

**Environment and Natural Resources Trust Fund
2014 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 115-E

Forecasting Minnesotas Future Forests

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

Total Project Budget: \$ 642,764

Proposed Project Time Period for the Funding Requested: 2 Years, July 2014 - June 2016

Summary:

The project will increase understanding of climate change impacts on Minnesota forests, use that information to forecast future forests, and provide managers with strategies to increase forest growth and health.

Name: Peter Reich

Sponsoring Organization: U of MN

Address: 1530 Cleveland Ave N
St. Paul MN 55108

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Location

Region: Northeast

County Name: Aitkin, Beltrami, Carlton, Cass, Cook, Crow Wing, Hubbard, Itasca, Kanabec, Koochiching, Lake, Lake of the Woods, Mille Lacs, Pine, St. Louis, Wadena

City / Township:

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



PROJECT TITLE: Forecasting Minnesota's Future Forests

I. PROJECT STATEMENT

Minnesota's forests face unprecedented challenges because of climate change and other pressures. Given the more than 16 million acres of forestland and their value to the forest products and recreation/tourism industries, maintaining forest growth and health is vitally important to our state. If forests fare poorly in the future, these industries will suffer. It is therefore important to understand how our forests will change; and use that understanding to enhance decision-making by land managers. To meet these needs, this project will assess potential changes to our forests attributable to climate change, including drought and extreme weather events; and develop a forecasting tool to enable mitigation, adaptation, and resiliency in the face of such change.

The project goals are to:

- (1) Increase understanding of forest responses to climate change.** This will be achieved by a combination of field experiments, field observations, and analyses of inventory data. The work will improve understanding of which species are likely to do well vs. poorly under projected climate change, of whether forest growth and timber yields will decrease or increase, and of the importance of direct climate change impacts vs. impacts of associated changes in insect pests or wildfire.
- (2) Use that knowledge to develop a model that can forecast responses to projected future climate.** This will be done by merging and refining two promising models that currently have some limited capacity to predict forest responses to climate, wildfire, harvest and other factors.
- (3) Forecast future forest growth, health, and composition for northern Minnesota.** This will be accomplished by using the predictive model to forecast changes in forests, given current forest composition, age structure and condition; projected future climate; and likely impacts of future climate on insects, droughts and wildfires. It will also identify climate-resilient species to promote through management.
- (4) Develop an on-line forest management tool for climate change adaptation.** This will require a user-friendly interface to a web based, information system that will provide land managers and the public projections of forest conditions for 2020-2080, and guidelines and strategies for adaptive management given forecast change.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Assess forest responses to climate and build a forecasting model. Budget: \$467,651.

Work will include experimental and observational studies of all major northern Minnesota tree species responses to climate, and to associated insect pest and weather extremes. Subsequently we will use this and prior knowledge to build a model that can predict individual species responses and overall forest growth to different climate, harvest, wildfire, windstorm, drought, and pest regimes.

Outcome	Completion Date
1. Improved understanding of Minnesota tree responses to climate change. Records of growth and survival of 10,000 saplings and 100,000 seedlings subjected to experimental warming and rainfall manipulation in Cloquet and Ely forestry field stations	11/30/2015
2. Improved understanding of recent forest change. Documented long-term forest change using >10,000 US Forest Service and >1,000 Univ. Minnesota census plots	12/31/2015
3. A forecasting model for projecting future Minnesota forests	8/30/2016



Activity 2: Forecast future forests and develop stakeholder user interface. Budget: \$175,113.

Work includes development of detailed baseline mapping of current forest conditions and climate, implementation of model routines to project responses to climate, insects, harvest, and wildfire, and development of the user interface to provide access to projections of forest change and to adaptive management strategies. This research will identify (at a detailed spatial scale) native tree species likely to regenerate, grow or survive poorly under future climate, as well as native and non-native species likely to perform well. Species that perform well may be important to encourage or control, depending on whether their enhanced performance will bring economic and ecological benefits or problems. The online "Forest Adaptive Management" tool will also identify potential strategies given specific forecasts region by region.

