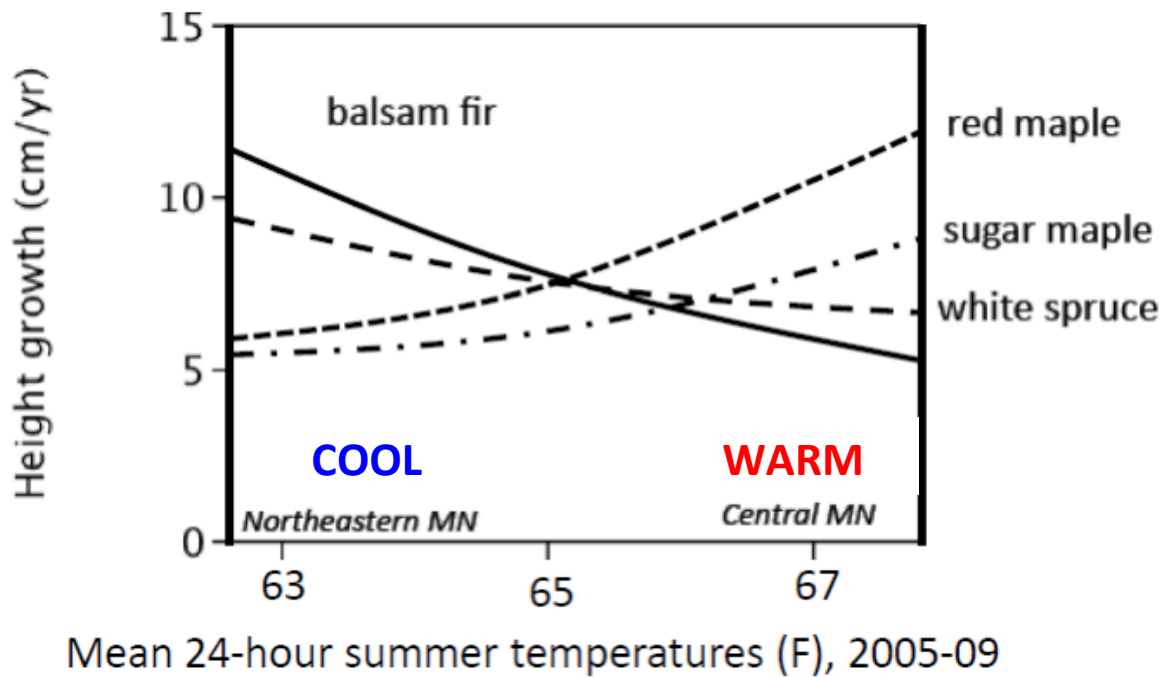
IV. TOTAL TRUST FUND REQUEST BUDGET 2 years funding

| BUDGET ITEM | AMOUNT |
|--|-------------------|
| Personnel: | \$ 312,000 |
| 1 Research associate- 100% time of \$53,000 annual + 33.7% fringe for 2 years | 144,000 |
| 1 Technician-50% time of \$47,150 annual + 27.4% fringe for 2 years | 61,000 |
| 1 Research Fellow- at 30% of \$46,927 annual + 33.7% fringe for 2 years | 39,000 |
| 3 Interns- for 4 months/year for 2 years, \$15/hr for approximately 520 hours each per yr + 7.9% fringe | 51,000 |
| 5 student workers - part time each academic year (1200 hours total) | 17,000 |
| Equipment/Tools/Supplies: | \$ 9,000 |
| Supplies/equipment: labels, sample bags, chainsaw maintenance and part replacement, plot tags, data sheets, data storage, light sensors, sandpaper, misc supplies | 9,000 |
| 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) | \$ 35,000 |
| Additional Budget Items: | \$ 29,000 |
| Web site, computer server, software licenses | 22,000 |
| Hosting the workshops (room rentals, refreshments, printing materials, meeting supplies, etc.) | 7,000 |
| TOTAL ENVIRONMENT & NATURAL RESOURCES TRUST FUND \$ REQUEST | \$ 385,000 |

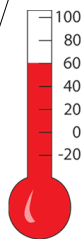
V. OTHER FUNDS

| SOURCE OF FUNDS | AMOUNT | Status |
|---|--------------|-------------|
| Other Non-State \$ Being Applied to Project During Project Period: | | |
| Wilderness Research Foundation | \$ 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 @ 53% FY17 and 54% FY18 of modified total direct cost base of \$385,000 | \$ 205,975 | Secured |
| Remaining \$ from Current ENTFF 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, 2011-16 | \$ 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?



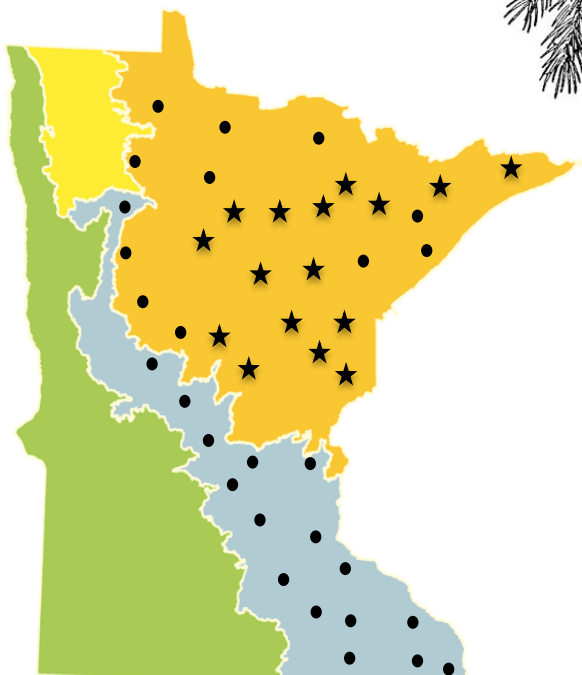
As temperatures rise...



Maple growth increases.



Spruce and 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

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:

> 510 scientific articles and book chapters, including > 35 in high profile general
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