Outcome	Completion Date
<i>1. Maps and associated data base of current forest conditions for the 15 million acres of northern Minnesota forest</i>	<i>4/30/2016</i>
<i>2. Maps and associated data base of what the future forests of Minnesota will look like for 2020-2080</i>	<i>8/30/2016</i>
<i>3. An online "Forest Adaptation Management" tool</i>	<i>3/31/2017</i>

III. PROJECT STRATEGY

A. Project Team/Partners. The project is a collaboration among multiple researchers. Univ. of Minnesota: P Reich (Project Manager), R Montgomery, S Hobbie, L Frelich, E Peters, K Wythers, A Stefanski. Only the latter three people will receive ENTF funds. Partners (no ENTF funds) include U.S. Forest Service, S Handler; Portland State Univ.: R Scheller; U. Wisconsin-Madison: R Lindroth, K Raffa. Additionally, other university and U.S. Forest Service scientists will cooperate on the project.

B. Timeline Requirements. The project requests two years of funding to be spent over three years (duration July 1 2014-June 30, 2017). We view it as imperative to work on the field research (goal 1), model development (goals 2 and 3), and outreach efforts to stakeholders (goal 4) simultaneously, as work on each component will inform the others moving forward and managers need information urgently.

C. Long-Term Strategy and Future Funding Needs.

This project will:

- enhance our ability to manage Minnesota forests in a changing climate.
- better inform public and private land managers about likely changes to forests that can help them adopt resilient management strategies.
- contribute to sustained economic yield and forest health for forest-based industries.

Our long-term strategy is for the Forest Resource Dept, U of Minnesota to maintain and host the web site and user interface for the Forest Adaptation Management tool, and work with partners (e.g., USFS, DNR, etc) to update the forecasting model (and subsequently the management tool) periodically to incorporate new understanding. Existing partnerships for disseminating this information will be maintained and expanded; these include close cooperation with USFS Climate Change Resource Center, Extension at Cloquet Forestry Center, Minnesota Forest Resources Council, and others. These partnerships will ensure the ongoing viability of this decision-support tool.

2014 Detailed Project Budget

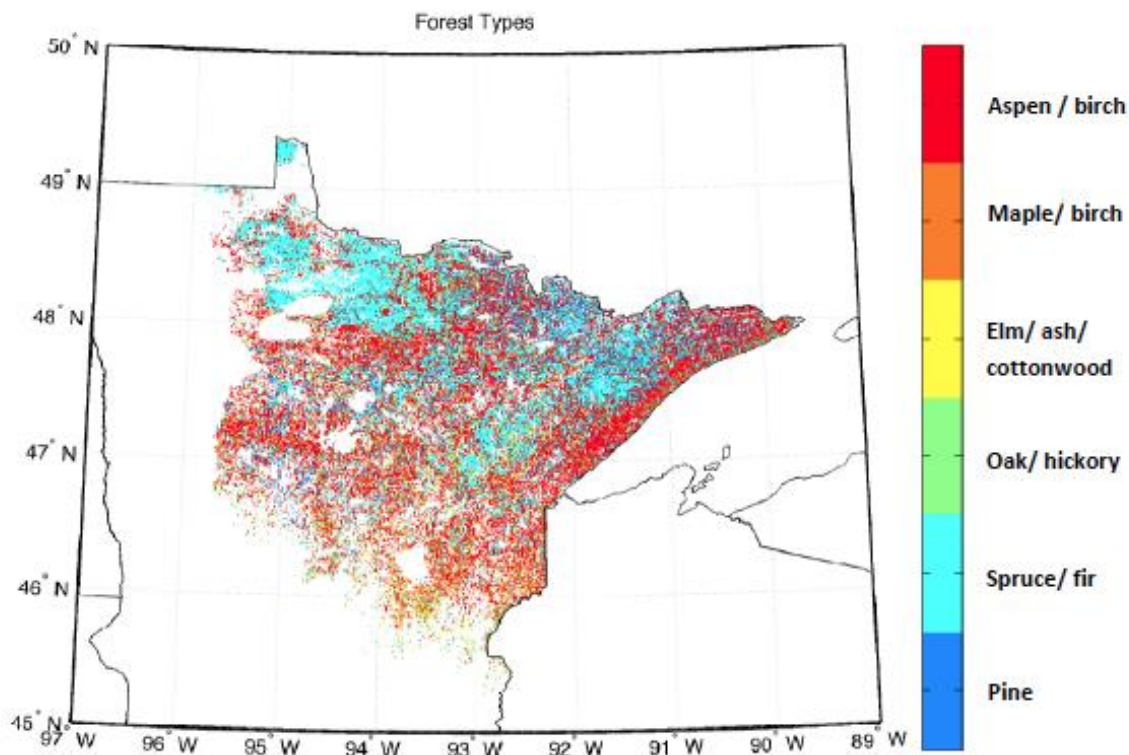
Project Title: Projecting Minnesota's Future Forests

IV. TOTAL TRUST FUND REQUEST BUDGET 2 years funding (to be spent over 3 yrs)

BUDGET ITEM	AMOUNT
Personnel:	\$ 536,874
1 Research associate- 100% time of \$56,842 annual + 33.6% fringe [\$151,882]	
1 Lead Technician-100% time of \$43,311 annual + 36.8% fringe [\$118,499]	
1 Research Fellow- 100% time of \$44,510 annual + 33.6% fringe [\$118,931]	
4 Interns- for seven months/year, \$13/hr for 1210 hours each + 8.23% fringe [\$136,197]	
5 student workers - at part time each academic year with work study funding [\$11,365]	
Equipment/Tools/Supplies:	\$ 61,690
Tree seeds - MN collected (200,000 seeds, from a total of 25 species) [\$7,200] and 6,000 seedlings, from a total of 15 species) [\$1,890]	
Equipment: Maintain, calibrate, repair and replace (as needed) air humidity and temperature sensors, light sensors, soil moisture sensors, fiber optic lines, dataloggers, handheld barcode scanners, deer fencing, rainfall exclusion "rolling tarp" systems, buried heating cables. [\$39,200]	
Supplies: Calipers, infra-red lamps, labels, sample bags, envelopes, vials, plot tags, data sheets, misc supplies. [\$12,400]	
Travel: From UMN Twin Cities campus to research sites at Cloquet and Ely, MN; as well as elsewhere in northeastern Minnesota	\$ 24,000
Additional Budget Items:	\$ 20,200
Laboratory analysis for samples (leaf chemistry, 2400 samples for 15 species) [\$11,000]	
Web site, computer server, software licenses [\$9,200]	
TOTAL ENVIRONMENT & NATURAL RESOURCES TRUST FUND \$ REQUEST	\$ 642,764

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ Being Applied to Project During Project Period:	\$ 690,000	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 (Hobbie, Montgomery, Frelich) will contribute 1% time to working with project employees and cooperators.	\$ 11,712	Secured
Unrecovered indirect costs @ 52% of modified total direct cost base of \$642,764	\$ 334,237	Secured
Remaining \$ from Current ENTFF Appropriation (if applicable):		
Funding History: \$330,000 awarded 2008 Subd_3p: "Climate change, CO2, and prairie/forest production". This largely supported an elevated CO2 experiment in grassland. A very small portion supported travel to the experimental forest warming sites for soil-root carbon sampling, and CO2 soil flux data collection, in late 2009 and 2010. Project ended 6-30-2011.	\$ 330,000	Project ended 6-30-2011
Funding History: US Department of Energy project (2011-15) \$2,420,000 includes funding to support half of the costs of the experimental field warming research to be incurred in the proposed research	\$ 2,420,000	in progress



Current distribution of forest types across northern Minnesota. Map is based on combined ground-based forest inventory and satellite remote-sensing imagery data (Wilson et al 2012).

Forest Type		Relative Abundance	
	Current	Year 2050	Year 2100
Aspen/birch	41.2%	Decrease	Large decrease
Spruce/fir	26.8%	No change	Large Decrease
Elm/ash/cottonwood	7.9%	Increase	Increase
Oak/hickory	6.9%	Increase	Large Increase
Pine	6.5%	Increase	Increase
Maple/birch	6.3%	Increase	Large Increase

Summary of preliminary modeling analysis of projected forest change for northern Minnesota by 2050 and 2100. Projections (i.e., decrease, increase) are relative to percent of landscape currently occupied. Species within forest types (e.g., different kinds of pine) may differ in projected change.

Results are based on three climate change response models, from the Minnesota Forest Ecosystem Vulnerability Assessment and Synthesis (in review), an initiative of the Northwoods Climate Change Response Framework (jointly run by the Minnesota Forest Resources Council and the U.S. Forest Service). Our LCCMR project team was deeply involved in that prior work, which will serve as a foundation for the more detailed and expansive work proposed herein.

Wilson, B.T.; Lister, A.J.; Riemann, R.I. 2012. Forest Ecology and Management. 271: 182-198.

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 CO₂; 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:

> 400 scientific articles and book chapters, including > 20 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